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DESIGNING SUSTAINABILITY FOR ALL

Edited by Marcelo Ambrosio and Carlo Vezzoli

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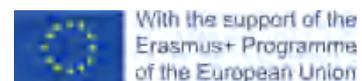
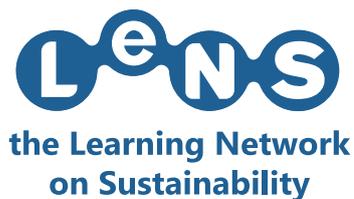
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Designing sustainability for all

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FOREWORD

Designing sustainability for All was a call for contributions and actions to the whole world design community, which is not limited to design researchers, design educators, and design practitioners but also unites other disciplines such as architecture, engineering, economy, policy-making, and sociology.

The Conference has been a unique event hosted simultaneously in Mexico City (Mexico), Curitiba (Brazil), Cape Town (South Africa), Bangalore (India), Beijing (China) and Milan (Italy), on 3rd-5th April 2019. In fact, in each of the 6 venues, it has been possible to listen to any of the presentations happening in the other ones.

LENSIN PROJECT

LeNSin, the International Learning Network of networks on Sustainability (2015-2018), is an EU-supported (ERASMUS+) project involving 36 universities from Europe, Asia, Africa, South America and Central America, aiming at the promotion of a new generation of designers (and design educators) capable to effectively contribute to the transition towards a sustainable society for all.

LeNSin ambitions to improve the internationalisation, intercultural cross-fertilisation and accessibility of higher education on Design for Sustainability (DfS). The project focuses on Sustainable Product-Service Systems (S.PSS) and Distributed Economies (DE) – considering both as promising models to couple environmental protection with social equity, cohesion and economic prosperity – applied in different contexts around the world. LeNSin connects a multi-polar network of Higher Education Institutions adopting and promoting a learning-by-sharing knowledge generation and dissemination, with an open and copyleft ethos.

During the three years of operation, LeNSin project activities involve five seminars, ten pilot courses, the setting up of ten regional LeNS Labs, and of a (decentralised) open web platform, any students/designers and any teachers can access to download, modify/remix and reuse an articulated set of open and copyleft learning resources, i.e. courses/lectures, tools, cases, criteria, projects.

LeNSin will also promote a series of diffusion activities targeting the design community worldwide. The final event will be a decentralised conference in 2018, based simultaneously in six partner universities, organised together by the 36 project partners from four continents.

THE LENS CONFERENCE

The Conference is the 3rd edition of one of the largest design international conferences for lecturers, researchers, professionals, and relevant institutions and organizations. It has become a reference event where experts from all over the world get together to present and share their knowledge, projects, tools, and visions to diffuse sustainability for all.

The Conference is organized as a part of the LeNSin, the International Learning Network of networks on Sustainability project (2015-2019, EU funded Erasmus+ program) that aims to be both visionary and pragmatic, and to stimulate new ways of thinking.

The scope is to share the latest knowledge and experiences around the concept of sustainability for all.

This will be achieved through cross-fertilizing a wide range of disciplines: predominantly design, but also engineering, economy, policy-making, and sociology.

LENS MANIFESTO

A new ethos for a design community: towards an open source and copy left learning-by-sharing attitude/action.

We, the undersigned, aware of both the urgent changes required by sustainable development, the potential role of design (and design thinking) in promoting system innovation in the way we produce, consume and interact, as well as the opportunities offered by the ever more interconnected society, propose the adoption and diffusion of a new ethos within a worldwide design community:

To view design as a unique multi-polar learning community promoting, enabling and activating any possible learning-by-sharing process aiming at effective knowledge osmosis and cross-fertilisation in design for sustainability in an open and copy left ethos.

We, the undersigned, commit our selves in such an ethos, trying our best to apply this in our daily life as individuals or representatives of institutions in the design community.

In relation to our competencies and possibilities we will make our acquired knowledge to be, as far as possible, freely and easily accessible in a copy left and open source modality (while safeguarding our authorship and scientific recognised publication activity), that enable others in the design community to acquire them free of charge, with the possibility to replicate, modify, remix and reuse, through e.g. adopting creative commons licences.

As researchers, this knowledge includes our acquired research knowledge base (e.g. papers, books, etc.) and knowhow (e.g. methods and tools).

As educators, this knowledge includes our educational resources (slideshows, texts, video of lecture, educational support tools, etc.)

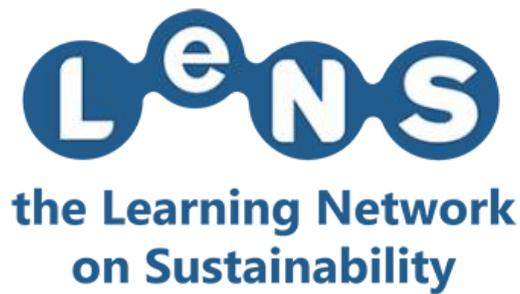
As designers and design thinkers, this knowledge includes the design for sustainability concept proposal of products, services, systems and scenarios, as well as a knowhow they used to design them.

We commit our selves to seek the commitment of other individuals or institutions in such an ethos within the design community. In relation to our competencies and possibilities we will:

do our best to commit individuals such as researchers, educators, professional designers and design thinkers as well as institutions such as research institutions, design schools, and designer's associations to adopt the same ethos

do our best to generate and/or enable open learning networking of sustainability of design researchers, design educators, professional designers and design thinkers.

9. ARCHITECTURAL AND INTERIOR DESIGN FOR SUSTAINABILITY



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SUSTAINABLE-ORIENTED CHANGE MANAGEMENT FOR ALL BUILDING DESIGN PRACTICE

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ABSTRACT

Design plays a key role in the transition towards Sustainability for All, especially in building sector demanding a change management to effectively enable the shift in thinking and in process. To this end, an assessment framework was developed to support design practice for integrating life cycle perspective into design process.

Indeed, the application of Life Cycle Thinking and related methodologies represents a turning point, calling for a profound transformation to switch from current to life cycle-oriented practice.

Based on current practice, the framework discloses for each phase of the process the set of life cycle information to be progressively considered and the connected actors in charge, envisioning the information-flow for a life cycle-oriented decision-making.

If the suggested framework is implemented in building design practice, remarkable effects will be visible, allowing practitioners to make aware decisions, avoid shifting problems, gain long-term perspective, optimize design process, lead decision-making and decrease construction impacts.

Key Words: design practice; change management; design process; life cycle perspective.

1. INTRODUCTION

The construction sector is esteemed as one of the most incisive and impacting sector at a global scale, due to the high consumption of soil, natural resources and energy and the high emission in air, water and soil. Just to provide an overview, from the environmental point of view, it consumes each year about 3 billion tons of raw materials to manufacture building products worldwide and it is responsible for 40% of solid waste derived from construction and demolition and for 25-40% of the total energy use at global level. From the economical point of view, the construction industry collects total annual revenues of almost \$10 trillion, accounting for about 5% of global GDP and employing more than 100 million people worldwide. Furthermore, from social point of view, it constantly shapes our daily life in unique ways, with high impacts on the users health status and well-being (WEF, 2016). On account of these, building sector encompasses not only all the three pillars of sustainability but it also affects them during the whole building life cycle, starting from the construction to the deconstruction/demolition process (Zhao et al., 2019).

In this context, design – as kick off phase of the building process – plays a key role in the transition towards sustainability for all, representing a strategic field of action to address the sustainable and environmental goals of construction sector along the whole life cycle. The hotspot in which to interfere is thus the set of design firms – as main responsible actors of the built environment - involving all the connected practitioners and working out on their way of practice to integrate a life cycle approach from the outset of the building process onward. Nonetheless, actually life cycle perspective is not so far established in current design practice, becoming for the building industry one of the main challenges of the next future (Ramani et al., 2010; Rusu and Popescu, 2018).

Purpose of the paper is therefore to disclose an assessment framework developed to support the design change management required for switching from current to life cycle-oriented practice. Focus is hence the design decision-making in terms of actors engaged, life cycle information considered and information flow suggested along the process.

2. BACKGROUND

Towards sustainability, the integration of Life Cycle Thinking (LCT) and the related methodologies within the design is even more considered as a turning point for the building sector to boost sustainable practice, promote environmentally-friendly innovations and business models (Antink et al., 2014). In fact, understood as a learning process, LCT helps identify where actions are most effective and efficient and thus improve resource efficiency with environmental, social and economic benefits (UN environment, 2017; Miah et al., 2017). However, the assimilation of a life cycle approach in all building design practice represents a demanding task, due to the complexities inherent buildings, the wide range of requirements to be achieved and the plurality of practitioners and disciplines involved. Furthermore, it calls within the practice for a shift both in thinking and in process.

The shift in thinking pertains to the mindset of all the actors involved during the project design, recommending to consider buildings not as objects but rather as unique systems where each individual part affects and is in relationships with the others. Moreover, it commits designers to direct the decision-making of each part and in turn of the building as a whole keeping in mind the entire life cycle and not involving – as traditionally happen – only the construction or use phase. In this way, during design, the set of products/components/systems are evaluated in relation to the proprieties and performance provided as well as, for instance, in relation to the distance between the factory and the site, the maintenance required, the service life declared and the reuse and recycle possibilities.

In addition, to face the complexities of buildings as systems and the amount of information and choices required during the decision-making, a shift in process is needed to change management in the way of design practice. Over the year, designers were trained in the process of optimizing each part of the system in isolation, but today this practice is no more compelling to fit current needs towards life cycle sustainability. Indeed, in the age of specialization, a single actor is not able to address all data and meet all building requirements: miscellaneous competences are engaged, bringing their specific know-how and interacting each other to look at the whole considering the entire life cycle. The integration of LCT into design entails therefore not only the understanding that every building system is in relation with other systems and the surrounding environment, but it also demands a holistic process where everybody integrates their work rather than design in isolated silos.

To this end, the challenge is twofold. On one hand, building need to be designed as systems, where every sub-system and component impact all the others. On the other hand, the design team itself need to function as a system (Boecker et al., 2009), where all design members have to be aware on how the decisions undertaken by each affect the decision made by all other, with the aim to jointly design and achieve sustainable and high-performance buildings. On this purpose, the information flow among the involved actors deserves particular attention for the decision-making process.

3. FRAMEWORK DEVELOPMENT

To support practitioners in the change management required to implement life cycle design, an assessment framework was developed with the aim to integrate LCT in building design practice. In particular, to put into effect LCT, that represents a general mind-set, Life Cycle Assessment (LCA) was taken as reference frame (EN 15978:2011;

EPD PCR UN CPC 531:2014), providing an added value since depicts a standardized methodology affirmed at international level. Note that for this reason it refers from the outset to environmental issues but with wider purpose, representing for instance the elementary frame also for economic issues. By contrast, design practice was deepened in relation to the design process, adopting and harmonizing classifications recognized worldwide (AIA, 2014; RIBA, 2013). In this way, the basic matrix of the framework is established, on one hand, by the different stage of life cycle from cradle to grave and, on the other, by the different phase of design process. On this basis, the framework sets out the life cycle information to be gathered along the process and the related actors in charge, disclosing the information flow required in practice for a life cycle-oriented decision-making.

The identification within the basic matrix of the life cycle information and related actors and thus of the resulting information flow along the process was done through three main development steps. The first step identifies them for each life cycle stage and process phase by means of hypothesis based on the sustainability researches available in literature, providing the general concept of the assessment framework. The second step is their mapping based on the design process of real building projects, providing the testing of the assessment framework *ex post* the process, not affecting directly the decision-making but giving an overview on how it is actually faced by current design practice. The third step is the adjustment of the supposed life cycle information, actors and information flow based on current practice, providing at the end the assessment framework proposal to implement life cycle-oriented practice.

The methodology adopted for the framework development interrelated therefore the know-how acquired in the field of research about sustainability and life cycle approach with the ethnographic experience conducted within an US architectural and engineering firm affirmed at international level and joined for the deepening of the project case studies. Indeed, ethnography is now emerging as part of the set of techniques used to understand the construction industry (Pink et al., 2013), a sector considered extremely complex and influential but that despite this remains mostly unexplored and under-theorized. The effort was thus to fill the gap, looking into the current state of life cycle integration into design practice to consequently recommend through the assessment framework how to gradually implement and strengthen a life cycle perspective during the decision-making process.

4. FRAMEWORK TO SUPPORT LIFE CYCLE DESIGN

Based on current practice, the framework discloses for each phase of the process the set of life cycle information to be progressively considered and the connected actors in charge and information flow in order to implement a life cycle perspective into design process. In this regard, it is worth mentioning that the framework was tailored to fit the most demanding projects, in particular new building projects with federal mandates and called for LEED certification. In this way, it recommends the most virtuous life cycle-oriented building design practice feasible at current state but that can be overcome in the next future when more life cycle data and database will be available. Moreover, it allows to provide some levels of simplification for its implementation also in less complex projects, depending on how deeply life cycle perspective has to be integrated into the design process in relation to the building project at issue.

Concerning life cycle information, it is important to underline that the framework focuses only on life cycle quantitative data, since they represents the type of information directly demanded to design firms and therefore to bear in mind during the design process. Furthermore, the aim is to support and promote along the process, on one hand, a progressive implementation and, on the other, a progressive detailing of the life cycle information accordingly to the process development. For this purpose, to simulate the progressive definition of the design process in a realistic way, the life cycle information recommended by the framework were established in compliance with the minimum submission requirements defined by federal mandates specifications.

For each advised life cycle information, the design team is expected to integrate within the framework the relative life cycle data according to the design phase in progress. In addition, for boosting the optimization of the process, the whole set of life cycle quantitative data embedded in the framework turns out to be the thresholds to be not exceeded in the following phases of the process, if not expressly justified and proved. This is certainly valid in the transition of one phase to another of the design process as well as in the shifting from the design process to the construction process. Indeed, it is expected that in a life cycle-oriented practice the final life cycle information related to the building projects will be included in the specifications, placing constraints on the selection process of the bidding phase.

The suggested assessment framework intends therefore to support the implementation of LCT into design process, pointing out step by step the life cycle information in relation to the different process phases and showing a growing level of detail and accuracy during the process. With regard to materials selection process, for instance, it endorses an approach by parts, progressively evaluating alternative options for each technological system designed and choosing materials based on life cycle criteria.

4.1. Empowering design disciplines in the accomplishment of life cycle tasks

To support the change management demanded to shift from current to life cycle-oriented design practice, the proposed framework discloses the set of life cycle information to be considered during the design process. However, due to the amount of information required, to put the framework into practice, the life cycle information were broken down for each involved technological elements, explaining thereafter the competences responsible for each tech-

nological element related to both construction materials and building systems. In this way, the actors in charge of gathering the recommended life cycle information were identified in order to share the connected roles. Based on the analysis of current practice and on the set of technological elements in question, the involved competences turn out to be the following: architecture, interior design, structural engineering, mechanical engineering, plumbing engineering, electrical engineering, building energy design and environmental design/sustainability.

Envisioning a life cycle-oriented practice, each of these competences is responsible not only for the design of the committed technological elements – as happens nowadays – but also for finding and evaluating along the process the connected life cycle information. To this end, the suggested assessment framework supports the appointed actors in the progressive implementation of life cycle information and data, establishing for each the information required at each phase of the process. Nonetheless, it is important to note that these actors represent the leading competences involved, with the awareness that also the pertaining specializations, if included within the project, may be engaged for the accomplishment of the life cycle tasks. Anyway, to not overburden their assignments, since each competence is entrusted with one or more technological elements and with all the connected life cycle information, the framework endorses a progressive implementation of the information and a growing level of detail and accuracy of the related data over the process. In this way, during the decision-making process each commissioned team of actors has to take into consideration step by step the quantitative data of the designed technological elements and to collect the related life cycle data in compliance with the progressive implementation stated by the framework.

With the aim to encourage the team in adopting a systemic approach for life cycle design, a personal worksheet was inferred from the framework for each competence in charge, explaining the main life cycle topics at issue for each technological element appointed in relation to the design phase. Note that, to allow a gradual integration of the life cycle information and data, only the main life cycle topics are included for each phase of the process, since potentially all could be taken into consideration at the same time.

In this perspective, for instance, along the design process, architecture team is in charge of the development especially of cladding, envelope, walls and floors solutions, being thus entrusted with the connected life cycle information, including them as further criteria for the decision-making process. As an example, concerning only the decision-making for cladding systems, starting from the early phase of the process focused on the definition of building massing, architects have to select the best building scheme including beyond architectural, functional and environmental issues, such as orientation, view and energy consumption, the amount of construction materials as further life cycle-oriented criteria. To this end, due to the preliminary phase and the still no definition of envelope materials, cladding area turns out to be the reference data, since it is indicative of the amount of construction materials and significant for the massing comparison. Going on with the process, the team subdivides the envelope in the glazing and massive parts, evaluating different materials for cladding solutions to be proposed to the clients in order to figure out the overall appearance of the building under design. In this case, in the assessment of different cladding materials, beyond the relative performance metrics and aesthetic features, materials quantity is taken as further criteria as well as the distance from the manufacturing in order to reduce the impacts derived from transport. Going on with the process, architects specify the assigned technological elements, calculating with a progressive level of detail the quantity of construction materials and embracing further life cycle-criteria. For each selected cladding solution, they concern the transport distance from factory to building site, the amount of construction waste, the VOC emissions as well as the materials and related transport required for both maintenance and replacement process. Furthermore, in overall terms, architecture team has to state the expected energy use for installation of products and water use for on-site production, assuming the first as percentage of the construction material and the second on the base of the adopted technological solutions. Finally, in the last design phase, architects update all the previous claimed life-cycle oriented data for cladding, providing additional specifications on the end of life stage, including transport of waste from building site to landfill, waste derived from deconstruction process and potential materials used for reuse, recycling and energy recovery. Thereafter, all details have to be clearly communicated to contractor as minimum requirements for the bidding phase as well as the complete drawings, fully coordinated with the other disciplines.

4.2. Information flow to build up a project-based life cycle database

If according to the framework all the involved design disciplines includes within the decision-making process the committed life cycle criteria, tracking all information in one-single and well-framed record, they progressively build up a life cycle database of the facility, envisioned in line with current trends in a BIM-oriented working environment. Indeed, following the framework recommendations, all the actors in charge and/or allowed contribute information to and extract information from the building virtual model, providing a long-term vision of the building project. In this way, the suggested life cycle BIM database allows the establishment in one-record of the life cycle information and data of the building in question, fostering a systemic vision of the project and representing an added value for the design firm as well as for clients and a continuous build-up of know-how.

In this perspective, contrary to what happens in current practice, the information flow demanded along the process does not involve the single competences in relationship when needed one-to-one for the exchange of information. In a life cycle-oriented design practice, all the responsible actors enter the life cycle data into the BIM model/database of the facility. In this way, all the life cycle data are collected in one single record enabling all the actors to insert their assigned life cycle information but also to use all the other available data to carry out the most varied design studies. Indeed, the whole set of life cycle data or part of it, depending on the cases, represents the input data

required to perform the most miscellaneous environmental and life cycle design studies, constituting especially the building inventory phase for Life Cycle Assessment (LCA) but also Life Cycle Costing (LCC) analyses.

For this purpose, to build up the life cycle database of building projects, it is crucial to have the support of all the main competences, committed to considering, retrieving and entering the life cycle information and data of the assigned technological elements. The joint combination of all individual efforts results thereafter in the overall and systemic vision of the designed building, represented by the life cycle BIM database with the connected offered opportunities. However, since the implementation of life cycle practice is a challenging task, demanding a shifting both in thinking and in process, the project management competences have a key role in the transformation, being called for soliciting the involved actors in the accomplishment of the life cycle tasks and for verifying the congruency with the proposed framework. In this context, it is important to note that during the design process the actors in charge for the life cycle information and data remain almost the same: what changes are the life cycle topics and the technological elements to be progressively evaluated.

5. CONCLUSION

The proposed assessment framework was developed to support and enhance the necessary shift in thinking and in process required in practice to integrate LCT into design process. In fact, it points out not only the progressive set of life cycle information to be considered at each design phase, but also the related actors in charge and the resulting information flow demanded during the process. Concerning the recommended life cycle information, two are the key points stressed by the framework. On one hand, the progressive implementation of life cycle information and data to orient starting from the beginning the decision-making process. On the other, the growing level of detail of the data embedded in the resulting life cycle database of the project. Moreover, to put it in practice, it identifies as first the main competences that must be strengthened or implemented from a life cycle perspective. Thereafter, it assigns to each responsible competence the life cycle information and data to be progressively gathered and considered as further design life cycle-oriented criteria during the decision-making of the committed technological elements. Finally, depicting the information flow required during the design process, it provides an overall vision of the life cycle information required by each actor at each phase, pointing out the change management required to turn into life cycle AE(C) practice.

The application of the proposed assessment framework in practice is twofold. From the life cycle perspective, it solicits each responsible actors for the progressive inclusion of life cycle, establishing at the end in one-single record a project-based and well-frame set of data of the facility during the whole life cycle. This factor is crucial for the project decision-making, supporting practitioners to make aware decisions, avoid shifting problems from one phase to another and gain long-term perspective. Moreover, from the design process perspective, it allows the overall monitoring of the process as well as the verification or not of its optimization, since the assessed life cycle data stand for the thresholds to be not exceeded in the following phases of the process. This factor is pivotal to optimize design process, lead decision-making and to support practitioners in decreasing construction impacts. Nevertheless, it should be not underestimated that the implementation in practice of the suggested framework calls for a sharing of roles and responsibility. If on one hand this organizational set-up represents a point of strengths to put LCT in practice, not overburdening their design competences, on the other hand it constitutes a point of weakness, since it involves a wide range of competences that must be trained and successfully managed to embed life cycle perspective in all building design practice.

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RELIGIOUS BUILDINGS AND SUSTAINABLE BEHAVIOUR: UNDERSTANDING IMPACT OF DESIGN ELEMENTS ON HUMAN BEHAVIOUR

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ABSTRACT

Peoples' behaviours are projection of their experiences in everyday life. Mental adaptation of rapid changing environment results in subconscious stress. This has become one of the major concerns in current developing urban contexts. Well planned architectural elements contribute significantly to environment influences well being and sustainable behaviour. Religious buildings are apt cases of those environments designed for human mind and higher spirituality. Study mapped human behaviours in three different religious buildings, i.e., mosque, temple and church located in Bhopal city of India. It compares the conscious and subconscious behaviour of visitors based on common parameters mapping of movement patterns, sitting angles and resting points in religious premises. These behaviour patterns analyze with sensory perception of those design elements and principles which provoked the same common to all case studies. Study discusses impact of design elements on user mind and their effect on sustainable behaviour and well-being.

Key Words: Build Environment, Design Elements, Sustainable Behaviour, Religious Buildings

1. INTRODUCTION

India is a country rich with various religious architectural styles. Every style differ with common design principles and purposes i.e., an experience of well being and higher spirituality. During last decade, India is the fastest developing economies influencing infrastructure and built-environment catering large population. Since, maximum times are spent in either work place or home; built environment is integral part of our lives and has a significant contribution in formation of our experiences. Along with new work culture; increase in productivity, better output and maintaining good health has become priority and therefore demand of alternate practices like Vaastu and Feng shui has increased to keep pace with current life style by making spaces positive in experience and sustainable behaviour. Religious building design and its elements evolved with spreading of culture based on geographic conditions, availability of material, craftsmanship and cultural influences. These design principles and elements contribute to unique experience of spiritual self. Objective of study is to find those elements and principles which contribute to spiritual experience and sustainable behaviour. Many interdisciplinary researches are focusing user experiences within a built environment. Neuroscience, psychology and environment behaviour are few of such disciplines. Focus of the study is to understand mind experiences through human behaviour mapping by analysing design elements and sensory perception within build environments of religious buildings. Results re-evaluate design principles focusing user experience of existing religious buildings in current context. The understanding can taken forward to future religious buildings design and spiritual built environments integrating contemporary approaches and advance technologies. Also, the learning can apply to other built environments focusing human experience and well being resulting in sustainable behaviour.

2. LITERATURE REVIEW

Experiencing architecture is a sensory exercise of various design elements like lines, colours, materials, texture, etc. that has psychological and physiological affect over biological and spiritual self. Therefore, it's important to understand definition and relationship of spirituality and sustainable behaviour. Thereafter, the process of affordance discusses influence on sensory perception and cognition induced by elements of design. Perception leads to precognitive emotional responses in a build environment which cause conscious and subconscious behaviours.

2.1. Spirituality and Sustainable Behaviour

The principle function of human mind is to make sense of itself with respect to environment that brings one closer to awareness of self, consciousness and truth each time we contemplate.¹ “*Spirituality is a way of being in the world in which a person feels a sense of connectedness to self, others, and/or a higher power or nature; a sense of meaning in life; and transcendence beyond self, everyday living, and suffering.*”² Similar to a piece of an art, profound architecture connects consciousness back to world; and direct our senses to self and being. Collective stimulation of senses construct self-image to get imbibes in our experience of the world and makes us experience as spiritual being.³ The brain, mind and behaviour of humans are resultant of biological and cultural evolution of past.⁴ Our mind perceives spirituality in various forms and needs. Few of those needs are social, seeking sense of belonging, self-actualization, seeking meaning or truth, wisdom and justice.⁵ These formulate sustainable behaviour. Sustainable behaviour integrate realization of values, norms, beliefs and senses of responsibility focused to provide well-being for self and other living beings, including present and future generations.⁶

2.2. AFFORDANCES OF BUILT ENVIRONMENT

Based on people's experiences in an environment, in 1970's, J.J.Gibson coined a concept called *affordances*. Affordance is cognitive abilities of understanding opportunities offered by a space or an object, by indulging or communicating within an environment.⁷ For example, a doorway invites to pass through it and stepping stones in garden lead to walk a specific route. According to Jon Lang any built environment has potential to induce human experience and behaviour:

“Information about the environment is obtained through perceptual processes that are guided by schemata motivated by needs. These schemata are partially innate and partially learned. They form the linkage between perception and cognition. They guide not only the perceptual processes but also emotional responses (affect) and actions (spatial behaviour), which in turn affect the schemata as the outcomes of behaviour are discerned.”⁸

¹ (Zeisel, 2006)

² (Weathers, McCarthy, & Coffey, 2015)

³ (Pallasma, 2008)

⁴ (Gazzaniga, 2008)

⁵ (L.Nussbaumer, 2014)

⁶ (Dunja Andic (University of Rijeka, 2014)

⁷ (Goldhagen, 2017)

⁸ (Kder)

2.3. Perception of Design Elements – The Stimulus to Mind

Act of mind coordinated with inputs from senses results in perception.⁹ Human sees space upright create a vertical axis of reference and since, we see from two eyes at equal height create the horizontal axis of reference to observe our immediate environment. Distance between point of observation and object of observation create depth which ultimately leads to sense of space in human mind.¹⁰ Most fundamental concept of human mind is to find meaning from the information gathered by the sensory system. Our mind is an outcome of primitive evolution, it start interpreting preliminary data instinctively gathered from random visual or aural phenomenon. Hence, perception is influenced by already known information embodied in human mind. Visual perception is one of the dominant affordance offered by architecture. The basic elements of architecture those contribute to perception are: Proportion, Scale, Rhythm, Texture, Light, Colour and Ornamentation.¹¹ These elements contribute significantly to aesthetic experience of mind.

2.4. Senses – Windows to Cognition

The senses act as interaction points to the world. Sensory cognition leads to thoughts and perception.¹² The mind perceives a space through visual sense which is soon informed by all other senses- sensory and motor system, and by the memory and the metaphors.¹³ Edward T. Hall (1982) classified human sensory systems in two categories, i.e., Distance Receptors and Immediate Receptors. Distance receptors cover visual, auditory, olfactory and gustatory senses whereas immediate receptor which is touch or skin based are kinesthetic, tactile and thermal senses.¹⁴ Senses are the windows to human mind. Cognition is nonconscious to conscious process in collaboration of mind, body and environment. We cannot recall memory unless we revisit at least a few elements of the place where it happened either consciously or nonconsciously.¹⁵ Vision is one of the most important sense in perceiving architecture and its aesthetics. Colours strongly influence emotions. Natural light has not only significant psychological but physiological effect on human beings.¹⁶ By reducing the noise, tranquillity becomes most powerful auditory experience of any good architecture.¹⁷ High noise creates stress, increase blood pressure and heart rate; on the other hand, music does the reverse and is comforting.¹⁸ A carefully carved architectural environment is sensitive to silence, sound and echo. Olfactory Sense has deeper memories than vision or sound.¹⁹ Tactile sense integrates our experience of world to our experience of self as body. Skin is the oldest and first medium of communication to our environment. Hence tactile sense is parent to all our sensory organs.²⁰

2.5. Human Behaviour – Reflection of Mind Experiences in an Environment

Even though spaces are organized in a systematic order but most of the time user is unable to identify the pattern in a designed environment. While user present in the environment, senses and motor system are active without him aware of it. Instead user registers nonconsciously such spaces and chooses the affordances while experiencing the environment. Brain becomes conscious with constant bombardment of stimuli in a built environment. Cognition can be linguistic or pre-linguistic which can happen in realm of nonconscious to consciousness. ²¹ Metaphors are linguistic tools for creative cognition.²² Our fundamental conceptual system of thinking is metaphorical in nature. For example, “Argument” is “War”, “Good” is “Up” and “affection” is “warmth”.²³ Similarly, architecture is interpreted and experienced through embodied metaphors. For example, high plinth symbolizes power, fat columns symbolize strength and high minarets or vaulted ceiling symbolizes greatness. Complex processes in mind with both stimulus i.e., external (visual) and internal (metaphorical) evokes involuntary emotions, memories and thoughts. Mental and physical response of human body to environment is called behaviour. External physical responses are overt behaviours whereas internal responses like emotions and feelings are covert behaviours.

⁹ (Benson, 2007)

¹⁰ (V.S.Parmar, 1973)

¹¹ (Roth, 2007)

¹² (Karunamuni, 2015)

¹³ (Goldhagen, 2017)

¹⁴ (L.Nussbaumer, 2014)

¹⁵ (Goldhagen, 2017)

¹⁶ (L.Nussbaumer, 2014)

¹⁷ (Pallasma, 2008)

¹⁸ (Kder)

¹⁹ (L.Nussbaumer, 2014)

²⁰ (Pallasma, 2008)

²¹ (Goldhagen, 2017) pg-113

²² (Indurkha)

²³ (Johnsen, 2003)

3. METHODOLOGY

Three religious buildings were selected i.e., Mosque, Temple and Church within a city. Physical environment of these buildings were recorded individually based on elements of design and sensory perception. User analysis and their behaviour were recorded for each case study based on common parameters, i.e., movement pattern in the complex, halting zones, sitting zones and talking or interaction zones. Similar patterns identified in all three case studies induced due to design elements and sensory perception. Finally, behaviour pattern analysis was done with respect to design elements and sensory perception common in all case studies to understand relationship of design elements, sensory perception and human behaviour.

3.1. Case Studies

Following religious buildings are identified as case studies (Figure 1). The study executed during month of September. All the selected buildings are important structures located at Bhopal, a city in central India:

1. Moti Mosque (Case Study-I, Mosque):

It is an Islamic religious structure built in 1860. Located on the junction of busy roads, the noise is significantly cut by high plinth and introvert courtyard planning. The structure is built in Indian Islamic style with three gateway approach. Fourth side has mihrab facing west, the direction for offering prayer. The name “Moti” means pearl was given to mosque because of its mihrab’s construction in white marble highlighting it from the rest of the building constructed in red sandstone including two huge minarets.

2. Laxmi Narayan Temple (Case Study-II, Temple):

Also known as Birla Mandir was constructed in 1960. The site of Hindu temple is located on one of the highest point in the city with cliff towards north. The panoramic view of city creates added interest among visitors. The tall cupola and bright colours highlight the building and its complex from a distance located on a silent road. The building structure sits in the middle of landscaped complex periphery covered with deciduous trees along with high plinth and facing east direction.

3. St. Francis of Assisi Cathedral (Case Study-III, Church):

The oldest church in Bhopal city was funded by the British constructed before independence in 1824. It is a typically designed Christian structure with central isle and nave constructed in vault structure, beautifully painted rear wall and cross behind the Altar catches the eye of the visitor entering the church. The tapered high façade catches the eye with sculpture of St. Francis and cross on top while entering the small complex. Statue of Mother Mary of left and baby Jesus grotto on right to entrance gate are cosy places to sit and contemplate under large shades of trees’ canopy in hot summers.



[Figure 1] Left: Moti Mosque, Centre: Laxmi Narayan Temple, Right: St. Francis of Assisi Cathedral

4. FINDINGS

4.1. Analysis of Design Elements

Several common findings while analysing design elements in the religious buildings. Scale and built forms of all case studies are large span structures to accommodate large numbers of visitors with emphases on verticality. Tapered façade of church, tall cupola in temple and minarets in mosque are examples of same. The building structures rest on plinths almost twice the human height in case of mosque and temple. All the buildings designed symmetrically to central axis accommodating other design elements like entrance and centre of worship. Orientation of axis in mosque and temple are aligned to particular direction based on religious believes. Carvings and cornices are based on respective architectural styles. Most of the elements like openings, vaults, columns constructed with constant pattern also representing the structural system of these buildings. Tall main halls segregated by humane entrance foyer or canopy. All entrances are highlighted by mouldings or carvings along with detailed wooden door in all cases. Local stones are used in floor except the church where new tiles are used during later renovation. The wall surfaces are painted plaster in church & temple whereas mosque is built in sandstone majorly. Where church is white in colour; the mosque exhibit natural colours of stones applied that is red and white. The temple is painted in bright colours. Other features like water body in mosque; small worship structure and water body in temple and; grotto and Mother Mary statue are parts of enhancing the build environment.

4.2. Sensory Perception

Prominent stimuli were observed in context to common design elements in all religious case studies. Design elements leads to perception and experience. Design elements like high plinth and tall structure attract attention of user. While perceiving case studies visually; traditional carvings and motifs leads to stimulation of cultural memory, taking one mentally in past, and bringing attention to dynamics of time. The precognitive emotions of time are further strengthen by wear-tear of natural materials like stone, wood, trees, and metal enhancing consciousness of mind. Silence and sound has unique effect on user's experience. In all case studies, religious buildings cut sound due to design elements like thick walls, high plinths and dense natural vegetation. Ringing sounds of bells or chants of prayers draw attention from our own thoughts as well as take mind to a soothing and contemplative zone. The source smell is from flowers or incense used during ritualistic ceremony in the religious case studies. Since, observations were noted at different time frame of the day; the ambiance varied through morning to afternoon and till evening. Stone transferred heat in temple and mosque through the day time whereas wooden bench in the church protected the touch of cold in the evening. Shade of trees and water features reduced ambient temperature on a sunny day. The touch of wind while cross ventilation from window openings and at high plinth comforts the skin in all these premises.

4.3. User Behaviours

Behaviour of visitors mapped in each case study. User's movement patterns, halting locations, talking zones, sitting location and the orientation of sittings along with group size details were noticed. Following are the behaviour similarity pattern observed common in all the built environments:

4.3.1 Users:

The typology of users identified based on gender and group size in all the case studies. Mosque had either individual or pair of local regular users with largely male visitors. Temple had both, regular and tourist visitors, with mix of males, females and children where majority were in groups or pair but rarely single. Females were dominant visitors in church during evening time visiting in pairs or individually and less in groups.

4.3.2 Movement patterns:

Most of the movements happened on the primary or secondary axis of buildings. This behaviour caused due to affordances induced by design elements like entrance gate to site, steps to plinth, design features in complex, entrance porch and worship point planned on the primary axis. Deviation of movement patterns from primary axis caused due to secondary magnets or design features like grotto and mother Mary statue in church, secondary worship points in temple and priest's room in mosque; or due to solar pattern. Movements deviated from major axis and followed shadow zones in case of mosque and temple. Since, temple complex is located at edge of cliff, visitors moment influenced by panoramic city view towards south of the complex. Also, visitors approached close to holy place in temple and church while distance was maintained from mihrab while movement in court as per religious believes.

4.3.3 Halting zones:

Halting zones observed either on the major axis or close to prominent design features in the religious complexes. These zones represent attentive behaviour, mark of respect or realization. For example, halt zones in front of entrance doors represent footwear removal points as mark of respect in all the case studies including church in Indian context. Halting points inside main halls of temple, front of water feature in mosque; and close to Alter represent zones of attention in the built environments. All the halting points outside covered area are influenced by shadow of either building or trees; and points of secondary worship inside temple and church complex.

4.3.4 Sitting zones:

These are well defined zones either inside buildings or under shadow zones in open. Important thing to notice about the behaviour was that maximum of these zones are visually connected to worship place if inside the building and sitting orientation was facing towards the same. External sitting zones were dominated by shadow patterns in the day time.

4.3.5 Talking zones:

Talking happened within groups and pairs of visitors. Maximum of these activities coincides with sitting zones and almost maximum of these are away from worship points showing subconscious acknowledgement to environment.

5. RECOMMENDATIONS:

The study restricted within Bhopal. The study applied on larger geographic conditions with specific time periods will provides new insights. Also, validation of facts based on extensive interviews will give better understand of human experiences in future studies.

6. DISCUSSION:

We see world with the eyes of our mind. Design elements are part of the world that affect our senses and perception of our minds. This generates precognitive emotional response and thus feelings. Sensitively designed elements make one aware of self as being in the world. This contemplation leads to mental rest, peace and improved spiritual

experience in religious settings. Design elements like axis, symmetry and rhythm are subtle experiences and thus remain unconscious to mind whereas elements like scale and proportions stimulate mind to gain attention. Natural elements like sunlight and shadows, water, wind, trees and natural materials keeps mind connected to world in architectural settings whereas, traditional patterns makes mind travel back to time.

The study highlights the importance of all the senses in comprehending built environment. Sensory richness in an environment leads to attention to time, self and world around us, thus make being conscious. Richer the aesthetic experience, more likely lead to spiritual awareness, sustainable behaviour and well being. Rituals play important role in religious buildings. Ritualistic ceremony provides experience to olfactory and gustatory senses thus religious building becomes ordinary piece of architecture without rituals. The spiritual environment makes one aware of moment of time, experiencing through stimulation of senses by design elements in a built-environment resulting in creative imagination (meditation) of his being (conscious) which connect him with *God or Nature or Truth* and Sustainability.

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RESTRICTING FACTORS IN THE SELECTION AND SPECIFICATION OF SUSTAINABLE MATERIALS: AN INTERIOR DESIGN PERSPECTIVE.

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ABSTRACT

Internationally and in South Africa, interior designers are faced with the objective to reconsider and replace traditional surface materials with materials that meet sustainability criteria. The process contributes to many challenges that impact on the accurate selection and specification of appropriate sustainable materials during the design and implementation stages of a project. This paper aims to focus on the factors that restrict and limit designers to specify sustainable surface materials and therefore prevent them from converting their conventional design processes within a South African context. In order to identify the factors, a critical review of literature was conducted as well as interviews with practicing interior designers situated in Johannesburg. The literature review identified that the task of selecting and specifying sustainable materials is a prominent barrier which ultimately affects the implementation of sustainable practice. This task commences during the first stages of the design process and if it is associated with restriction or limitations, it could contribute to resistance toward adopting sustainable design practices. Feedback from interior designers shed light on the barriers applicable to a South African context and reveals the radical change that is needed to assist in addressing the lack of transforming the sustainable market and adoption of sustainable practices.

Key Words: Interior design, selection and specification, sustainable surface materials, restricting factors.

1. INTRODUCTION

Since 1999, studies have been conducted to understand why interior designers are not implementing sustainable practice in their decision-making process. The studies conducted by Mariam Landman (1999, pp. 29-33), Alison Terry, Andrew Walker-Morison, Usha Iyer-Raniga and Margaret Bates (2007, p. 12), Kirsty Máté (2009, p. 2), Elif Sonmez & Filiz Tavsan (2018, p. 28) and Michelle Hankinson (2011, pp. 17, 30,80-94), provide a global insight of the factors that influence the implementation of sustainable interior design practice. These studies identify sustainable material selection and specification as one of the prominent barriers to the implementation of sustainable interior design practice due to various influential factors that have a hindering or limiting impact on the selection of sustainable materials.

During the design of a sustainable building the selection and specification of sustainable materials forms part of the first decisions taken in the initial stages of the design process (Akadiri, 2011, p. 7; Pearce & Venegas, 2002; Sonmez & Tavsan, 2018; Zhang, 2012, p. 5). The decisions taken during the initial stages of the sustainable design process, make an important contribution to the final sustainability outcomes of the building. For this reason, the selection and specification of sustainable material should be included in the decisions taken during the conceptual design stages (Akadiri, 2011, p. 7; Pearce & Venegas, 2002; Zhang, 2012, p. 5). The selection process should furthermore be addressed in a holistic manner, which takes into account the entire lifecycle of material and addressing the ecological, social and economic consequences affecting the outcome of the selection. Interior designers are well positioned to positively contribute to the implementation of sustainable building practices through holistic sustainable material selection due to their decision making roles in the initial stages of the design process. However, Mihyun Kang and Denise Guerin (2009, p. 179), Máté (2009, p. 1) and Eunsil Lee, April Allen and BoKyung Kim (2013, p. 1), explain that while interior designers can make conscious decisions about material selection and specification, their task of implementing sustainable practices is limited. The task of selection and specification of sustainable surface interior materials remains challenging due to the many restricting factors that hinder or limit the material selection process. Thus, this paper aims to focus on identifying the factors influencing sustainable material selection and specification that are specific to South African interior designers.

2. RETHINKING THE TRADITIONAL APPROACH TO SUSTAINABLE MATERIAL SELECTION

With the global mind shift advocating the need for holistic thinking and natural environmental preservation for future generations, the way in which all realms of the society operate has changed and the criteria for traditional material selection will no longer suffice. Kang and Guerin (2009, p. 179) argue that, traditionally, interior design decisions were dictated by the main influential factors which are: functionality, aesthetics, and costs. Although these remain influential in the material selection process, these criteria do not necessarily consider the life cycle of a material.

Interior designers are repeatedly tasked to select materials, which places the designers in a position of control over the choices made with regards to the selection and specification of sustainable materials. Rachael Brown and Lorraine Farrelly investigated the extensive use of surface materials by interior designers in order to reveal why and how materials are identified, selected and specified for interior environments. Brown and Farrelly (2012, p. 30) explain that “design is an act of will, a considered response to an identified need or desire, a process that often results in a... material solution”.

However, the process of arriving at a final material solution is often a challenging task and remains a contentious issue (Calkins, 2009, p. iv; Trusty, 2003, p. 6). Brown and Farrelly (2012, p. 30) explain that it is challenging because there are many contributing factors that influence the material selection process. Kang and Guerin (2009, pp. 179-180) state that it is due to the fact that there is now another influential factor, sustainability, which lies beyond the border of the traditional interior design approach to material selection. With sustainability as an influential factor in the material selection process, it is more challenging as there are now more factors that have to be taken into consideration in the material selection process.

2.1. Influential factors hindering the selection of sustainable materials globally

Fatima Ghani (2012, p. 21) explains that the debate in understanding the ecological crises “still focusses on the symptoms rather than the causes”. Focussing on Ghani’s statement it is necessary to investigate what the influential factors are hindering the implementation of sustainable practices. Globally, influential factors have been identified that influence interior designers’ decisions in the implementation of sustainable design practices and on the selection of sustainable materials. For a global perspective, we will reflect on the studies conducted by Landman (1999, pp. 29-33) in America, Terry et al. (2007, p. 12) in Australia, Máté (2009, p. 2) in Australia, Sonmez and Tavsan (2018, p. 28) in Turkey and Hankinson (2011, pp. 17,30,80-94) in KwaZulu-Natal, South Africa.

2.1.1. Barriers in America

In her study, Landman (1999, p. 30) identified the primary barriers hindering sustainable building practices prompted by a series of questionnaires directed to American building professionals. These barriers included ‘clients not having an interest in sustainability’, the building profession not thoroughly being ‘educated in sustainable design’, the ‘high costs associated with sustainability’ which is also related to ‘availability of sustainable materials’, and

'the long-term savings not being reflected in the service fee structure' (Landman, 1999, pp. 29-33).

2.1.2. Barriers in Australia

Máté's research conducted in 2006 (as cited in Máté, 2009, p. 2), identified both internal and external factors influencing interior designers' material selection which included the 'knowledge on sustainable design', the 'access to trustworthy information available about sustainable materials', the 'perception clients and designers have' about sustainable materials and lastly the interior designer's 'experience in the field of sustainable design'.

In 2007, Terry et al. (2007, p. 12) identified similar barriers that influence decisions regarding sustainable material selection. These factors included 'perceived relative cost'; the wide range of 'rating tools' available making the evaluation of materials even more difficult; 'inconsistencies in industry responses due to a lack of authorities governing sustainable development; 'slower building turnover' resulting in limited living examples; and lastly tenants, owners and building managers having "existing perceptions about acceptable churn rates" (Terry et al., 2007, p. 12).

Research conducted by Máté coincides with research done by Coleman (as cited in Máté, 2009, p. 2) in 2000 who surveyed 100 interior designers of the United States International Design Association. Coleman's research identified the designer having a lack of information, awareness and education on sustainable practices, the client who is not prioritising sustainability as design criterion, the client and or the designer having reservations about sustainable materials, and lastly the associated perceived cost of sustainable materials and systems, which directly impacts the decision making and implementation of sustainable practice. Máté (2009, p. 2) explains that these factors have a direct impact on decision making regarding sustainability. This indicates that external factors are continuously affecting the selection of sustainable materials for interiors.

2.1.3. Barriers in Turkey

In their research, Sonmez and Tavsan (2018, p. 28) approached 15 interior design firms to comment, in an interview process, on the factors that impact their material selection process. The research focusses on the responses of 12 design firms who identifies sustainability as a factor that influences materials selection. This indicates that sustainability is still not a necessity for all interior designers to consider during their material selection process.

2.1.4. Barriers in KwaZulu-Natal, South Africa

In her research, Hankinson studied the barriers impacting on the implementation of sustainable interior design practices. Hankinson (2011, pp. 80-94) identified three main barriers, including the 'cost of sustainable interior design', the 'education and experience of interior designers' in the field of sustainable interior design and lastly 'materials'. It is noteworthy that Hankinson indicates materials as a prominent barrier that must be overcome in order to implement sustainable interior design practices in South Africa.

Materials were identified as being a barrier because of the factors that influence the selection of sustainable materials and that ultimately affect the implementation of sustainable practices. Hankinson (2011, p. 90) pinpointed the influential factors as: 'supplier greenwashing', 'limited selection of sustainable materials available', 'products are imported', that it is 'costly to test products and set standards' and lastly the 'use of sustainable material as opposed to their traditional counterparts can prove to be an inconvenience'.

Although Hankinson (2011, p. 17) identified some factors influencing the selection of sustainable materials for South African interiors, she explains that her study is limited in explaining all the factors influencing sustainable material selection in South Africa because it is not the only barrier which was researched. Research is thus expanded to understand the factors influencing sustainable material selection for interiors.

2.2. Reasons for the existence of prominent barriers

A critical reflection of the selected literature reveals similar hindering and limiting barriers to selecting and specifying sustainable interior materials. These include:

- The cost associated with sustainable materials (Landman, 1999, pp. 29-33; Terry et al., 2007, p. 12)
- 'Greenwashing' from suppliers (Hankinson, 2011, p. 90; Máté, 2009, p. 2; Terry et al., 2007, p. 12)
- The interior designer's education and knowledge (Landman, 1999, pp. 29-33; Máté, 2009, p. 2; Terry et al., 2007, p. 12)
- Availability (Landman, 1999, pp. 29-33; Hankinson, 2011, p. 90)
- Lack of industry standards and guidelines (Terry et al., 2007, p. 12)

Further exploration into the prominent factors is required to gain an informed understanding of why these factors are hindering and limiting the implementation of sustainable materials and ultimately affect the implementation of sustainable design practices.

2.2.1. The cost associated with sustainable materials

The increased cost associated with sustainable materials is often only a misconceived perception (Milne, 2012; Spiegel & Meadows, 2006, p. 31) However, in some cases the initial cost of some sustainable materials is more than their traditional counterparts. Sustainable projects, suggested by Spiegel and Meadows (2006, p. 32) can cost five to 15 per cent more compared to projects without sustainability as a criterion. In 2012 this cost gap was further investigated by Milne, founding Chief Executive officer of the Green Building Council of South Africa (GBCSA). This report revealed that in the United States buildings with sustainability as criteria, cost between zero and four per cent more. The report also indicated that in Australia, buildings with sustainability as criterion ranged between being less expensive and up to six per cent more expensive compared to their traditional counterparts.

Spiegel and Meadows (2006, p. 31) suggest that the perception of sustainable materials costing more is difficult

to change. It is evident that the initial cost of some sustainable materials is more than their traditional counterparts due to new systems or alternative systems which can be more expensive to purchase as they are not commonly available and contractors are not yet familiar with installations. However, according to Penny Bonda, Katie Sosnowchik, & Summer Minchew (2012, p. 174), the initial cost is offset by the material's durability, reduced maintenance cost, and health benefits to occupants and their well-being.

2.2.2. 'Greenwashing' from suppliers

The increased interest in building sustainably flooded the market with manufacturers marketing their materials and products as 'green' in response to the demand. As a result, the term 'greenwashing' became synonymous with the 'green painted' market. The term emerged after the Earth Summit held in Rio de Janeiro in June 1992. The term greenwashing refers to the "superficial and unreliable dissemination of environmental hype" (Spiegel & Meadows, 2006, p. 45).

Manufacturers often indulge in 'greenwashing', exaggerating the green or sustainability characteristics of their products (American Society of Interior Designers, 2006, p. 18; Bonda et al., 2012, p. 148; Jones, 2008, p. 85; Spiegel & Meadows, 2006, p. 45). This creates additional difficulties for interior designers when they specify sustainable materials as interior designers rely on available information and transparency from manufacturers in aiding the selection and specification process of sustainable materials (Hansen as cited in Bonda et al., 2012, p. 159). As sustainable, green and environmentally responsible design gains momentum manufacturers and those whose success is central to product image could easily exploit it (Bonda et al., 2012, p. 148; Jones, 2008, p. 85) making the task of holistically selecting and specifying materials more strenuous.

2.2.3. Availability

According to Bonda et al. (2012, p. 174), manufacturers have taken note of the economic benefits due to an increased interest and need for sustainable materials. Additionally, manufacturers have also assumed responsibility themselves in the area of environmental stewardship. According to Bonda et al. (2012, p. 174), this dispels the myth and results in sustainable materials being available and accessible. However, Hankinson's (2011, p. 93) study, which is contextual to South Africa, reveals that there is a limited selection of environmentally responsible materials available for interior designers to choose from locally. The study also reveals that the sustainable materials that are available come from material ranges, which have limited variety.

2.2.4. Lack of industry standards, guidelines, and consensus

Previously, practicing designers operated on a trial-and-error basis to negotiate sustainable design challenges, thus discovering the wrong and right solutions. Bonda et al. (2012, p. 24) claim that this problem subsided with the release of Leadership in Energy and Environmental Design (LEED) by the United States Green Building Council (USGBC) in 2000. However, this measuring tool is not without controversy. According to Bonda et al. (2012, p. 24), the USGBC was forced to delay the release of the LEED v4 by an entire year. This was due to too many changes occurring especially to the Materials and Resources category, as the approach to selecting materials has significantly changed. Additionally, industry experts are contemplating how to successfully incorporate the life cycle assessments (LCA) into the material selection process.

2.2.5. The interior designer's education and knowledge on sustainable materials

By using the infamous phrase "what we don't know can't hurt us" Bonda et al. (2012, p. 23) call our attention to the dangers of designing with such a mind-set. They further explain that the need for education, updating information and remaining informed is crucial to all matters pertaining to sustainability. The foregoing discussion of Bonda et al. (2012, p. 23) states that education and accessible information becomes a priority as humans, sometimes unintentionally and due to ignorance, continue to cause harm to the natural environment. According to Bonda et al. (2012, p. 24) sustainable interior design and related concepts have been introduced into curricula at tertiary institutions, and most design professionals are aware of sustainable interior design. However, Bonda et al. (2012, p. 24) explain that due to the "vastness and complexity" of this concept, interior designers can feel intimidated. Interior designers often shy away from energy concerns involving mechanical systems, those not being part of an interior designer's expertise. But, it is evident that this is not the best-case scenario, as Bonda et al. (2012, p. 24) explain, for a sustainable interior to be successful, all project participants should participate from the outset of a project.

The foregoing discussion of Bonda et al. (2012, p. 24) therefore, implies that interior designers should remain constantly informed about new technologies and the necessary sciences relevant to sustainable design. As a result, interior designers can make informed decisions yielding the best outcomes for the client's needs. Furthermore, studies have indicated that the more experience team members have regarding sustainable design, as well as an understanding of the accompanying systems that contribute to sustainable design, the more successful the outcome of the planned project will be.

Esti Jacobs (2015, p. 110) states that there is a country-wide lack of much needed and relevant education at tertiary institutions within the field of sustainable building in South Africa. This results in those responsible for the built environment lacking the necessary awareness, knowledge, and skill in green building principles. Jacobs, therefore, argues that this is as a direct result of the lack of green building principles being implemented in the built environment. Research validates Jacobs's view that the lack of education on green building is often cited as a significant barrier to implementing green design (Landman, 1999, p. 29; Shafii, Ali & Othmon, 2006, p.41 as

cited in Jacobs, 2015, p. 110).

3. RESEARCH METHODOLOGY

In order to identify the factors that restrict and limit designers from specifying sustainable interior surface materials within a South African context, the research adopted a qualitative approach. This approach is situated in the interpretivist paradigm which enables the research to uncover “inside perspectives or real meanings” (Wahyuni, 2012, p. 71) which is essential to reveal what the factors are that influence interior designers when selecting sustainable interior materials. The research for this paper focused on one-to-one, semi-structured interviews as the primary source of data. Participants were identified through an online search. The search for individuals was limited to interior designers practicing as Accredited Professionals identified by the Green Building Council of South Africa or those affiliated with a leading, environmentally conscious, interior design firm in South Africa based in Johannesburg. Interior designers were specifically selected for their decisionmaking powers regarding sustainable interior material selection and specification.

4. FINDINGS

4.1. Lack of market transformation

The lack of market transformation in the market supply of sustainable materials in South Africa has emerged as a prominent factor that influences the selection of sustainable materials. This indicates that the required progress to support the sustainable building sector is slow. The findings revealed that the lack of market transformation is the accumulative effect of the availability of sustainable materials, imported materials, the limited selection of sustainable materials, the necessary and reliable information needed from suppliers and manufacturers, the building industry that has a lack of the necessary knowledge on sustainability, and the lack of regulatory requirements that govern the use of sustainable materials.

Interior designers rely on the market supply for sustainable materials to the building sector. This supply is expressed by a research participant as a “niche” market in South Africa. As a result, there are not enough reliable materials from well-established manufacturers and suppliers available locally. Participants admit that, compared to imported sustainable materials, locally manufactured sustainable materials are not always readily obtainable. The ranges are limited. Information on locally manufactured and supplied materials are not readily available and often not reliable and frequently results in materials being advertised that are riddled with ‘greenwashed’ information. Installation is not as smooth and lead times are prolonged. As a consequence, South African designers rely on imported materials instead of locally manufactured and supplied sustainable interior surface material.

4.2. Cost of sustainable materials

The majority of research participants indicated that the cost of sustainable materials is the second most influential factor hindering selection and specification of sustainable materials and limiting the implementation of sustainable materials. The participants explained that the impact of the cost on the selection and specification of sustainable materials can be categorized according to the initial cost of sustainable materials which are higher compared to traditional materials, and secondly, the possibility of selecting sustainable materials is influenced by the client’s agreement with sustainability and the associated initial cost.

4.3. The base building

Research participants have identified the base building, the building envelope, as an influential factor. One research participant explained that design implementation and material selection will be influenced, due to the constraints and requirements of the design in response to the base building. The base building presents as a factor that can have both a positive impact that promotes sustainable materials selection or a hindering and limiting factor.

4.4. The lack of collaboration among industry professionals in the built environment

Due to the various built environment industry professionals not willing to collaborate with interior designers, it hinders the implementations of sustainable materials. The research participants explain that this is after the fact that interior designers have already specified and selected sustainable materials for interiors. One participant has however expressed that even though this is a barrier to overcome in the implementation of sustainable materials, it is the least of the hindering factors to sustainable material selection and specification.

4.5. Green Building Council of South Africa’s Green Star South Africa

Majority of participants have expressed that the GBCSA can have a positive impact on the selection of sustainable materials. Interior spaces can be awarded a Green Star rating by the GBCSA. The GBCSA has developed the Green Star South African (GSSA) rating system, which is the official certification body for South African projects. The objective of the GSSA is to acknowledge and award environmental leadership in the built environment. According to the Green Star Interiors V1 Technical Manual, the materials credit accounts for 30 points of

a possible 110 points obtainable in order to receive a Green Star rating. Thus the participants are motivated by the drive to obtain a Green Star rating which results in it being a major influential factor promoting the selection of sustainable interior materials.

4.6. Aesthetics, innovation and sustainability

Two participants have expressed that the innovative use of sustainable materials to arrive at a sustainable solution has placed aesthetics in the background. Instead, the challenges to innovatively use sustainable materials have become a promoting factor in the selection and specification of sustainable materials. One participant expresses that because of the creative drive of interior design, it allows the designer to create with sustainability as a criterion.

4.7. The 'buzzword'

Participants explain that the marketability of sustainability is promoting the selection of sustainable materials. One participant states that sustainability has become "cool". A research participant explains that the words associated with sustainability such as 'reuse, retrofit and green' have become "buzzwords" that promote the implementation of sustainable design thus promoting sustainable material selection and specification.

5. CONCLUSION

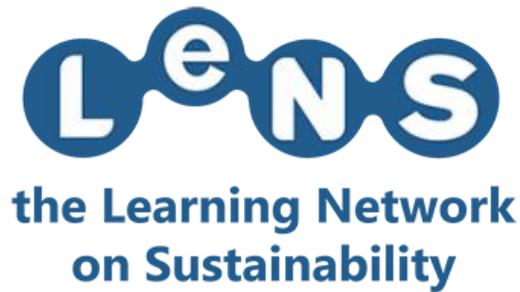
As limited local research on sustainable interior design and sustainable interior materials selection was located, we mostly consulted international sources to inform the research process. Taking into consideration the 20-year time lapse since Landman's study, similar factors are still being identified that are hindering and limiting the selection of sustainable materials. It is concerning that sustainable material selection – which contributes significantly to the sustainability outcome of a building – remains a significant hurdle to overcome. Our paper thus offers suggestive evidence for the need for improved market transformation. Our paper presents the argument for a change in regulatory requirements and improvement in legislation that governs sustainable building practices.

Progress is slow. Taking into account the limited mandatory regulations and the GBCSA's leadership for greening the South African built environment, radical change is still needed. The successful market transformation towards a sustainable built environment will, therefore, require various role-players to proactively take part in a radical transformation. Government regulation and implementation of GBCSA standards cannot function in isolation but need the support of suppliers, designers, and their clients to ensure that transformation is understood and implemented throughout the entire life cycle of a material.

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OPTIMIZATION AND LCSA-BASED DESIGN METHOD FOR ENERGY RETROFITTING OF EXISTING BUILDINGS

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ABSTRACT

This paper aims to provide a framework for integration of life cycle sustainability assessment into design process. For this purpose, at first the meaning of efficiency will be defined mathematically by proposing a set of equations. The equations will be designed to be capable to measure life cycle values and costs and able to provide a comparative index for each design alternative applicable in an optimization process.

Finally, in order to evaluate the performance of our proposed integrated design-assessment framework, a set of design variables of a building envelope such as geometry and construction materials will be selected as optimization variables. By using parametric design software and simulation tools such as Rhino-Grasshopper and Energy plus, our proposed framework will be applied on a hypothetical case study, then the results and future development and research directions in this field will be discussed.

Key Words: LCSA, Optimization, Energy retrofit, Building

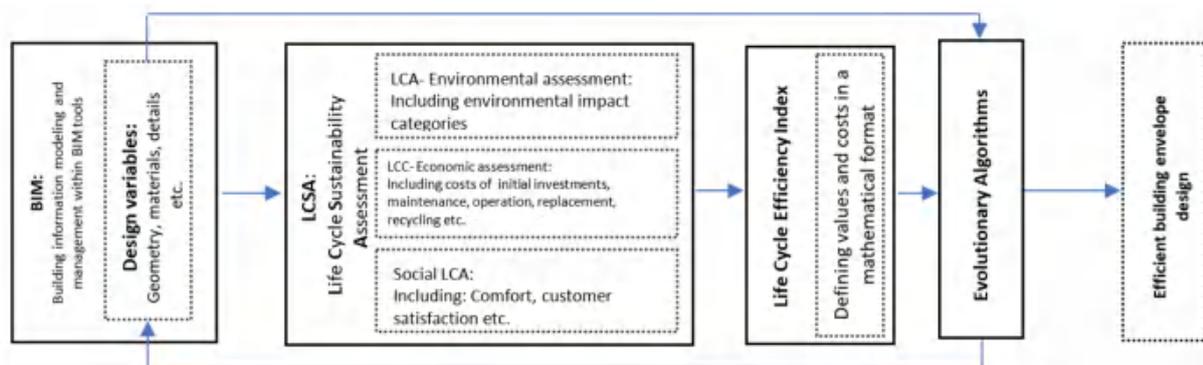
1. INTRODUCTION

The considerable share of energy consumption in existing buildings which is estimated around 40 percent of total energy consumption and noticeable environmental impacts in this sector (Iribarren et al. 2015), alongside the fact that a large proportion of existing building in Europe were constructed before 1950s with low energy efficiency (Vilches et al. 2017) and the reports which show that the renovation rate in building sector is only 1.2 % per year (European-Commission, 2015) indicate that there is a huge potential for reducing the environmental impacts of built environment by energy retrofitting existing buildings. Building envelopes are critical components which can considerably affect the energy performance of buildings (Hay and Ostertag 2018). Designing efficient envelopes both for new and existing buildings can significantly reduce the energy consumption and environmental impacts of buildings (Kheiri 2018). Therefore, in order to achieve sustainability goals in the building sector, designing efficient envelopes have a high importance and priority in energy retrofit interventions.

To answer the question of sustainability in building sector, it is required to have a comprehensive approach for building performance assessment capable to evaluate various sustainability criteria such as environmental, economic and social aspects, over all phases of a building life cycle (Jensen et al. 2018). Life cycle sustainability assessment (LCSA) is a method capable to quantify the environmental impacts, economic and social aspects of products or services with a whole life cycle perspective (Geng et al. 2017) however few studies have addressed to all three main areas of sustainability (Invidiata et al., 2018) and most of them have only focused on environmental or economic aspects (Gilani et al. 2017). Integrating life cycle sustainability assessment and optimization into design process is a new research topic, few studies have been published in this subject and further studies should be carried out in future. Research works performed by Holberg and Ruth (2016), Lobaccaro et al. (2018), Jusselme et al. (2018) and Amini Toosi and Lavagna (2018) are some of few papers published in this subject in recent years.

2. RESEARCH METHOD

A Framework for integrating life cycle sustainability assessment into designing efficient building envelope is presented in figure1. The framework is comprised of different steps in an iterative process. First, the definition of efficiency should be determined according to the project targets. For this purpose, the efficiency should be defined by a quan-



titative method.

[Figure. 1] Conceptual framework for integrating LCSA into designing efficient building envelope

$$Life\ Cycle\ Efficiency\ Index\ J = \sum_{i=Production\ Phase}^{End\ of\ life\ Phase} (Values\ increment_{jt} + Costs\ decrement_{jt}) \quad (1)$$

Equation1, presents a mathematical definition for Life Cycle Efficiency Index (LCEI).

Where: I: the different stages of the building's life cycle J: the building, product or scenario under assessment

Life cycle efficiency index is defined by values and costs. The values and costs should also be defined and presented in a dimensionless format. The environmental (LCA), economic (LCC) and social aspects (S-LCA) will be analysed according to European standards and guidelines. Values and costs will be calculated by equation 2 and 3 To make the

$$Values\ increment_j = \left[CFTWt \left(\frac{Thermal\ Comfort}{Baseline\ Thermal\ Comfort} \right) + \dots \right] \quad (2)$$

$$Costs\ decrement_j = \left[EnvWt \left(\frac{Baseline\ environmental\ impacts\ value}{Environmental\ impacts_j} \right) + ICWt \left(\frac{Baseline\ global\ costs\ value}{global\ costs_j} \right) + \dots \right] \quad (3)$$

values and costs dimensionless, the existing performance of the case study could be considered as the baseline.

Where: CFTWt, EnvWt, ICWt: weight of Comfort, Environmental, Energy, global costs, respectively.

In this paper, thermal comfort is defined as value, and as S-LCA indicator since it is directly affect the inhabitants' satisfaction level. Thermal comfort will be evaluated and reported as percentage of comfortable time according to adaptive thermal comfort theory. The costs are defined in terms of environmental impacts and life cycle costs. The environmental impacts will be calculated according to EN 15978, the CML LCIA method is considered and

7 midpoint indicators corresponding to 7 impact categories will be evaluated (table 3). The environmental impacts will be assessed both for materials and total energy consumption (heating, cooling and lighting) of the thermal zone. The thermal zone geometry will be defined parametrically in Rhino-Grasshopper and the operational energy demand, thermal comfort will be analysed by Honeybee plugin (using Energy plus live connection). The LCA, LCC and S-LCA as well as proposed equations will be defined in Grasshopper and will be inserted in the optimization process by Galapagos component.

3. RESULTS

According to above-mentioned methodology, a simple thermal zone is defined parametrically. The boundary conditions of all surfaces (walls, roof and floor) are set to outdoor condition. Table 1 and 2, present the geometric and physical properties of the thermal zone. In order to avoid any complexity in results, a very simplified thermal zone is modelled in this case study. Structural parts and window frames are excluded and the thermal bridge effect is not analysed. All the walls, roof and floor are modelled as components with two construction layers (EPS insulation and concrete).

[Table 1] Geometric description of the thermal zone

Location	Geometry		Life Span	Zone program	Temperature set points		Illuminance required	Fuels	
Milan-Italy	Floor area (m)	10*10	30 years	Residential	Heating	20 C	300 lux	Heating	Natural Gas
-	Height (m)	3	-	-	Cooling	25 C	-	Lighting/ Cooling	Electricity

[Table 2] Construction layers and materials used in the thermal zone

	Construction layers (from inside to outside)	Thickness (m)		Density (kg/m ³)	Thermal conductivity (W/m-K)	Specific heat (J/kg-K)	WWR		Boundary condition	
Floor, Roof	EPS insulation	Variable a 0.1 m b		20	0.035	1300	0		outdoor	
	Light concrete	0.1		1500	0.5	1100				
Wall	EPS insulation	South	Variable a 0.1 m b	20	0.035	1300	South	Variable a 0.1 b	South and north	outdoor
		North	Variable a 0.1 m b				North	Variable a 0.1 b		
		East	Variable a 0.1 m b				East	0	east, west	
		West	Variable a 0.1 m b				West	0		
	Light concrete	0.1		1500	0.5	1100				
glass	U value is 3.3 W/m ² -K, Solar heat gain coefficient is 0.6, Visible transmittance is 0.65									

Only insulation thickness of walls, roof and floor, and window to wall ratio of south and north wall are defined as design variables in this study. In this study LCA, LCC and S-LCA are weighted equally.

The indexes in table 2 (a and b), refer to the different single- variable optimizations in which some parameters are kept fixed while the other is taken into account as a variable. For instance, in the first optimization the thickness of insulation is the variable while WWR of south and north wall are kept equal to 0.1.

The optimization process is performed in four times (3 single- variable and 1 multi-variable). In order to understand the influence of each variable on the optimization objective, only one parameter is set as variable and others are kept constant in optimizations 1 to 3 (according to the table 2). In the last optimization all input parameters are set as design variables at the same time.

[Table 3] Environmental and economic data of material and energy used in LCA and LCC calculations

	Environmental data							Economic data	
	GWP(kg CO ₂ eq)	ODP(kg CFC-11 eq)	AP(kg SO ₂ eq)	EP(kg PO ₄ eq)	POCP(kg C ₂ H ₄ eq)	ADP elements(kg sb eq)	ADP fossil fuels(MJ)	Material price (installation included) (^)	
Materials									
EPS (1 kg)	4.612979	1.2E-07	0.016389	0.002747	0.006862	7.58E-07	99.10928	40.9 per 1m ² with 20 mm thickness. 1.23 will be added for each 10 mm.	
Glass (1 kg)	36.31064	4.12E-06	0.282713	0.051654	0.011638	0.000137	410.641	22.69 per 1mm	
Energy									
Natural gas (1 MJ)	0.073375	5.78E-09	0.00019	1.47E-05	1.45E-05	2.71E-08	1.149727	0.0731 per 1 kWh	

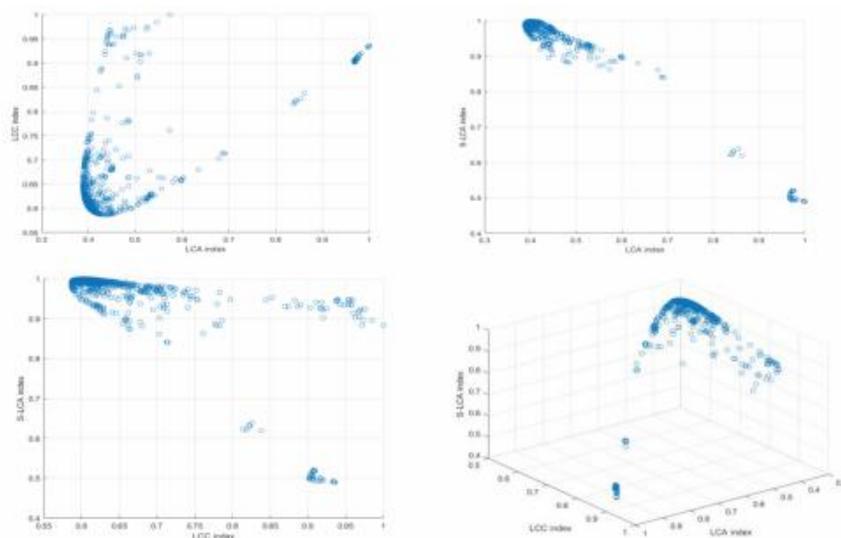
Electricity (1 MJ)	0.150662	1.96E-08	0.000656	0.000172	3.31E-05	7.11E-08	2.000522	0.2142 per 1 kWh
Normalization								
N values	5.79E13	1.61E8	3.83E11	1.22E12	2.80E11	4.39E8	4.5E14	-

Since in this study, only insulation thickness and window to wall ratio are taken into account as design variables and will affect the comparative results, these materials and energy consumption are considered in LCC and LCA calculations. The environmental and economic input data of materials and fuels are presented in table 3. The environmental impacts are calculated by SimaPro, based on Eco-invent database, the normalization values are taken from the document published by EU (Sala et al. 2017). The price of materials and installation costs are taken from the price list published by municipality of Milan (Premia, Adulti, & Anni, 2017).

The Result showed that the S-LCA index which represent the thermal comfort level increases by insulation thickness from 0 to 0.22 m, then it gradually decreases. The optimum insulation thickness is 0.22m. Reverse relations are found for LCA and LCC indexes. The optimum insulation thickness for minimizing environmental impacts and global costs over the life cycle are 0.39m and 0.18m for LCA and LCC respectively.

According to these results for minimizing the total life cycle environmental impacts more insulation is required compared to LCC minimization. These results are directly connected to the thermal performance of insulation materials as well as their embodied environmental impact and the cost of materials and installation. However, other parameters such as annual increasing rate of energy prices and interest rate of investments affect the results over the life span of the building.

The results for WWR-Optimization are acquired in 2 different optimization processes in each of them the insulation thickness is fixed on 0.1 m and the south and north window to wall ratio is set as variable and 0.1 respectively and



vice versa. The optimum WWR for south and north wall is 0.1 and 0.05 if the total energy consumption is the optimization objective. But according to S-LCA, LCA and LCC indexes, the optimum WWR for south wall are 0.07, 0.09 and 0.11 respectively. These values for optimum WWR of north wall are 0, 0.12 and 0.17 correspondingly.

[Figure 2] 3D and 2D illustration of all simulation results in multi variable optimization

The results showed that life cycle efficiency index is more sensitive on WWR of south wall in comparison with north wall and rapidly decreases by increasing WWR. This behaviour of LCEI is directly and vividly influenced by energy demand in different WWR of south wall. The optimum window to wall ratio of south and north wall are found equal to 0.1 and 0.14 respectively. Due to the significant increment in cooling energy demand by increasing south WWR and regarding that cooling energy is assumed to be supplied by electricity which is more expensive economically and environmentally compared to natural gas in this Italian case study, the optimum WWR is higher for north wall than south for maximizing life cycle efficiency index.

Finally, the multi-variable optimization is performed by 3000 simulations, figure 2, shows the result of simultaneous optimization for insulation thickness, south WWR and north WWR according to equal weighting factors for S-LCA, LCA and LCC indexes.

The important point is that the result of this multi-variable optimization is acquired in a combinational form of design variables, which allow designers to understand the performance of different design alternatives and choose each of them according to their preferences and compare them with the maximum achievable performance. The results show the combination of variables for achieving a set of optimum results could be very different. In this case study, by the equal weighting for S-LCA, LCA and LCC, minimum and maximum LCEI are obtained from 0.4951 and 1 respectively. In this range the maximum LCEI corresponds with 0.3 m, 0.22 and 0.02 for insulation thickness, north WWR and south WWR. However, there are many different combinations with less than 0.04 reduction in performance which could be chosen as the final solution in accordance with other design criteria. For instance,

the values 0.26 m, 0.17 and 0.22 for insulation thickness, north WWR and south WWR will result in life cycle efficiency index (LCEI) equal to 0.9619 which has a negligible difference with maximum performance and a considerable difference in the variables combination. These results and findings also show that there is a flexibility in some design variables such as window to wall ratio if a quasi-optimization is considered in the optimization process.

4. CONCLUSION

In this paper, a new method for integrating life cycle sustainability assessment is applied into designing the external envelope of a simple thermal zone. The framework includes life cycle environmental impacts of materials and energy consumption over the life cycle of the thermal zone as well as life cycle costs (material price, installation costs and energy price) over 30 years of life span. This research is the first part of an ongoing PhD research which has been started by authors and the purpose was to show how this framework is effectively able to find the best scenarios for designing efficient building envelopes. The results showed that the proposed method is capable to perform as a decision making support within a design process and is able to find the best scenario considering various life cycle values and costs. The method is also applicable for designing different parts of building envelope and facades and for finding the optimum shape and geometry of a building facade or any components of a building. In future research works, more complicated design variables and scenarios could be taken into account and also more values and costs will be considered into defining life cycle efficiency index. The other question which will be answered in future research works is how to select the best weighting method for comparing different values and costs for each case study.

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INDOOR ENVIRONMENTAL QUALITY DESIGN OF HOTELS IN THE UNITED STATES AND EUROPE

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ABSTRACT

The last 50 years marked a deep change in the way people travel. The great development of tourism created the necessity of building more and more hotels and accommodations, polluting and wasting much energy. The aim of this research is to understand how the accommodations face the environmental impact of the structure using LEED parameters. The starting point is the analysis based on a survey made on a sample of hotels located in places with opposite climate conditions; the purpose is to understand which strategies the structures adopted in order to adapt to extremely different climate conditions.

Key Words: LEED certification, indoor environmental quality, Hotel environment, tourism

1. INTRODUCTION

1.1. The impact of tourism

From 1950s to nowadays tourism experienced a 49 fold increase, passing from 25 million global tourist arrivals to 1.2 billion in 2016¹. This incremental growth in the number of travelers consequently led to a raise in demand of tourist accommodations such as hotels. The hospitality industry is among the most polluting in the world because: hotels are one of the few architectures that work every day of the year and both night and day; particularly electricity is the most wasted resource, taking between 60% and 70% of the consumption costs, of which 25% is represented by lights. Overall this means a doubled consumption per night compared to 50 years ago².

Moreover, tourists are getting more conscious about the environmental issues, and they are consequently more interested in the greening of tourism. In fact, more than one third of the travelers pay attention about their choices in order to become “greener” tourists. Furthermore, both ecotourism and cultural tourism are taking the lead and are predicted to grow rapidly over the next twenty years. It is estimated that global spending on ecotourism is increasing about six times the industry-wide rate of growth³. In this context, the LEED - Leadership in Energy and Environmental Design- parameters could be used as a valid help to understand how eco-sustainability could bring an improvement for both the environment and the economy of the hotel industry.

1.2. LEED and IEQ

The LEED certification was created by the United States Green Building Council (USGBC) with the aim of promoting sustainability in the building and construction industry⁴. The LEED works through the evaluation of parameters, such as the IEQ (Indoor Environmental Quality), used to rate the quality of the environment surrounding the guest.

- The IEQ is based on multiple parameters⁵:
- IAQ (Indoor Air Quality)
- artificial and natural ventilation
- the thermal comfort
- the interior lighting
- the daylight
- the view and
- the acoustic performance

Therefore, through their use the LEED parameters can guarantee a more satisfying stay for the travelers and a reduction in the environmental print left by the structure. Nonetheless researchers found out that there is no specific evidence of an implement in the revenue of the building certified with LEED, even though a slight difference can be spotted; the research anyway is based on a very few structures (93 certified hotels) that may not be enough incisive in the data analysis. The absence of utter proofs of bigger revenues can be one of the possible explanations for the lack of LEED certified buildings. On the other side, the LEED certification could provide a good standard to be featured in building projects in order to create greener constructions. Indeed, the parameters of LEED certifications concern many steps of the project, such as the water saving systems and paintings with low contaminants⁶. Including these parameters in the project and later in the development of the architecture could produce benefits both for people and revenues: a healthy and comfortable stay for the guest, and a cut in the consumption of resources through saving systems and renewable energy.

2. AIM AND METHODOLOGY

The aim of this research is to study which solutions the hotels engaged in to solve climate issues, according to the specific climate condition.

Among the LEED parameters, the research focused explicitly on the IEQ of the rooms considered.

A survey has been developed on quantitative data and has been distributed to the chosen hotels after contacting via phone call the general manager of the hotels and being sent by postal services. After a month, the general managers have been contacted again so that they could send back the results via mail or e-mail.

The hotel samples for this research were chosen from different areas of the world, to represent opposite climate conditions:

- The Mediterranean Sea

¹ See <https://ourworldindata.org/tourism>

² See <https://www.calrecycle.ca.gov/EPP/GreenLodging/>

³ (Pratt et al., 2011)

⁴ See www.usgbc.org/about/history

⁵ (USGBC, 2019)

⁶ (Walsman et al., 2014)

- Upstate New York surrounding Ithaca

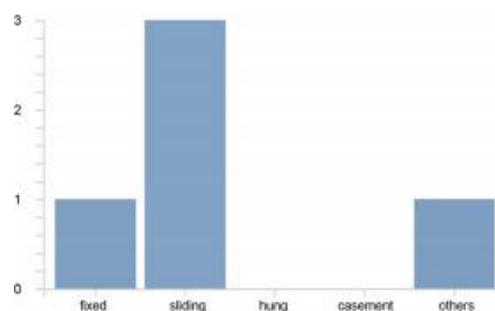
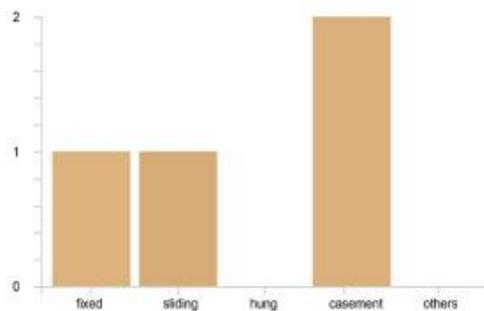
The survey text is common for all the sampled hotels, concerning a standard double room, that has been scanned through 25 questions to sum up and verify the 11 parameters that represent the IEQ (Indoor Environmental Quality).

The 25 questions asked were regrouped in 5 main groups:

- General information: - How many rooms has the hotel? - What is the category of the hotel? – How many square metres approximately has the room? – How many people can stay in it?
- Windows: - Does the client have the possibility to open the window and get fresh air? - Type of window installed in the room – Type of glass installed on the window – Type of frame installed on the window – Approximate dimension of the window – Does the room have a clerestory window installed?
- Natural and artificial lighting: - May the customer change the light intensity in the room? - Does the room have an occupancy sensor to switch on or off the lights? – Does the room have light shelves on the façade? – Which kind of adjustable window shades has the room?
- IAQ and HVAC systems: - Is it allowed to smoke into the room? – Has the Hotel installed an HVAC equipment? - Which is the furniture installed over the windows? – Does the room have a thermostat that allows the customer to change the temperature in their immediate environment? – Does the room have an adjustable air diffuser that allows customer adjusting the airflow?
- Façade and external environment: - Which is the orientation of the main façade of the room chosen? – Has the room a rooftop solar water heating system? – Has the room a balcony or a terrace? – Has the room a pool in front of the room? – Has the room vegetation/flora in its immediate environment? – What visual connection has the customer outside the room?

3. RESULTS

The survey analysed 9 facilities including one economy, three mid-range (3 stars) and 5 deluxe (5 stars) hotels. The buildings have on average 72 rooms each, with a minimum of 9 rooms in a three-star hotel on American soil and with a maximum of 149 rooms found in a five-star hotel in Europe. The rooms usually range around 30 square metres, the only exceptions being a three-star hotel in the USA with a room of 20 square metres, and two luxury hotels



in the Mediterranean having a floor plan of, respectively, 80 and 137 square metres each. Three of the rooms analysed are to be used by two customers, three of them by four adults and a baby, one by three adults and two babies and two hotels chose not to answer this question.

[Graph 1] American hotels window type

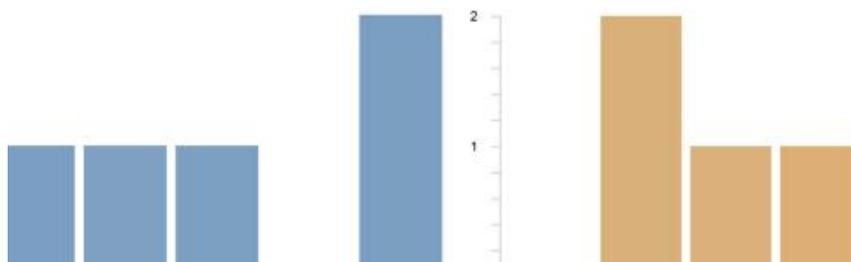
[Graph 2] European hotels window type

3.1. Windows

Three hotels in America and one in Europe present sliding windows, two hotels in Europe have a casement window, one in Europe and one in America have a fixed window, and another American hotel would rather not answer that question (see graphs 1-2). We can therefore see that in America the sliding windows are the ones usually chosen as in Europe casement windows are vastly more in use, probably due to climatic issues:

- casement windows let fresh air flow in the room more easily in summer months,
- sliding windows offer a better control of the air flow in colder environments;

All of the windows have clear glass, usually them being single or double glazed in American hotels and high performance double glazed or triple glazed glasses in European hotels, giving therefore to Mediterranean hotels a



better control over outside environmental factors.

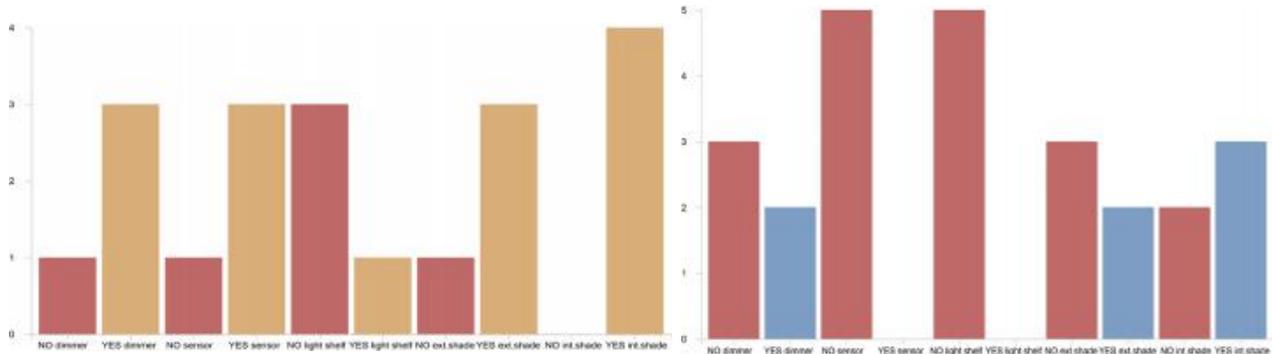
Five out of nine window frames are made in aluminium, being a light and efficient material, two (one in Europe and one in America) are made in wood and just one American economy hotel has them done in vinyl, that choice being probably made for economic and insulation factors.

[Graph 3] American hotels window dimension

[Graph 4] European hotels window dimension

The window dimensions range from 100 by 50 cm to 190 by 170 cm in American hotels, while in the European ones they range from 180 by 120 cm to 225 by 350 cm (see graphs 3-4); this difference in dimensions is due to climatic reasons:

- smaller windows in fact result in a minor area of the room exposed to outside weather and climatic conditions



- bigger windows allow for a much freer airflow and an increased exposure to natural sunlight.

None of the American hotels has clerestory windows, while two out of four European hotels have them in some rooms.

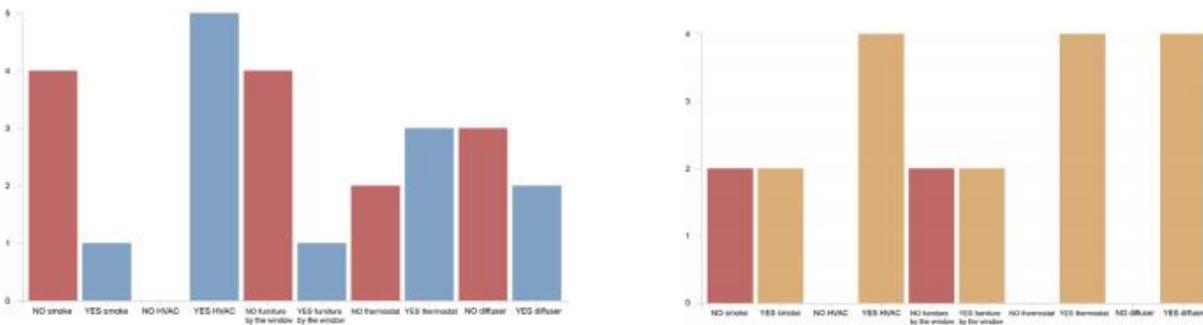
3.2. Natural and artificial lighting

[Graph 5] American hotels lighting

[Graph 6] European hotels lighting

If we analyse the artificial illumination we can see that just two hotels in America and two in Europe have the possibility of varying the light intensity in the room, and that no American hotels have an occupancy sensor for switching off lights when the client is out of the room, while that practice is well established in Mediterranean hotels: just one out of four of them doesn't have an occupancy sensor, two of them have one and one of them has a key-card holder that works as the main switch for the lights in the room (see graphs 5-6);

Analysing instead the amount of natural lighting entering the room, we can observe how just one of the European hotels and none of the American ones have light shelves on the façade for a better light penetration and solar access in the room. Another parameter worth considering for the natural lighting is the type of light shades available



in the rooms: two out of five hotels on American soil have an adjustable outside window shade, and two out of five of them have an interior one. Instead, all of the European ones have an interior shade and three out of four of them also have an adjustable exterior one, resulting in an increased visual comfort (see graphs 5-6).

3.3. HVAC systems and IAQ

[Graph 7] American hotels HVAC/IAQ

[Graph 8] European hotels HVAC/IAQ

In six out of nine of the rooms analysed by the survey, smoking inside the room is not allowed: in fact just one of the given hotels in the USA and one in Europe allow their clients to smoke in all of the rooms and one European one in some of the rooms; tobacco smoke, and its negative impact on IAQ, is therefore more accepted in indoor spaces in the Mediterranean than in the American ones;

All of the rooms taken into consideration present an HVAC system (see graphs 7-8).

Regarding the possibility to adjust the temperature in the room, only two mid-range hotels in America haven't got the possibility to adjust it through a thermostat, while in Europe all the hotels allow it; same thing applies for the air diffusers, where all the European hotels display one and three out of five American hotels don't have the possibility to adjust the airflow in the room (see graphs 7-8)

One out of five American Hotels and two out of four European hotels have the HVAC system placed close to the windows, resulting in a greater thermic dispersion in the Mediterranean Area.

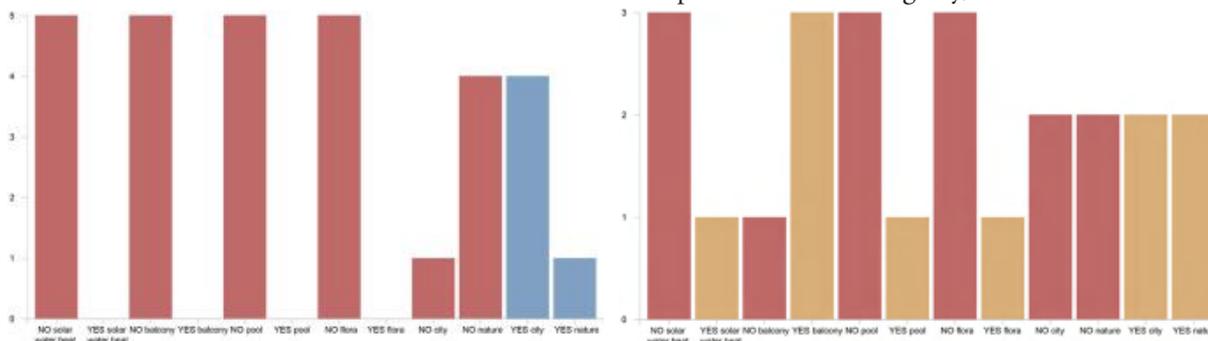
3.4. Façade and external environment

The orientation of the facades of the hotel buildings considered vary vastly, with two hotel rooms facing north, two south, two south east, one west and one northeast: it is therefore not possible to find a design pattern nor in Europe nor in northern America based on the orientation of the buildings and their consequent solar exposition, that could result in a more efficient temperature, IAQ and natural light control.

Furthermore, only the European hotels have balconies: two out of four of them have an uncovered balcony and one has a covered one, while the American hotels considered don't have any, and just one among the European hotels and none of the American ones has a rooftop solar water heating system, a pool in front of the room and some vegetation around it (see graphs 9-10).

The visual connection outside of the room is also an element of interest:

- four out of five of the American hotels have as a first impact the surrounding city,



- two out of four European hotels also have as a first impact the surrounding city;
- natural elements outside one room in America are the hotel private garden and facilities,
- natural elements outside two of the Europeans room are the sea and the hotel private garden, those hotels having also the pool in one case and other facilities like the Spa or the gym in another (see graphs 9-10).

[Graph 9] American hotels façade and exterior

[Graph 10] European hotels façade and exterior

We can therefore see how different the emotional impact would be in the occupants of those rooms, as in the hotels with an outside view on the garden or other natural element the effect on the customer is a relaxing one, as it is safe to assume that the purpose of their trip is a leisure or holiday one.

Instead the effect on the customers with a room on the city would be not a relaxing one, but an exciting one, as a built environment could create a state of psychological arousal on the occupants, that is safe to assume could be business travellers.

4. CONCLUSION

The research highlighted the consequent differences between the two geographic areas.

In Europe:

- Windows appear to be bigger and more easily opened, to take advantage of the natural ventilation thanks to the mild weather, though also causing thermic dispersion;
- European hotels have power consumption reduction systems put in place;
- all the rooms have an HVAC system, presumably focused on the refrigeration due to the high temperatures in summer. Smoking is better tolerated than in America, resulting in a lower IAQ.
- Most hotels are located in vacation places, so the environment suggests relaxation and leisure. Only the European hotels have balconies.

In America:

- windows are smaller than the European ones to keep the warm temperature inside the room;
- American hotels do not have any electric power consumption reduction systems in place;
- as the European ones, the American rooms are all supplied with an HVAC system, in this case focused on the heating, but with a limited possibility to adjust temperature and air diffusion; smoking inside is less tolerated, resulting in better IAQ.
- Many of the surveyed American hotels are located in the city, so the views don't have the same relaxing features found in the Mediterranean Sea, but instead a more exciting one.

4.1. Limitations

The survey was completed on a restricted number of hotels, the same methodology could be applied on a broader sample of hotels for more uniform and complete results. Further considerations on the maintenance and on the life cycle of the furniture and objects found in the room could also be applied to evaluate the IEQ.

5. ACKNOWLEDGMENT

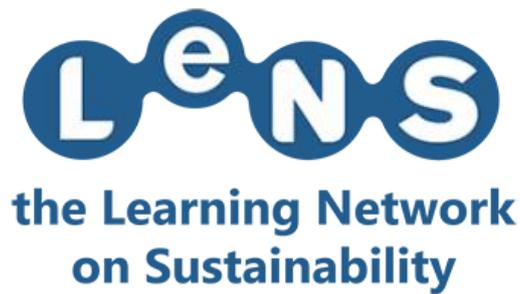
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SUSTAINABLE TECHNIQUES TO IMPROVE THE INDOOR AIR QUALITY (IAQ) AND THERMAL COMFORT IN HOT AND ARID CLIMATE.

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ABSTRACT

Nowadays an increasing number of people spend a lot of their time in indoor spaces and the global market for Heating, Ventilation and Air Conditioning (HVAC) is increasing very quickly to improve the indoor air quality and the thermal comfort. The International Energy Agency assesses that almost the 20% of global energy consumption is addressed to mechanical air conditioning. The use of local resources and the rediscovery opportunities given by passive cooling and ventilation systems may suggest interesting ways to provide benefits for humans and to reduce environmental footprint. The paper focuses on the application of wind-catcher system in a modern public school in the city of Yazd (Iran), in a hot and arid climate zone. Opportunities and benefits are discussed to evaluate the efficiency of the redesign of the traditional wind-catcher and its integration in new modern buildings.

Key Words: Natural ventilation, Cultural identity, Climate adaptation, Low-carbon solution.

1. INTRODUCTION

In recent years, an increasing number of people around the world spend about 90% of their time in indoor spaces (Liu et al., 2019) such as school, work place, home and other public spaces. The attention addressed to the improvement of indoor environmental comfort and to indoor air quality (IAQ) is increasing in new building design strategy. In the WHO's report (2000), the Working Group established that all organizations, public and private, must ensure adequate air quality for their occupants (Principle 4), because everyone has the right to breathe healthy indoor air and to live in healthy environments. The high level of indoor chemical pollutants, such as carbon dioxide (CO₂), nitrogen dioxide (NO₂), formaldehyde, benzene and other volatile organic compounds (VOCs), can contribute to causing the Sick Building Syndrome (SBS) in occupants. These chemical pollutants are present, in different concentration, in all indoor environments, because they are released by furniture, paints, cleaning products, computers and photocopiers (Yanpeng et al., 2018). The SBS is healthy condition that occurs with headache, fatigue, irritation of eyes, nose and throat, problems in focus and dry/itchy skin.

These health problems can adversely affect working and learning skills, especially in young people and children (Kishi et al., 2018), because they often spend a lot of their time in schools, libraries and study halls and they are particularly sensitive to chemical and microbiological pollutants. Another important aspect for the welfare of occupants and their productivity in public spaces regards the thermal comfort. Existing building code, such as ASHRAE Standards and the ISO Regulations, require a minimum ventilation rates, but very often it doesn't satisfy people's requests. The research published by Nduka et al. (2018) asserts that the quality of ventilation and cleaning mostly affect the perception of human comfort in indoor spaces than other factors. In new buildings mechanized and automatic systems are used to provide high performances to improve the indoor environmental quality (IEQ). Nowadays the global demand for Heating, Ventilation and Air Conditioning (HVAC) is strongly increasing and many studies assert that buildings are responsible for 40% of global energy consumption for operation and control and more than 30% of worldwide carbon emission (Liu et al., 2019).

These numbers might increase in the future and the increase of energy consumption might affect the integrity and the quality of built environment. Green policies promote the reduction of the environmental impact of HVAC, without neglecting well-being and work productivity of occupants. In many cases, the problem can be solved by providing proper passive systems of ventilation, that contributes to ensure the provision of air quality and quantity, to reduce energy costs for building management and also to decrease the ecological footprint. This paper focus on the investigation of benefits of natural ventilation strategy and its application in the design of a public school in the city of Yazd (Iran), characterized by hot and arid climate. In the framework of sustainability, the study of the context is essential to analyse local resources and to design an efficient low-energy-carbon ventilation system. In conclusion, the paper highlights the importance of connections between natural ventilation, thermal comfort and healthy indoor environment through the rediscovery of traditional architectural techniques, applied in a new building, for the provision of fresh air in indoor spaces.

2. DESIGN FOR SUSTAINABLE LIVING: SUSTAINABILITY AS DRIVER IN DESIGN PRACTICE

The concept of sustainability is a key issue in many fields of our society. The UN Sustainable Development Goals (SDGs), especially the SDG 11, remark that the main global challenge is to provide high quality standards of living spaces for a large population, without damaging natural ecosystems. In the design practice of indoor spaces, sustainability assumes a humanistic dimension, that focuses on human wellbeing, and an environmental dimension, that concerns energy reduction for building control. Another important aspect to deal with sustainability in architecture is the relationship between the design practice and the territory.

Local geography, cultural identity and especially the bond between man and nature have played a crucial role in defining main features of traditional Iranian architecture (Khaki et al., 2015). One of the challenges in contemporary architecture is to understand if the traditional holistic attitude can respond to the optimization of energy consumption and to the provision of satisfying comfort. Looking at the seven principles of sustainability in Iranian traditional architecture (Khaki et al. 2015), the use of renewable energy, the reduction of use of raw materials and the design in coordination with the local geography are considered as main drivers in designing solutions to satisfy needs of the occupants. In the sustainable view, buildings are considered as parts of wider environmental system, characterized by specific regional and economic conditions, microclimate, culture, material and energy resources. In addition to these, it may be useful to also consider the 4R rules (reduce, recycle, reuse and renewable) in the design process (Li, 2011) to chase sustainability in the management of conditions of indoor spaces that affect the thermal comfort and air quality.

These principles suggest that traditional Iranian architectural elements have been designed based on available local resources and in order to minimize the environmental impact. The analysis of the regional context investigates all important features of a specific territory, not only geographical and climate characteristics, but also the traditional know-how, the material culture and history. This analysis is the first important step in the research methodology to identify local opportunities in order to ensure environmental resilience and sustainable development.

3. REGIONAL FRAMEWORK AND CLIMATE ADAPTATION BY DESIGN

3.1. Geographic and climate framework

Iran is the second largest country in the Middle East it is located between the Persian Gulf and the Oman Sea in the south, and the Caspian Sea in the North. From the North to the South the country presents three climate areas: the desert with hot-arid climate, semi-arid climate in the wider part of Iran and Mediterranean. Yazd city is located in the desert region in the middle of Iran. Yazd province has a very typical climate conditions that presents cold winters and very hot and long summers. Low precipitation (60 mm in a year) and humidity (between 12% and 16%), shortage of water, high season temperature range (40°C in summer and -8°C in winter), dusty and sandy winds and scarcity of vegetation covering are perceived as limitations for planners and residents (Etminen, Ilkhanlar, 2017). On the other hand, the high amount of wind and solar radiation are considered as valid resources for the development of new opportunities for the transition of the use of fossil fuels to renewable energies. Iran is considered as one of richest country all over the world for alternative energy resources. In particular, in the Yazd province there is the perfect condition for the development of diffuse wind farms. The city of Yazd is located in a natural wind tunnel with almost permanent wind flow that provides suitable conditions for harnessing the wind energy.

3.2. Traditional elements for climate-adaptive architecture

Looking at the contemporary urban planning of Yazd, it appears inadequate for the local climatic features and the design of buildings fails to meet environmentally friendly requirements. The fast growth of Yazd to accommodate rural mitigation, as the result of the Reza Shah's land reforms in 1960, has created a strong demand for housing. Cheap and quick construction buildings were adopted as the best solution by the government. In modern buildings the importance of traditional architectonic elements was strongly decreased, and the main result is the inadequate provision of quality standards regard comfort and liveability. In the past, people have always been affected by harsh climate and this has led them to finding solutions to make the weather condition more tolerable and less annoying (Dalvand et al. 2015). Ancient buildings, houses and streets was designed considering range of temperature, speed and frequency of wind, number of hours of sunshine per day, precipitation and relative humidity (RH). Climate-adaptive architecture is usually based on the worst climate conditions of the year, available resources and constraints. On the other hand, many opportunities should be taken into consideration to mitigate harsh climate conditions, such as the use of underground water canals (Qanats), the increase of humidity, shading and ventilation using wind tower system and planting trees and bushes in courtyard.

Following principles of design for sustainability (Khaki et al. 2015), natural resources should be used in architecture to provide comfort and benefits for occupants. The vernacular architecture is strongly influenced by nature to comply with the geographical and climatic features. Traditional elements should be combined with high-tech solutions to decrease the environmental impact while increasing the thermal comfort and the IAQ. The air circulation, through passive cooling and natural ventilation, is a central aspect in vernacular architecture of Yazd, at the level of single building, of neighbourhood and of city. Courtyards, vegetation, internal pools and underground canals for water and windcatchers contribute to provide high quality standards for indoor spaces. Windcatchers are ancient passive cooling and ventilation systems hailing from the Persian Gulf area, Pakistan and North Africa region. The air flow occurs either due to the wind blowing or the temperature difference between the interior and the exterior of the building. When the wind blows, it is captured by the chimney and flows downwards cooling itself and it is distributed in the rooms, while the warm air flows upwards. In windless conditions, the wind-catchers operate like an air trap according to the stack effect: hot and less dense air rises and outflows from the wind-catcher's openings (Ahmadikia et al. 2012).

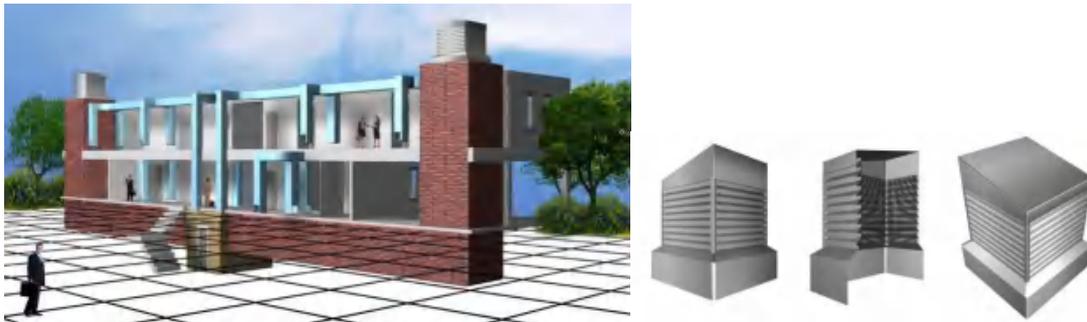
3.3. The use of windcatchers in contemporary architecture

In many cases architects and engineers integrate the principles of traditional windcatchers with contemporary technology as helpful devices to increase the quality and the efficiency of the supplied air. Modern windcatchers are usually more compact and smaller than traditional ones. In these modern systems, air is supplied to indoor spaces through diffusers located at the ceiling level, allowing for more space for ventilation. From Eastern to Western countries, there are many application of windcatchers technology in modern public buildings, such as the Sohrabji Godrej green business center in Hyderabad (Andra Pradesh, India), the Zion national park visitor center in Utah (USA), the Lanchester library in Coventry (UK), the UCL school of Slavonic and Eastern European studies in London (UK) and the Bluewater shopping mall in Kent (UK). In these building windcatchers contribute to the provision of natural ventilation, lighting and fresh indoor air.

4. THE APPLICATION OF SUSTAINABLE PRINCIPLE IN NEW SCHOOL BUILDING IN YAZD

The goal of this study is to design a new school building in Yazd, following the principles of sustainability, in order to reduce the energy consumption for its operational control. The area under study is located in the new urban fabric in the North-West of Yazd, a rapidly expanding area. The focus is addressed on natural ventilation as a valid choice for air conditioning, thermal comfort and air flows. Natural ventilation provides also many secondary bene-

fits for the well-being of the occupants, such as the disposal of fan noise linked to mechanical systems and the cost effective for the maintenance. Classrooms, dining halls, libraries and gymnasiums are spaces where natural ventilation is vital for the well-being of the occupants. Wind-catcher system is also appropriate for transition spaces without windows, such as corridors and store rooms. The application here presented is designed for a primary school with a maximum capacity of 140 students, divided into 10 classes on two floors. However, the ventilation system is designed to be applied in different type of buildings in the same climate zone. The school is equipped with two air supplier canals and six exhaust air ducts (wind-catchers). On the top of two chimney there are special wind rotation caps equipped with wind lead sheets to rotate in the direction of the wind. Functions of these caps are to better catch the external air, to reduce the amount of dust and suspended particles, which are being channeled into the canals, and to protect canals against rain water (Figure 1). The two main canals of the wind-catcher are linked with the air division room (or technical room), placed at the basement of the building, where the incoming air is divided between the other ducts that terminate into classes.



[Figure 1] Section of building that shows the two main canals and the air ducts and details of wind-catchers structure.

Canals of the wind-catchers and of the basement are made by adobe material capable of absorbing humidity. In order to increase the absorption of humidity, the internal surfaces of wind-catchers canals are made of adobe. The cooling effect is more efficient by spraying the pads of air division room with water, a technique frequently used in cooling towers, humidifiers and evaporative coolers. Firstly, warm air (almost 40°C and 10% of RH) is drawn inside through a porous wet pad and the water contained into the material absorbs heat and evaporates from the pad. At the end, the air leaves the systems at lower temperature of 22°C and 50% of RH and it exits by four opening on the ceiling to enter into air ducts to be distributed in indoor spaces (Figure 2).



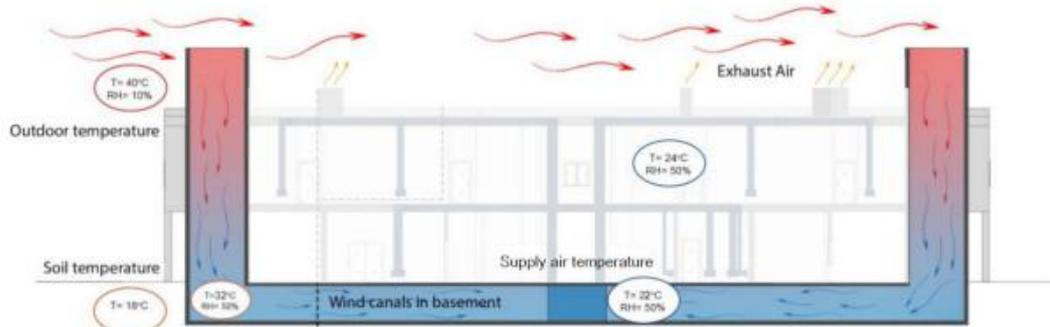
[Figure 2] Air flow through the windows composed by three cellulose pads in the technical room placed at the basement of the building.

The efficiency of evaporative pad system is affected by the surface area and thickness of pads, the type of material, the size of perforations, the flow rate and humidity of incoming air and the volume of water used. Considering locally available cheap materials and previous studies (Hou, 2016), cellulose pads, recently designed for evaporative cooling for industrial and residential sectors, are chosen as the best solution for this application. These pads have high ability in absorbing water, and they are chemically treated to prevent disintegration. The technical room is provided with two windows for the inlet of air from wind-catchers canals, which are made by three cellulose pads for each window. Windows are also equipped with automated water supplier for spraying water on cellulose pads and with an automatic door to close the ventilation system in winter season.

5. CONCLUSIONS AND REMARKS

According to meteorological data collected regard temperature (maximum around 38°C in the daytime) and relative humidity (between 12% and 16%) in Yazd during the summer, these parameters are beyond the comfort zone. In the transition period between April and October, Yazd is the comfort zone, but in the other months of the year it is necessary to provide more comfortable indoor temperature and moisture (Soleymanpour et al. 2015). The case study illustrates very simple but effective moisturizing in order to increase the evaporation process and also moisturize the dry air in winter. In the natural cooling process the air flows through the adobe wind canals in the basement. During summer the underground temperature in Yazd is between 16°C and 24°C and the air gets cooler passing through underground canals and wet cellulose pads. Natural ventilation contributes to improve the thermal comfort and the IAQ, using natural resources and reducing the energy consumption. The case study presents the application of an hybrid strategy of vernacular and modern systems to improve levels of standards of comfort and sustainability in new public buildings. The analysis of the efficiency of the cooling and ventilation system shows that in the hottest days in Yazd (40°C and 10% of RH) the air could be cooled down up to 24°C and 50% of RH (Figure 3). The rediscovery of traditional architectural elements can be useful to improve the sustainable liveability of modern build-

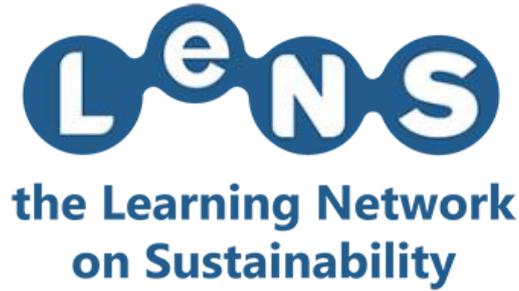
ings and also to preserve the cultural identity and the traditional know-how of the Yazd territory.



[Figure 3] Temperature course diagram and air flow scheme in the natural cooling system in the school in a hot summer day.

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DEVELOPMENT AND PROPOSITION OF A TOOL TO EVALUATE THE ECOLOGICAL IDENTITY OF PRODUCTS: FURNITURE CASE

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ABSTRACT

This paper focuses on the quest for the ecological identity in furniture design. From a historical point of view in the last century, the evolution of furniture products has been examined through some examples that paved the way for clear identities by including some apparent design features. By this review, the first furniture products were spotted that could be representatives of an eco-identity. In the literature, investigation of recent eco-strategies, considering product life cycle and also product-service system approaches ended up as a list of criteria to evaluate eco-products. As a result in this paper, a checklist model was proposed and visually presented in order to assess and choose products with this regard to the eco-identity. This proposition of checklist is a re-interpretation by altering an evaluative method in design process. This tool was used to assess and compare 6 different eco-furniture products that are presented in ecodesign books.

Key Words: Product Identity Ecological production Sustainable product lifespan

1. INTRODUCTION

In order to comprehend a product's identity with eco-friendly characteristics, Gotzsch (2008) offers a model of the key aspects for the attraction of ecological products. However, there are still questions to be conceived. The query is whether or not there are ecological codes that can be easily understood? What are the criteria to form such an apparent eco-identity?

As to research method, the effect of material selection will be evaluated together with new production techniques and will have an important place in this study. The selection and use of materials in industrial products are determined according to many parameters such as production method, cost and aesthetics. The contribution of materials is crucial in order to embody product identities in some product categories that establish emotional bonds with users such as furniture.

2. RESEARCH

In the history of product design, before the definition of 'ecological design' had not yet been established by first examples in the early 1970s, it may be a proper suggestion to regard "Arts and Crafts" movement and William & Morris furniture as the foundation of ecological design. Although the term 'ecological design' had not been defined yet, the ideas and discourse behind these designs are remarkable since they formed as a reaction against cheap production of industrialization at the end of 19th century. During this period, Ruskin examined the relations between art, society and the working class and Morris put Ruskin's ideas into practice so opposed the way of production and heavily imitative materials and style of furniture at that time. On contrary, the natural beauty of materials and the value of craftsmanship are highlighted.

This individualistic design initiative, started by Ruskin and Morris, had followed by the style of Art Nouveau conveying the traces and effect of Romantic Era (Sen, 2014). In this period, organic shapes and forms inspired by nature were visible in furniture products.

As the result of industrialization, the structure of society and consumption habits had changed completely. Mass production in large quantities, inexpensive and fast production, transformed the design and use of products. By introducing steam bending as a new production method, Thonet chairs could achieve a distinctive identity due to its form features. The parts of the chair that were mass produced on the assembly line could be easily identified and marked as Thonet production by the properties of its form.

New materials and production techniques had developed after the First World War and led to aesthetics of 'Machine Age' and pioneering approaches in design. Inspired by the art movements and cultural change of this period, pioneers had come up with designs that embody their ideological approaches. As a leading representative of the De Stijl movement, G. Rietveld designed the Red Blue chair (1918) which is like a three-dimensional installation that reflects the abstract and geometrical form of the movement. The chair was composed and manufactured of standard wooden parts easily available at that time to be produced in series.

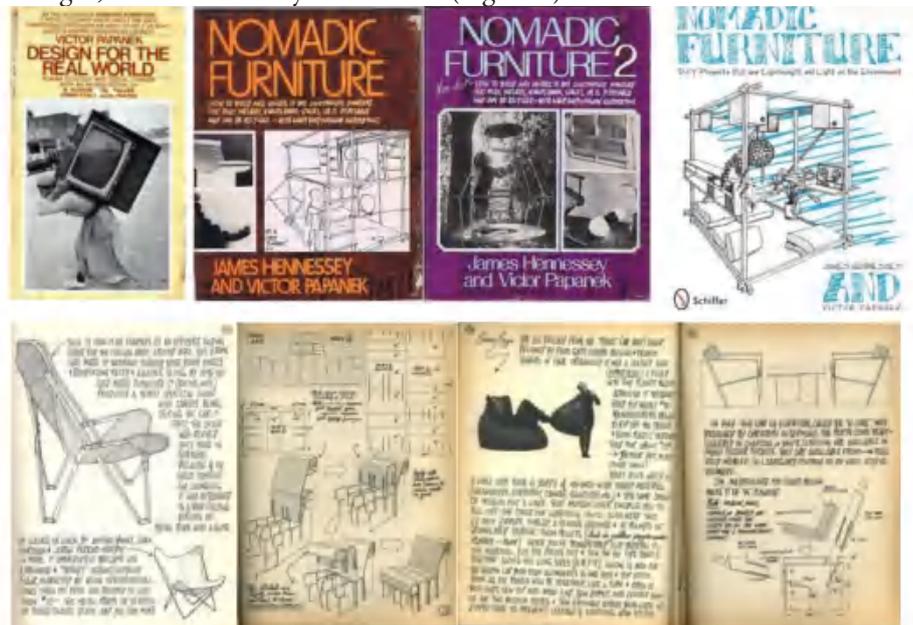
This minimalist approach continued in the Bauhaus design school in Germany and laid the foundation of modern design. The main intention was to combine all arts with technique by rejecting ornament and to derive the form from the function through simple shapes. M. Breuer considered a chair that could be produced on a serial assembly line as if Ford Model T in the automobile factory. His design, the 'Wassily' chair (Model B3) was the first design (1925) that consists of tubular steel. Later, designers such as M. Van der Rohe and A. Aalto continued to incorporate new production techniques.

The Second World War is another turning point that introduced new materials and production methods such as development in plastics and fiber-glass. After the stagnation of wartime, some original designers and manufacturers could benefit from the developments in the defense industry and transformed furniture products. During this period of rising prosperity in the USA, innovative designers and producers such as C. & R. Eames, R. Loewy and H. Miller stepped forward. First design attempts of C. & R. Eames resulted in DCW and LCW chairs (1946) made of plywood. These were comfortable chairs with a wide seating surface and a robust, durable structure, designed to meet the requirement of light, compact and low-price furniture for young families of rising population. Their experiments with the new material, glass-fiber led to a family of chairs named LAR, DAR and RAR (1948). These chairs are still design icons that provide lightness, ease of use and cleaning while their steel legs and wooden feet can be changed, assembled and disassembled on the glass-fiber body.

This way, social effects of World War II decreased through the technological innovations. In 1950's, people started fostering hope in a rapidly developing society. This optimistic view brought a period of interest in more moderate, pastel colors and organic forms made of natural materials such as wood. This organic modernism gave direction to furniture design by the pioneers such as C. & R. Eames in USA and A. Jacobsen in Europe. In Italy, Castiglioni brothers introduced the first examples of recycled 'ready-made' designs. Sella stool (1957) was designed by converting a bicycle saddle into a seating unit that provides free movement in all directions and intended to be used in telephone booths.

As the modernist movement, dominated by organic forms, continued in 1960s; a few designers who were against the rational values of modernism set the scene for extraordinary furniture designs which were mostly differ-

ent type of plastics by new production techniques, especially in vivid colors and fluid forms. By 1970s, the scene changed again as the cultural and social situation had become pessimistic due to a polarized world, wars and political scandals together with negative effects such as global oil crisis, increasing unemployment and inflation. This change in socio-economic conditions also improved the perception of design in a direction; sensitive to social issues. Therefore, the first examples of design responsible of social and environmental concerns appeared by the studies of V. Papanek (Papanek, 1971, 1973). The ecological identity of furniture design started to appear by these approaches aiming at materials in light, efficient and recyclable forms (Figure 1).



[Figure 1] First examples of ecological identity in furniture design

Decades after this introduction in today's world, daily human life has completely changed by information, communication and transportation technologies. Consequently, there is need for diverse furniture designs that are suitable for the changing lifestyles and identities of users of different social and cultural background. The environmental effects of this rapid lifestyle and consumption habits inevitably put a strain on the concern for sustainability.

Ecological and sustainable design approaches have become very important in recent years considering the environmental pollution and risks which are increasing day by day with industrial development. As the interest of public in this matter has risen due to climatic changes, research and information towards eco-products and eco-design strategies aggregated through articles and books.

Thus, during this study in order to identify the leading criteria for ecological identity, different books and sources over ecological design have been examined (Fuad-Luke, 2010; Bhamra et al., 2013; Liu and Wong, 2013; Vezzoli et al., 2014; Proctor, 2015). Beside sets of criteria according to life cycle assessment in these sources, ecological evaluation of chosen products can be seen by the criteria determined in some sources. It is seen that ecological evaluation has taken place in the product descriptions often by writing material information briefly together with related ecological terms and methods or by expressing these methods via associated symbols shown next to products.

The aim of this study is a more measurable evaluation and comparison between products. Therefore, the main criteria for evaluation are determined as a result of searching the headings of chapters in ecodesign books and by examining the methods of sustainability in the literature. The criteria have been categorized under three main phases: production, use and end of life in order to correspond to product life cycle stages. The relevant criteria to be used for the evaluation, comparison and selection of eco-products are as follows:

Production:

- Material Economy (No waste & Reduce Resources)
- Natural Materials (Low-impact & Biocompatible)
- Technology (Production methods & Optimization)
- Crafts (Local production & Social contribution)

Use:

- Product Service System
- User Perception & Awareness
- User Lifetime (Durability, Product-user relationship & adoption)
- End of Life:
- Reuse & Recycle

In the production stage; material economy indicates the consumption of material resource being used; the amount of energy needed for these materials and their production containing the necessary labor force or machin-

ery. This can be called as embodied energy. Natural materials are raw materials obtained from the biosphere or lithosphere on earth. They are not transformed by technological processes so cause little environmental impact and they can biodegrade in nature. This way, materials can be compared according to their embodied energy. Technology incorporates the ease and efficiency of the production method with total number of production phases, workforce and the amount of energy consumption. Harmful substances or gases emitted during the production method and phases are considered in this criterion for the proposed model. Crafts mean the level of local production and labor force and social contribution to the region where it is produced. Fair trade can be considered in this criterion.

As to use, product service system approach indicates the degree to what extent the product and business model are designed together as the product is evaluated together with its infrastructure and the system if it's applicable. Logistics, packaging and distribution are considered in this criterion. User perception and awareness means the level of increase in the ecological awareness of the user as a result of the product usage embracing material experience, usability and interaction with the user. User lifetime corresponds to the durability of the product due to materials and production method as well as the product-user relationship which can extend its life span. Functional and aesthetic features that can increase its user adoption are rated in this criterion.

In the final stage, the suitability of the materials for recycling and reusability is taken into account to rate this criterion while comparing the product samples.

For the evaluation, the samples were chosen among chairs as a product category which is more functional in furniture products. With regard to the criteria of use and product lifetime, product-user relationship is the major issue of seating products in terms of functionality. For selection of the chairs to be evaluated by the specified criteria, a search has taken place in ecological design books. Among the chairs having common reference in these sources, eight outstanding chair designs of different materials were chosen and rated by a checklist tool formed out of these criteria (Table 1). Similar evaluative profiles (Harris profile) are used in the conceptual stage of the design process in order to rate different product alternatives according to design requirements (Langeveld, 2007). As a result, the most appropriate conceptual solution can be chosen by comparing the total ratings set by the design specification.

1	Material Economy			
2	Natural Materials			
3	Technology			
4	Crafts			
5	Product Service System			
6	User Awareness			
7	User Lifetime			
8	Reuse & Recycle			
T				

[Table 1] Table for the evaluation of eco-products

In this table, the chairs are rated according to eight steps that are arranged according to the ecological design criteria. For each criterion during the product life cycle, parameters such as the amount of embodied energy required for the materials and production method together with labour need of the design, product service system involving distribution, the way of use, usability and interaction with the user so its adoption and durability, end of life are compared and rated. The criteria were rated on a three-grade scale by comparing the design parameters among the

Eco Chair, iform (Fuad-Luke, 2010, IF Ecology Design Award 2000)
 Materials and production: Plywood, compression molding



1	Material Economy			
2	Natural Materials			
3	Technology			
4	Crafts			
5	Product Service System			
6	User Awareness			
7	User Lifetime			
8	Reuse & Recycle			
T				14

Pressed Chair, 2011 (Liu & Wong, 2013)
 Materials and production: Aluminum plate (2.5 mm), cutting, pressing and bending



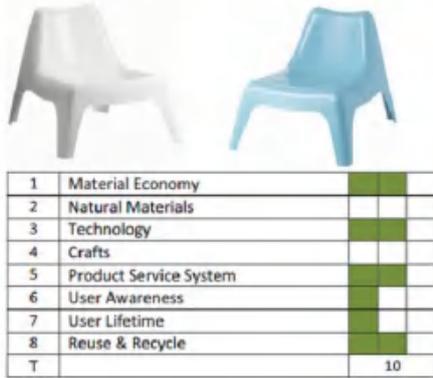
1	Material Economy			
2	Natural Materials			
3	Technology			
4	Crafts			
5	Product Service System			
6	User Awareness			
7	User Lifetime			
8	Reuse & Recycle			
T				12

Ikea Vagö, 2000 (Fuad-Luke, 2010)
 Materials and production: Polypropylene, monobloc molding

Hemp Chair, 2011 (Proctor, 2015)
 Materials and production: Hemp-fiber composite material, compression molding by water-based resin

selected samples. Six out of eight products rated in this study can be seen in figure 2.

Ikea Vagö, 2000 (Fuad-Luke, 2010)
 Materials and production: Polypropylene, monobloc molding



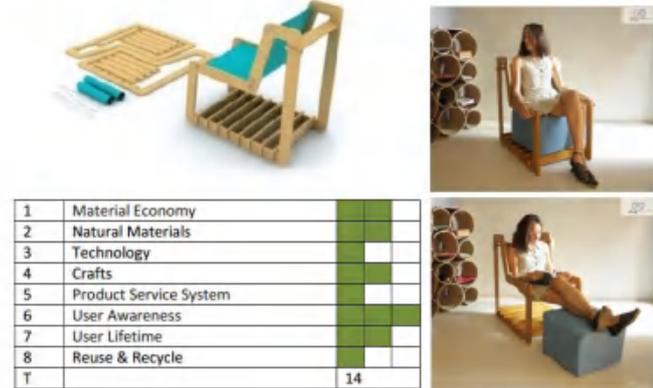
Hemp Chair, 2011 (Proctor, 2015)
 Materials and production: Hemp-fiber composite material, compression molding by water-based resin



Flux Chair, 2010 (Liu & Wong, 2013)
 Materials and production: Polypropylene sheet, injection molding



FS Chair, 2011 (Lucas, 2013)
 Materials and production: Plywood, organic fabric and rope, assembly without screws or glue



[Figure 2] Ratings and comparison between the design samples
 [Figure 2] Ratings and comparison between the design samples (continue)

3. CONCLUSION

This tool proposes an evaluative model for the comparison and rating of eco-products. 3-grade scales offer an estimation of each criterion as the parameters related to that criterion were considered and compared for the chosen samples. By eight criteria, products can be compared and rated approximately with the aim of reaching an overall score for every product. These ratings for each criterion are based on the author's consideration for the product design over its life cycle. However, its accuracy can improve when it is used in a focus group of designers and experts. This way, an average score can be obtained according to the number of participants.

As this tool may be usable for the conceptual evaluation of eco-products in the design process; it is good to keep in mind that design parameters which must be taken into account for the criteria associated with user stage of life cycle (PSS, user awareness and user lifetime) may vary for different product categories. In this case, chair design is a product category which is supposed to be highly durable while users tend to adopt seating products more emotionally rather than others in furniture category. Consequently, this research was conducted as a part of the phd. study which is currently going on and aiming at contribution to the lifespan of eco-products.

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INTERVENING ON ‘BUILDING AS A PRODUCT’ AND ‘HABITATION AS A SERVICE’ IN CONTEMPORARY URBAN SETTINGS FOR ADAPTIVE MICRO HABITATION DESIGN – INDICATIVE GLOBAL CASE STUDIES

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ABSTRACT

Increasing population in urban areas has put up additional pressure on urban and city resources. Housing, being in one of the three basic amenities required for human survival, is the worst hit. Widening income disparity, lack of space, and costly construction has added to the misery. This has become a worldwide phenomenon and is posing challenges to Indian cities as well. To bridge this gap between need and fulfillment, can architecture be considered as a service? rather than an end product; for those who need it severely and doesn't have capacity. A possibility is being explored to how the same can be planned? The paper tries to find out an opportunity to consider architecture as a service and plan micro habitats in the urban areas as an extension to the existing infrastructure.

Key Words: Adaptive Architecture, Urban Regeneration, Modular Habitat Design, Architecture as a Service, Approaches to Sustainability.

1. INTRODUCTION

Close to 12 million houses are lying unoccupied across urban India. Between year 2001 – 2011, number of households increased by 60 million (187m – 247m) and number of houses rose by 38 million (250m – 331m) in India. In urban India, 38 million new homes were built as against 24 million new households [CBRE South Asia, (2015)]. It is evident, there is surplus growth seen in the real estate sector in India as against demand. But on contrary, there is a shortage of approximately 20 million homes in India. This shortage affects, the economically weaker section (EWS), the most. 95.6% of housing shortage is in EWS group. The average house prices in India's three metropolitan cities vis-à-vis, Mumbai, Bengaluru and New Delhi are \$203,602; \$134,690; and \$115,897 respectively. Given this, a large number of household's need for a house is unmet owing to high prices. Real estate sector has become a money making sector rather serving the basic need of humanity. Projected prices are being asked as against actual cost. It is not surprising to see why slums, unauthorized settlements, unauthorized additions in buildings, encroachments, etc. in and around urban areas are common. Nearly 30% of population lives in urban areas and this is rising every year due to migration from rural to urban areas for various reasons.

Housing, being one of the basic needs of human survival, is hit by soaring prices; lesser available space than ever, rising costs of materials and labor, stringent civic building bye-laws, etc. Further, income disparity, demand by increasing population, is making the whole thing difficult to get. Though Government of India is trying to frame policies to provide housing to EWS group, minimum one house per family, safeguard interests of people from builder lobby, etc., but scene is the still the same. Policies such as Smart City are also initiated. This whole scenario of real estate sector in India, is giving a strong push to construction sector. A huge volume of almost every construction material is required, largest than ever. The push is observed in manufacturing sector, lifestyle changes, growing aspirations, consumeristic approach of living, etc. To meet such scenario, we may require concept of compact living [Sassi, P. (2006)] high density, with mix land use, access to facilities by choosing of end 'product delivery' or 'service rendered' by the product.

2. NEED

Is there a way to deliver an "unit of satisfaction" in above scenario? Can architecture be delivered as a service to the end user? May be if it can be separated as two entities of an end product and service. Since the cost of average house has gone beyond affordability limits of most, the economics behind housing needs may be in need of rejuvenation. A systemic innovation is needed to derive an economic model delivering habitation as a service to the needy in urban settings. The accessibility to the one of basic need may be extended to the wider audience by paradigm shift from traditional individually owned buildings to a commonly owned resource. The value is in decoupling it with traditional ownerships of bigger units than to make it smaller and decentralized. This would have distributed model of service delivery and exert lesser consumption and environmental impact due to wider distribution of users per unit of traditional space consumption. An increased social equity can be achieved in current scenario of economic disparity and affordability challenges. Stakeholder configuration approach of SPSS [Vezzoli, C., et.al. (2014)] system design for sustainability shall increase interaction and participation of end users in the proposed habitation as a service satisfaction-system. A unit of satisfaction in habitation as a service can be defined as an end user having access to a living space for a given timeframe. It may include all products and services associated with housing needs and their fulfillment.

Further, collaborative services of community habitation and extended home can be developed based on particular housing infrastructure to share domestic resources and shared household activities for developing a model collective infrastructure system for social innovation and sustainability. Domains of building services like facility management, energy & utility, building automation & BIM, operations, maintenance & system integration can be distributed among the peers. Besides, spaces can be shared and utilized as multi user laundry, play areas, gardens, neighborhood library, parking, party places, laundry restaurants and guest rooms, etc.

Some case examples from across world are available in form of commercial hospitality accommodation services. The first to mention here was Nakagin capsule tower, Tokyo. It was designed by architect Kisho Kurokawa and was completed in year 1972. It was a mixed use building having 11 & 13 floors in two tower structures. It had 140 self-contained prefabricated capsules for stay. Lately similar attempts are made in Osaka, Mumbai, Hong Kong and New York, etc. Extremely small rooms (capsules) intended to provide economic overnight accommodation, fitted with modern automated amenities are coming in vogue. Micro apartments are being planned in concrete pipes to ease out negative and leftover urban spaces to ease congestion of cities. Stackable, modular, 3D printed composite units with prefabricated units are used on scaffolding on a dead wall of an existing building. At present it may not look like a permanent solution but at least it offers a temporary relief of the crisis for people who are in need of affordable habitation in shorter time. The effort may not be sufficient in its present form but establishes a dialogue in the bigger conversation of the above stated problem.

What if the same concept be implemented in regular housing schema of habitation in urban settings? The paper explores the creative planning in relation to human needs of habitation to the present economic ecosystem in urban areas. Intervening on buildings as a product and habitation as a service is at the second level of increasing

potential role for design in approaches to sustainability.

3. THE SCENARIO OF COLLABORATIVE SERVICES

The collaborative services in housing can be shared at two levels of community and house.

3.1. Tentative design for social innovation and sustainability

- Community Housing based on particular housing infrastructure, which could allow for sharing domestic resources. Since the cost of everything is rising every day, affording a host of resources are proving to be costly and is not allowing possible use of the resource to its optimum limit.
- Extended Home whereby a share of household activities are outsourced to collective infrastructures in the vicinity. The neighborhood and vicinity become more serviceable and usable thus integrating the society. This increasing the interaction and a formal structure of management emerges at micro level. The recent phenomenon of gated community is one of the nascent examples at much smaller level sharing very few things such as security and outdoor open spaces only. In the next version of integration of many more services which carry the potential to optimize on possession cost/maintenance and resource usefulness at larger perspective on sustainability factors.

4. ARCHITECTURE AS A SERVICE

4.1. Domains of Sustainability and their Impact on Micro Habitation (EWS)

- Environmental aspects
- As a consumer the EWS sector could share resources and consumables in small groups as compared to individual. Some sharable entities are listed below, apart from these, material consumption against infrastructure could also be lowered. Shared thermal comfort, control on GHG emissions, energy consumption, etc can be lowered.
- Social aspects
- The concept could bring together a group of unknown people sharing common resources and brought together with a common cause. Promoting well-being and creating support group for material as well as emotional needs of people. The quality of relationships created through this group could play vital role in mutual growth and development.
- Economical aspects

A long term economic growth can be achieved by sustaining the social bonding and economic model based on mutual cooperative structures. A whole new model of economic sustenance can be developed and better opportunities can be created for people belonging to EWS. Over a long term a stabilized level can be achieved by them proving the worth of cooperative formats of helping in group. Several NGOs are working for empowerment of low strata people, they may get an opportunity to work with them easily.

4.2. Spaces

- Community Housing
- Multi user laundry
- Play grounds
- Gardens
- Neighbourhood library
- Parking
- Extended Home
- Party place
- Laundry restaurant (Combining two unconventional activities)
- Guest rooms

5. GLOBAL CASE STUDIES: DESIGN OF MICRO HABITAT HOTELS IN URBAN SETTING

5.1. Japan

Nakagin Capsule Tower, Tokyo was the first example of Capsule Architecture by Architect Kisho Kurokawa [Source: Wikipedia]. The project was completed 1972 and it was a mixed use building with two towers of 11 & 13 floors each. The building has 140 self-contained prefabricated capsules of 2.5 m (8.2 ft) by 4.0 m (13.1 ft) sizes with a 1.3 metre diameter window at one end and functions as a small living or office space. The cubes can be connected and combined to create larger spaces. Many such other projects came in existence later in other cities of Japan such as Osaka where modular plastic or fiberglass block roughly 2 x 1 x 1.25 m with amenities like TV, an electronic con-

sole, and wireless internet were provided. Luggage is stored in a locker; and washrooms are common on the floor. Later extremely small “rooms” (capsules) intended to provide cheap, basic overnight accommodation (US\$ 18-37) a night were designed in Capsule Hotel 9h in Osaka.

5.2. India

Urbanpod Hotel, Mumbai is the so called next generation smart hotel came up for the first time in India. Its strategic location and new concept has caught attention of people and it remains booked in advance. It is mainly popular with new age travellers looking for personal and business travel to the city. The unique experience provided this hotel is the USP. It taps on the conventional hotel industry with providing all regular functions with amazing and convenient solution in much optimized way in space, consumption and energy needs. It offers an exclusive Ladies Only floor also for the ease of female travellers. Pre-fabricated pods are installed in area from 50 to 90 square feet to suit various needs for individuals and couples. It adopts technologically superior interior finishing and common lockers and washrooms.

5.3. Hong Kong

Urbanovation, Hong Kong are the micro apartments in concrete pipes designed to ease Hong Kong's housing crisis [Source: Dezeen]. It is an amalgamation of Urban environment with Innovation. Hong Kong studio James Law Cybertecture has developed a prototype for low-cost, stackable micro homes in concrete pipes, which could slot into gaps between city buildings. Called OPod Tube Housing, the project sees 2.5 meter wide concrete water pipes transformed into 9.29-square-meter homes, with doors that can be unlocked using smartphones. Hong Kong is currently facing a major housing crisis, due to a rising population, a high demand for accommodation, skyrocketing property prices, and land limited by the city's island geography. The 2017 Demographia International Housing Affordability Survey ranked Hong Kong as having the least affordable housing market in the world. Law doesn't see his proposal



as a permanent solution to the crisis, but he believes his design could provide temporary relief for residents looking for something affordable in the short-term. It appeals to “young people who can't afford private housing”. It is proving to be an effective social experiment in architecture to provide sustainable temporary and semi-permanent accommodation needs to the economically sensitive segment of society.

[Figure 1] Nakagin Capsule Tower, Tokyo (Source: wikipedia); Urbanpod Hotel, Mumbai (Source: Urbanpod); Urbanovation Micro apartments, Hong Kong (Source: James Law Cybertecture); A Unit Detail of Framlab's Parasitic Hexagonal Pods, New York (Source: Framlab/dezeen)

5.4. New York

Pods from New York are Framlab proposed parasitic hexagonal pods to sleep New York's homeless [Source: Dezeen]. Empty walls could be covered with honeycomb-like clusters of pods to house the city's growing homeless, proposal by creative agency Framlab. formed by building walls to create temporary shelters. Construction of scaffolding onto windowless facades across the city, and slotting the hexagon-shaped modules inside. Outer aluminium shells intended to withstand harsh weather, which would encase inner 3D-printed wall structures made from recycled polycarbonate. Proposal would not solve the homeless crisis in its entirety, but it is important for Architects to be a part of the conversation. “It is critical that the design community is part of the social development.”

5.5. Critical Evaluation of above Case Studies

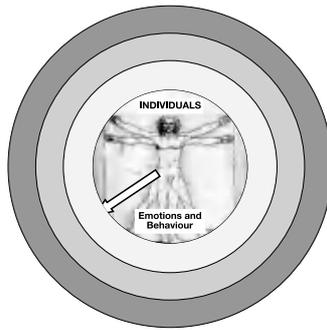
The concepts offer a time bound solution to the situation and tries to utilize existing resources and infrastructure. The lack of habitable spaces in urban areas is in a crisis and a huge number of people find themselves far behind the purchasing capacity of real estate. It saves from filthy, unhygienic and chaotic slums. The concept offers a modern solution with a dignified living environment. Besides, people in a short term requirement for living space may find it suitable for them. It is evolving from hospitality sector to residential needs which validates the need for such service based solutions for the needy.

The approach itself seems sustainable however ownership of units remain public and not individual. This may cause a mental stigma to first get into this and later to move ahead beyond it and own a individual space. This seems perfectly fine with the thematic approach of this concept. The solution doesn't offers for a living of full size family either. It is actually does not offer a permanent solution rather a temporary or semi-permanent stop by in journey of person which sounds fine keeping in mind the floating population of major urban cities of the world today.

6. COMMUNITY HOUSING

Instead of owning everything from bedrooms to service areas like laundry, parking, etc., the concept of community housing is evolving of shared areas and services in the building. It saves a lot in terms of individual ownership and put valuable resource to its optimized usage over time. Why a washing machine runs only once a week to serve a family? Why can't it run every day and serve a set of seven families in the neighborhood? Eventually high cost of living and maintenance is pushing many of such amenities to go service based rather than product based. From ancient times also, there are innumerable common baths, recreation areas, and shared meal halls. Paper intends to explore idea of developing community spaces in the regular built-environments on the similar lines of proving accommodation in transit (hotels).

Creative Planning in relation to the individual and to the ecosystems suggests a holistic, broad minded, multi-disciplinary, and creative inputs for problem solving. This attitude may come to the rescue of various common



problems from across the world such as related with consumerism patterns and product culture. The sense of ownership of a product may be replaced partly by sense of service because it is the sense of fulfilment from the product, we are looking for, rather than the product itself. This could be the approach for future living. Instead of owning a big house, it may be taken as a flexible space for living when required in a resource optimized environment.

[Figure 2] Creative Planning in Relation to the Individual and Ecosystems (Source: Nieminen 2008: 39)

7. DESIGN OF MICROHABITATS IN URBAN SETTING

Two main challenges remain for development of an ecosystem are geographical and temporal challenges. The evolution and development of design revolves around these to function over time. As the populations are increasing, resources are falling short, time is getting scarce, lifestyle is changing to minimal & direct, material science is getting advanced and technological feats are achievable – it is imperative to frame an 'Umbrella Approach' towards design and development of living systems for inclusivity. As the Figure 2 suggests, architecture and design of human habitat has to develop from eco system and behavior of individual to its corresponding ecosystem in relation to culture and industrial advancements. In current scenario of urbanism where things are getting smaller every day; a minimalistic habitation could bear the key to fulfill mammoth demands.

Intervention in urban spaces: The shared community living and interactions of domains is key to have harmonic behaviour in the living system. Integration of process and systems engineering could create a cooperative environment to run the system effectively. The help from algorithms, automated computing and BIM could lead to minimal error smart city planning and its operations. The efficient energy and utilization of resources would lead to deliver AaaS as a fulfilment.

Materials and technology: The use of technological feats can be directly experimented and used in proposed settings. Context based designing, setting and scenario analysis, serving orientation, anthropometry, ergonomics, economics of scale, LCA of materials used and overall sustainable approach towards designing, construction/fabrication and usage are to be considered in pre planning stage.

8. DISCUSSION

The paper foresees a probable approach for habitation in urban areas in form of micro habitation. The similar need of temporary and permanent lodging/habitation is being served by capsule hotels in Japan and several such alternatives are cropping up worldwide. Whether it is India, Hong Kong or New York, etc. the similar design concepts and executions are coming up. These are the reflections of ongoing phenomenon as derivatives of AaaS. As seen above, a combined approach for bifurcating delivery of architecture as a product or as a service should be from both 'item ownership-specific' and 'need fulfillment-specific' approaches. Both have some advantages and disadvantages over the other but in overall terms, a satisfied need finds more importance and serves effectively on sustainability parameters. General action plan for the designing process of a product- service system may be framed, where sustainability-orienting tools can be integrated into the various stages of the design process, policy frameworks and implemen-

tation.

The concepts shown in above case studies offer a dialogue between the real world scenario and solution approaches. Starting from hospitality (Nakagin, Tokyo & Urbanpod, Mumbai) to adaptive residential approaches (Urbanovation, Hong Kong & Framlab's Parasitic Hexagonal Pods, New York) the idea is impregnating in the creative minds; to look for fresh approaches towards habitation. The author believes the proposal would not solve the homelessness crisis in its entirety, but it is important for Architects / Designers to be a part of the conversation. It is critical that the design community is part of the social development and mandates to work towards the common development. The concept of compact living [Sassi, P. (2006)] could be encouraging to promote for more people per unit of space in an optimized and comfortable way. For this we may need to frame an 'umbrella approach' towards design and development of living systems for inclusivity in "serving(verb) habitation" to humanity.

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RESEARCH ON THE SUSTAINABLE DESIGN OF TRADITIONAL ARCHITECTURAL NARRATIVE CULTURE OF BEIJING HUTONG BLOCKS: A CASE STUDY OF NANLUOGUXIANG STREET

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ABSTRACT

This paper is based on architecture, to folklore, sociology, Feng Shui, art, design and other interdisciplinary research, through the analysis of the traditional architectural space of the context of the continuation of the way, trying to achieve a harmonious unity of time and space, finally achieve the goal of sustainable cultural heritage. This paper first introduces the historical evolution and current situation of Nanluoguxiang, and through these, analyzes the role of traditional architecture in cultural continuity in contemporary society, as well as how to do a good job in cultural inheritance.

1. INTRODUCTION

In about 3 years ago, Nanluoguxiang street ranks one of the top sightseeing places in Beijing. As the governmental survey shows that the only 800 meters long street holds the visitors in working day over 50,000 people, weekend over 100,000 people, and spontaneously acceptable person over 170,000 people. As from the point of protecting the historical buildings and living place, the government had to cancel the AAA landscape tag to stop accepting the travelling tour.

Urban sociologists R. Parker thought, personality and cultural charm of different cities, different from both the historical memory in the city, also is different from the public in the one thousand form beliefs values and behaviors, and reflection of culture in the city's cultural style also each have each charm and originality, so found in inheriting classic and innovation of the way is feasible Therefore, have reason to say, success in the 21st century city, will be generated from cultural city.[1]

As a very famous traditional historical and cultural block, Nanluoguxiang in Beijing can not only be studied as a typical block, but also has a very large group of tourism consumers. Therefore, it is pertinent to study the sustainability of traditional historical and cultural in Nanluoguxiang as an example.

2. THE CULTURAL STORY THAT NANLUOGUXIANG COMMUNICATES

Nanluoguxiang is located in Dongcheng district of Beijing, adjacent to the Shichahai Lake scenic area, north east Gulou street, south to Gates east street to total length of 786 meters, 8 meters wide. (Figure 1)

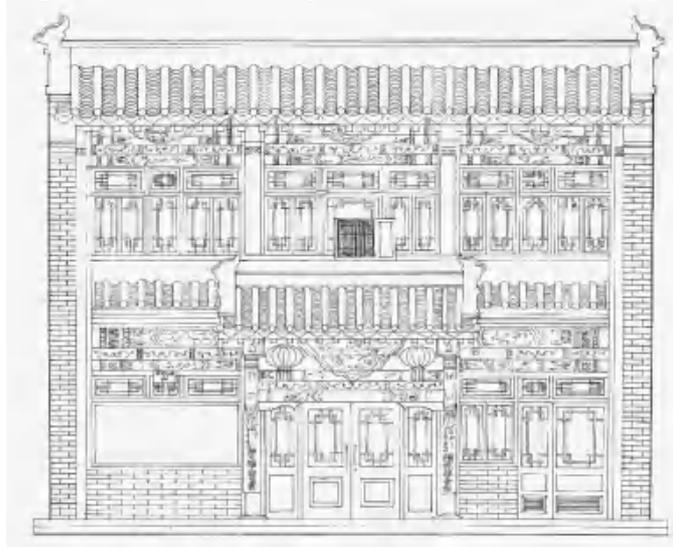


[Figure 1] Surveying and mapping, part of Nanluoguxiang in 2015 (draw by author)

Every great building tells great stories which makes people happy, sad, unforgettable, or sth. What we should tell? How architecture in Nanluoguxiang tells the story?

2.1. Nobility value of traditional moral, ethical, sequence in architecture in the past

Nanluoguxiang ancient street, which has more than 740 years' history, as one of the oldest neighborhoods in Beijing, is the only checkerboard traditional residential area in China that fully preserves the hutong courtyard texture of the yuan dynasty, with the largest scale, the highest grade and the richest resources. In the surrounding hutongs, there are various kinds of mansions and courtyards, which are colorful and profound. Nanluoguxiang and its surrounding areas used to be the center of the capital city of yuan dynasty. In the Ming and qing dynasties, the streets and lanes gathered together the nobility, dignitaries and the wealthy, and there were numerous royal courts. (Figure 2)



[Figure 2] One historical building in Nanluoguxiang in 2016 (draw by author)

Completely preserved Hutong courtyard and the courtyard area fang system embodied in the yuan dynasty courtyard and HuTong culture, reflect the traditional architecture in Beijing residential characteristics of old Beijing is grey local-style dwelling houses building more, to foil the glittering palace buildings south gong ancient street in the process of modern transformation, still retaining the characteristics of the northern traditional houses: kind of grey water brick gray tiles, whole gray tone simple quiet Building structure. Is the brick structure, including roof beam carved.

2.2. Nowadays traditional cultural is hidden in the commercial shops.

Nanluoguxiang street facade renovation, follow the traditional combined with business, old Beijing culture in harmony with the modern architectural style depend on the appearance of the traditional courtyard houses, shops according to the commercial function reconstruction of concrete building style is divided into three types: the first building main body structure and appearance has not changed, just to use building interior space has carried on the transformation, the second will be to meet the functional requirements of modern commercial traditional courtyard houses along the street facade, according to the specific business theme into the modern contracted style, the style is unified, building indoor and outdoor commercial elements in the whole building decoration, traditional architectural elements to keep only a few. The eclectic architectural style of the third party combines the western classical architectural style with the Chinese traditional architectural style. The building is still mainly in gray color, with blue bricks and gray tiles, but part of the style adopts the western classical form.

2.3 Traditional architecture aesthetic value

Nanluoguxiang ancient street in the development process of fully excavating the old buildings of historical and cultural value on both sides of the street store renovation are as much as possible to maintain the traditional flavor of primitive simplicity, the door frame and window frame color mostly black scarlet and red log color, even if the shop signs, design is given priority to with of primitive simplicity, still mostly use some wooden instinctive quality, fully refined the Chinese elements, find convergence points in such aspects as material and color, make it ingeniously integration with the surrounding environment.

2.4 Traditional hutong street culture in architecture

Nanluoguxiang historical and cultural blocks, as the representative of Beijing Hutong culture, its existing Hutong still retaining the characteristics of the northern traditional dwellings, grey brick gray tiles, whole gray tone and heavy Hutong architecture for the brick structure more simple, including carved wooden frame roof beams and other architectural decoration is divided into enamel and culture act the important role, enamel color is given priority to with red, the color is not luxuriant, but extremely rich national characteristics; Carved wooden brick and stone carvings, carver is exquisite, wonderful artical excelling nature, simply golden stone in the gate of drum stone column in the main set of interacting arch and the place such as a reminder the drum stone in front of the house is one of the highlights Hutong residences, the front and side often describe various forms of lions, carved front side engraved with four seasons flowers and plants of fret kirin pine crane and some auspicious patterns.

3. ANALYSIS OF THE CURRENT SITUATION OF NANLUOGUXIANG



[Figure 3] view from Nanluoguxiang and its side lanes in 2019

3.1 The lane becomes more and more cloudy—popular story

With the rapid expansion of the modern population, the number of people in the block increased rapidly. In 2006, the residential population density of Nanluoguxiang was as high as 20,000 people/square kilometers, within the limited living space bearing the huge population base of traditional courtyard residential development to dozens of families share a set of house, Nanluoguxiang traditional courtyard houses of the people to hold high density pressure, together with the mall the expansion of the scope and basis for land use, further compressed the residential living space as a result, the population evacuation and alleviate the pressure of the living is the precondition of improving Nanluoguxiang living environment problems, as we can see nearly everyone rushes into the narrow lane but the side lane keeps vacuum.

3.2 Aesthetical uncomfortable—still live in the lower line of living requirements according to the Maslow psychological theory.

The traditional Siheyuan residential buildings in the historical block of Nanluoguxiang are basically intact in the modern urban reconstruction, but most of them are in disrepair and badly damaged, with small space capacity and small living area. The government spends a large amount of money on the maintenance and repair of Nanluoguxiang every year, but most of it is invested in the building of the commercial street, and the architectural style of the residential area does not change much. Hutong lanes are densely wired, electricity meters, air conditioning outdoor

bare, these have seriously affected the overall architectural style of the Hutong. The architectural style of Nanluoguxiang is facing a serious chaotic situation. The traditional quadrangle courtyard has been transformed into a grotesque shape. It is in urgent need of standardization and rectification to maintain the style of traditional streets.

3.3 New life facilities, like plasters, invading the traditional life –Conflict stories

The public service facilities in Nanluoguxiang have not been systematically upgraded and improved for a long time, which lags behind the social development. The streets of Nanluoguxiang ancient lane have the common characteristics of Beijing Hutong: narrow streets. As it is transformed from traditional ancient streets, the planning and design of its spatial scale is based on the traditional living form of the ancients and follows the pedestrian scale, which does not match the design scale of today's motor vehicles. Limited space scale, narrow street width, the absence of parking space, is bound to cause the problem of random parking, traffic congestion.

4. HOW TO TELL THE CHINESE CULTURAL STORIES BETTER IN ARCHITECTURE IN THE FUTURE?

Chinese architectural culture solids not only in material but also in the spiritual core. With the time passes, essential positive and classical culture left, what kind of culture story we want to reserve to our descendants is a question taken into the calendar. The prerequisite to tell a good story is to decide what kind of story need to tell. Nowadays, the cultural stories' lights covered by the commercial flavor in Nanluoguxiang, which transform from its original inhabitants of bureaucratic privilege stratum into a public commercial district. Therefore, what story nowadays architectures tell also need to show highly important to.

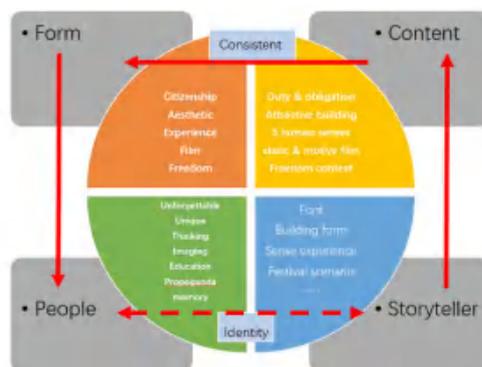
How to input motivate stories in the static space? As we know, Nanluoguxiang is a long space which structure is similar like a linear story, all of these characteristic decided the possibility to tell a story in the Nanluoguxiang. Sometimes, we tell a story with one clear line, but sometimes we tell a story with several lines. Sometimes we flashback, sometimes we deconstruction, all of these narrative methods offer the architecture stories full of theoretically.

What should our architecture space communicate better traditional cultural stories? As the book of "architectural Culture and Communication" references the view of Maurice Levy, chairman of publics group, the largest communication company in France, founded in 1926, wrote the book "100 terms of communication" with distinctive features. He could not only perceive the connotation of culture and communication, culture and society, culture and city, culture and family affection, but also appreciate the broad cultural implication of communication. Here are a few paragraphs. He concluded the contents into 6 Forms: Citizenship, Culture, Aesthetic, Experience, Film and Freedom.

Thus in the correspondent content, we need to put modern Chinese cultural citizenship content such as duty, obligation, moral, ethical etc. content into the building form. What's more, we need to renovate the building form more attractive, we need to combine with different human senses to experience and put into static and motive film into the building. Last but not least, the feeling of freedom not by pushing.

In the communication effects, we need to make the main body who experience the street. Especially the young generations, who would like to Nanluoguxiang the most, feel unforgettable, unique, thinking, imagine and be educated. [2] We need to know the psychological characteristics of the young generation, who live far away from traditional life style, own wide range of knowledge, chase unique, freedom and open life, born in the environmental of digital life.

Therefore, we have different forms to express the culture in the architecture. Such as we can print or draw some wall painting in the building in the prerequisite of preserve the building. And we need to design in the form of unified visual system. In some part, we use the language of international form into the core of traditional content. We make eye-pleasuring architectural constructor details to let the visitors feel from Vision, hearing, taste, smell and touch. In traditional festivals, we need to match the ritual atmosphere with architecture in the Nanluguxiang. (Figure 4. Nanluoguxiang architecture narratology structure)



[Figure 4] Nanluoguxiang architecture narratology structure (draw by author)

As we can see from figure 3, form, content, people, storyteller are connected close to each other, if people can fully get what storyteller told, we can say that this is a successful communication. Thus the storyteller need to think

up the content and its consistent form, then use different strategies to achieve the green parts, then we can say the people get the identity from the story teller in the architecture in the traditional culture.

5. CONCLUSION

To preserve the traditional culture from architecture, we need to think up the story first, no matter we tell the story for the full line or some episodes of traditional culture through the architecture. The best way to accept by the traditional culture to the young generation is to organize the story contents than find the suitable ways to realize it. Such as the traditional sustainable development concept--pursues the harmony of human, nature and ecology—need to express in the form of static painting or motive film ways, and realize by its most aesthetic and unique ways to attract person to remember and unforgettable. Besides, the idea reflected in the development and inheritance of architecture is to follow the law of history and respect history, environment and regional culture, so as to meet people's psychological needs and daily life needs.

The regional context has the continuity of time and the inheritance of times. The formation of architectural space is also a part of the regional context and the carrier of the regional context. It also follows the change of the context and develops with the development of times. Therefore, architectural space also has continuity and contemporaneity. At the same time, the architectural space design should also consider the implementation feasibility and long-term stability of the planning as a whole, so as to leave room for further development while inheriting the architectural context stably.

The sustainable development concept pursues the harmony of human, nature and ecology. The idea reflected in the development and inheritance of architecture is to follow the law of history and respect history, environment and regional culture, so as to meet people's psychological needs and daily life needs. Today's sustainable development concept must adapt to the current society and follow the principle of modern development, rather than blindly copy and mass production. Therefore, traditional culture should be absorbed, refined and created in the creation of architecture. Only when the current architectural culture is also adapted to the needs of society can there be an accurate direction of development. The sustainable development of traditional folk is more closely connected with traditional culture. The sustainable development of traditional folk houses is also the sustainable development of traditional regional culture, involving history, economy, politics, culture, folk customs and other fields. Therefore, to explore the sustainable development of traditional residential buildings, we should absorb advanced concepts and methods under the general premise of society and its culture, and create a road suitable for regional architectural culture, so that regional architectural culture can go on for a long time, and the characteristics and essence of regional architectural culture can be inherited permanently.

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SUSTAINABILITY INVOLVES EMOTION: AN INTERPRETATION ON THE EMOTIONAL CHARACTERISTICS OF SUSTAINABLE ARCHITECTURE

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ABSTRACT

Based on the theoretical foundation of emotion research in architecture and design, this study starts with design experience and practical cases. Taking form, space and feeling as the analysis elements, this paper explores the emotional attributes of sustainable architectural design strategies and space ontology from the four dimensions of aesthetic appreciation, psychological satisfaction, emotional care and spatial experience. This study found that, in diversified buildings design and sustainable strategies, the expression of emotion can be immediate, continuous and diversified. In the future, as the maturity of sustainable architectural design methods and technologies, people's attention will turn to the emotional perspective full of humanistic care. Paying attention to the integration of ecology and humane motion in architectural design and exploring its possibility will be another key point for the popularization and development of sustainable architecture.

Key words: sustainability; architecture; emotion

1. INTRODUCTION

Our reversion today to embark on the road of sustainability, which will inevitably bring about the new architecture movement and influence the development of architecture in the following century, including dramatically enriching the content of architectural science and technology and correspondingly developing and changing the artistic creation of architecture. (Wu, 1998) There is a certain dependence of psychological function on utility function in the integrity of sustainable architecture technology and art, which indicate the development orientation of sustainable architecture in the humanistic layer from the material and spiritual angles, namely that the integration of constantly developing sustainability technology into architecture will cause the change of "artistic creation" to architectural environment in terms of aesthetics, psychic satisfaction, emotional caring and spatial experience. Therefore, ecological aesthetics that mutually integrates and harmonizes with ecological technology has naturally turned into a theoretical basis of the artistic creation for sustainable architecture at present. The integration of all kinds of ecological technologies and sustainable strategies into sustainable architecture design will generate many of new architectural and spatial forms and develop new spatial spirit and environmental image. In addition to maintaining the human caring of traditionally architectural environment, sustainable architecture also displays new attributes of emotional connotation and manifestation mode by subsuming, restructuring and remodeling traditional architecture in the process of reflection on the nature.

2. EMOTION OF FORM: AESTHETIC FORM OF VISUAL PLEASURE

The sustainable function of six-sided shape can maintain the formal beauty in sustainable architecture just as the traditional one. The ecological metaphor and the deep-seated formal structure of natural environment lead the spatial environment to be immersed in the breath of natural ecology. Zong Baihua wrote in his *After Appreciating Rodin's Sculptures* that "the nature has an inconceivable vitality, which is the source of all of 'beautiful things'. The nature is always beautiful anywhere." (Zong, 2011) The emergence of the emotional field interacted between human's instinctive pursuit of visual pleasure and the saying of "the false thing is inferior to the real appearance and the false scenery is inferior to the nature" will be the simple beauty, ecological beauty and natural beauty of spatial environment, an artistic work of the "humanized nature".

The number of ecological materials, as the main material carriers to transform emotion formally, is not much, compared to traditional materials. However, ecologic materials can endow the aesthetics of natural ecology with better appearance in terms of color, texture, quality and form superior to those endowed by modern industrial materials, because of its quality of "shaping up based on objects". For example, the form and quality of soil, bamboo, crop fiber and reed are featured by the natural and wild artistic images, such aesthetic attributes are way beyond those rational and indifferent materials, such as stainless steel, iron, cement and plastics. Even more, the vivid effect of processed ecological materials is not second to that of natural materials.

Sustainable technology displayed and hid in spatial entities plays as the driving force and a catalyst to promote the generation and evolution of new forms. The so-called beauty lies in natural objects themselves and beauty is the attribute of objective matter. The moment of technology maturity marks the starting point of free release of beauty-pursuing consciousness and the emergence of spatial form with visual aesthetics. Modest, gentle, low-key and simple feelings can usually be sensed in the forms with low technology, showing the traditional and ecological beauty with the rural taste, the time precipitation and the integration into the nature. The infinity of high technology can endow forms with degree of freedom and novel creativity; and the image of modernity can demonstrate the fashionable and trendy beauty. The complicated structure of high technology can also demonstrate the beauty of spatial environment. For example, the dynamic beauty of pretension in cable-membrane structure and the formal beauty in the stability and power of steel structure; and the visual image of strength, stability and orderliness reflects the pleasure of technological formal beauty.

Due to difference of climatic regions and conditions, many beautiful architectural forms are generated in the contradiction and harmonization of climate and architecture. There is transparent and crystal beauty and thick-wall beauty in the glass-made greenhouses in cold regions, the artistic beauty of ventilation structure in dry and hot regions, the light and pass-through beauty of architectural structures in wet and hot regions and the formal beauty integrating heat preservation, sun shading and ventilation in the temperate regions. Architectural pattern language of traditional and geographical culture, including spatial form, feature component, ornament and pattern, is not only featured by the inexpensive cost, but also endowing architecture with the great visual expressive force. The so-called beauty is sourced from culture praise; therefore, designers are usually used to find out the dependence of geographic tradition on modernity and to utilize modelling language as the ideographic system in the transmission media of traditional culture.

The development of traditional low technology is usually controlled by geographically cultural genes; newborn technology is usually featured by the strong infiltration economically and socially; while low technology is a continuous expression of the uniformity of geographic tradition and modern culture. The application of low technology and construction materials of local tradition by designers can naturally demonstrate the beauty of traditional culture geographically.

3. EMOTION OF OBJECT: EMOTIONAL SUSTENANCE OF PERSONAL MEMORY

Old buildings are the features of history visible to human, as an emotional place of "lasting spirit". Günter Nitschke believed that place is the product of life space-time. (Nitschke, 1993) Old houses are not only connected with us materially in the biological sense, but also the emotional construction internalized in significance of life. Historical value (especially the geographic tradition) is the extending significance of trying to maintain the original architectural form and structure in the process of sustainable architectural reconstruction; the complicated and multiple emotional representation can waken up human's emotional memory subsided in the unrestrained old times. Witnessing a richer world also means to witness oneself more completely; such a spiritual caring can serve as a temporary harbor of refuge for human, for the sense of relaxation, comfort and warmth. For the purpose of ecologicalization and cultural spread, sustainable architectural design will also follow the forms and characteristics of traditional and geographic cultural architecture, in which the sense of recognition can directly or abstractly strengthen the emotional caring of spatial environment. Taking the so-called "family shrine" in front of the fireplace called by Bryan Lawson as the most central public space in the domestic realm as an instance, the warm and harmonious character of space is usually utilized at present.

What can generate richer emotion of personal exclusion than tradition and culture shall be self-built houses, which compose the important sustainable strategy with social ethical significance. According to Christian Norberg-Schulz, the most concrete explanation of environment shall be place, generally speaking, the occurrence of behaviors and events. (Norberg-Schulz, 1979) The behavior and event of building houses by oneself, as the process of creating the place of survival environment, can realize the emotional value expectation of "being" in the satisfaction of the objectively rational value of human survival. When someone makes great efforts to complete his/her own dwelling environment and integrates his/her own interests and habits into it, then this artificial environment can profoundly gather human's life, spirit and emotion and express the corresponding lifestyle authentically and concretely. The objectified self-realization of human's life value will give rise to the sense of satisfaction, achievement and pride; such a relationship is the foundation for human survival.

Small space, generated under the concept of resource conservation and efficiency, is another kind of place for exclusive emotional sustenance. As Rudolf Schwarz explained: a certain field can't be home unless it is on a smaller scale. Therefore, the size of the construction site must be restricted within the imaginable scope to become a home. (Norberg-Schulz, 1971) The charm of a small space lies in its spatial sheltering to the maximum extent for the sense of safe territory. The distinct envelope quality of a small space enables our personal space bubbles to touch each corner, to respond to our psychologically emotional diffraction, to isolate us from sight and noise outside, and to control and choose to exchange information with others. The separate dialog between human and indoor environment demonstrates certain absolute degree of freedom of emotional expression and the sense of center feeling of the place. The emotional connection between spatial environment and human can be built up rapidly in this everlasting experience; and the building up of this emotion will provide us with tranquility and the sense of belonging for being sheltered.

4. EMOTION OF MEANING: PSYCHOLOGICAL PLEASURE OF FRIENDLY ENVIRONMENT

David Hume indicated that the sight of "convenience" will give you the pleasant sensation, because convenience is a kind of beauty. (Zhu, 1979) "Convenience" can offer psychological comfort because of its ethical beauty of humanistic concern. Sustainable strategy has started resetting a potential mechanism of psychological pleasure on us under the premise of perceptive "precomposed sedimentation", when implementing the practical function. A comfortable state of good mood is the basic psychological feeling brought about by the naturalization of sustainable architecture. Similarly, comfortable sustainable architecture can also lead to the sense of novelty and freshness. Its totally natural interest and charm distinctively can create humorous, dramatic or surprising psychological experience elements in the environment; while interesting space of in-depth interesting connotation can make people unable to bear laughing or smiling inside.

Exaggerated, twisted, illusory and compound form and environment will take shape the triggering center for psychologically emotion experience; and experience effect with outstanding performance will leave a memorably emotional impression. As psychological experience gets richer and more impressively, impression and association can promote the development and deepening of psychological aesthetic emotion more actively.

The unreal effect and mystery generated in the specious information confirmation will lift up the internal pleasure and this is another reason for psychological pleasure generated in architecture sustainability. Visional and mysterious illusion is the same as a beautiful fairy tale essentially; the elusively unreal feeling is the matter understood by us flying in the mind, recreated from the objects perceived in the space. Such complicated and confusing image generated from the determinate and known space will give us a great pleasure; while illusion can create the sense of mystery in spatial environment, which can cause the associative effect greatly and drive us to explore the future, think about the past and upgrade from experiencing the world to transcend the world. Cognitive schema, which is unable to be generated from the rational sublimation of emotional aesthetics will call forth human's sense of pleasure about tasting the unknown. For instance, the slightly transparent chiffon weaved obliquely decorated on the reverse side of

the stage applied in Casa da Música of Rem Koolhaas is the model of such pleasing effect. (Heybroek, 2014)

Compared to divertingness and mystery, the psychological pleasure in the deeper layer of sustainable architecture is usually originated from the synesthesia product of the dominant position of the object over the subject, namely a kind of seductively overwhelming beauty of shock hidden in the strength of sustainable high-tech. First, it is certain fear or pain under the convergence of natural force and manpower, which is transferred by the "pouring", "enriching" and "upgrading" value included in the non-existing confirmation of threats. This traction of sustainable architectural technology to human transforms the sense of terror and pain into the sensation of pleasure, expressed in the turbulent, dynamic, rugged, vigorous and majestic form with the soul-stirring aesthetic feeling. Along with our more thorough understanding of the nature and human strength, we will have a stronger and deeper psychological and emotional pleasure.

5. EMOTION OF ENVIRONMENT: LIFE EXPERIENCE OF NATURAL INTEGRATION

The traditional architecture, featured by multiple barriers linking to the nature, fails to lead human up to a higher level is the reason that life experience offered by sustainable architecture different from and transcending that offered by traditional architecture. The psychological explanation of space image full of vitality and significance has activated our natural attributes and built up a more extensive life and emotional realm. Sustainable architectural design, based on the natural community, puts human back to the larger integrity of earth, nature and universe to conceive and narrate the stories of human. Architecture concretely displays the orderly and harmonious interrelationship between human and surrounding environment; and the habitat for human and the nature home have become into one. For instance, Tadao Ando usually takes slate, cement, wood, steel and glass as the materials and applies fog, rain, wind, sunshine and other design elements ingeniously beyond description to express the integrity harmony between indoor environment and the nature. Based on our experience and connection with the nature, this integral feeling will enable us to profoundly realize the fact that we are surrounded by our life environment and we are unable to be out of the nature. Only incorporation into the nature can be the authentic attribute of real life. The uniform construction between human and nature at a higher level transcending subjectivity and space will help us acquire the sense of belonging and integrity of life feeling.

The moment of understanding one's survival basis shall be the moment to wake up the awareness that degree of freedom only exists in respecting and protecting the nature and that we can only release our natural instincts in harmony and orderliness. Meanwhile, sustainable architecture has thoroughly demonstrated the free quality of the nature. Large glass, expanding surface and high parvis can express the natural conception of infinite space integrated into the nature, offering the free and unfettered roaming situation to shake off us from various ideological burden and concern first, to expand our conception of consciousness boundary by the free and liberal feeling and to maintain our freedom and infinity. "Facing upwards to the blue sky, we behold the vast immensity of the universe; when bowing our heads towards the ground, we again satisfy ourselves with the diversity of species. Thereby we can refresh our views and let free our souls, with luxuriant satisfaction done to both ears and eyes. How infinite the cheer is !" (Preface to the Poems Collected from the Orchid Pavilion) You will realize the simple existence; and your feeling and spirit will be integrated into the nature to fly around freely; all of objects in the world will be included in your mind, the authentic human instinct of freedom will rest in the nature, and human's life and life consciousness will be upgraded in the aesthetic sublimity of freedom.

What opened in the conception of psychological freedom is the internal clarity. Human longing for perfection starts to use the lofty divine scale to deny the worldly scale; to detach from the falling during doubting and examining "being" voluntarily to reappear beautiful things in human instincts, to transcend the limit of human, to reach a clear and bright world with the coexistence of "heaven, earth, human and divine", and to feel the bright, ordinary and calm existence status of the essence of human survival. In addition, sustainable architecture can also provide the sense of clarity and quietness. The parvis with glass ceiling, the sunshine full of vitality and holiness, the openness of space, and the infiltration of natural scenery and taste.....are generated in the authentic function and the virtuous technology, to express the clear, orderly, light and transparent space image. Space with purity can offer the disenchantment experience infinitely tending to the nature and divine loftiness, releasing human from internal pressure to openness with certain influences physically, emotionally and spiritually. Such a clarified openness can maintain each object in quietness and integrity, acting as the strength symbol to affect, [Figure 1] Emotional attribute of sustainable architecture cleanse, mobilize, excite and transform the spirit, revealing the truth of "being". As a result, human in the spatial environment can look up to the sky while being based on the land. This space of looking up penetrating the sky and the land is distributed to human, shaping up the clarified and roaming circumstance of human freedom. Consequently, human's inward world starts to be bright and clear; human reaches the realm of clarification in the light of automatic aletheia; and the natural glow of human survival starts to light up gradually.

6. THE RELATIONSHIP OF FOUR EMOTION TYPES

The use function of sustainability and the emotional expression of visualization are the mutual penetrating contents of sustainable architecture materially and spiritually. Spatial environment displays human's lifestyle, spiritual

personality and aesthetic concept, which directly exist in the relation construction between spatial experience and environment feeling; and this is the special "agreement" between emotion and sustainable architecture. As the object of human experience in a special mood, it has a subtle and huge scale to have a closer or farther look; it can not only be touched, but also entered; and it can also put the heaven and earth as the background and incorporate them into one. The meaning form displayed in the brand-new place spirit provides us with a wide, profound and heart-warming experience of natural beauty and human beauty. Sustainable architecture, based on its emotional characteristics of beautiful form, emotional sustenance, psychological pleasure and profound perception, displays the new conno-



tation of its emotional quality, making people accept and realize its emotional care at the physical, emotional and psychological levels (figure 1).

[Figure 1] Emotional attribute of sustainable architecture

First, sustainable architecture displays the beautiful form and pleasant spatial environment in terms of ecology, technology and geographic tradition, offering us the visual beauty and pleasant feeling; meanwhile, the humorous, interesting, illusory, mysterious and shocking spatial environment of interest and charm endows us with the pleasant emotion and psychologically pleasant sensation, which are the emotional representation of physical and psychological pleasure. Second, sustainable architecture implies human emotion in various ways, offers the sense of "home returning", this sense of belonging enables us to experience the warmth, comfort and freedom. The introduction of nature into spatial environment helps human realize that ascity is a part of the wholeness of earth and nature; the sense of belonging to nature helps human experience the integrity and completeness of life, which is the emotional representation of the sense of belonging. Third, the natural taste and quality of sustainable architecture always cleanse our souls and provide us with the highest life experience in the free and clarified spatial environment. This is extremely different from the spiritual openness and temperamental liberation in the past. The new cognition of life and emotion enables our mind to perceive, understand and experience certain lofty and clarified realm with the sense of holiness, displaying and demonstrating the detached and big-hearted situation of human, which is the emotional representation of being open minded.

The emotional attribute offered by sustainable architecture covers from the "reality" of outside form to "illusion" of psychological emotion and to the "truth" of life experience, from the sensory representation outside to the spiritual comprehending inside and from the physical experience to the mind world evolutionarily, to lead human to the connotation of spatial language from the externalized image step by step, based on the emotional perception mechanism of instinct (desired and aesthetic), experience (behavioral and cognitive) and awareness (conscious and valuable), to access into a brand-new experience situation in the re-recognition of ascity. There are abundant and profound psychological situation and development of various experience and feelings in spatial environment, which enable us to experience the more complete life emotion, to reach the situation of integrating comfort, completeness and spiritual sublimation into one in ordinary life and to be much closer to the ideal of sustainable habitation of poetic dwelling.

7. CONCLUSION

The seemingly beautiful life created by industrialization and technologies is lack of authentically humanistic care, but turning each of us into the so-called "one-dimensional man" proposed by philosopher Herbert Marcuse, who only pursues cake and ale but losing the spiritual and emotional pursuit. Gradually, human sinks into the "materialized" existence who yields to the reality instead of criticizing it, and will never go after (or be able to imagine) the scene of a better life. As the expansion of instrumental reason, we have hardly lost the sense of recognition and direction in the increasingly barren homeland. The lack and crisis of emotional significance suffered by human as well as the problems to be solved urgently are very obvious.

The discussion above has suggested that sustainable architecture enjoying the prosperous development at present can actively answer those questions. For architecture as an important carrier and major way of storytelling and emotional expression, its sustainable development and emotional inclusion can't be isolated and separated. Sustainability is featured by some attributes of emotional expression, which can be added and integrated consciously. There can be a unitary interweaving relation; those externalized, ecological technological and index content and internalized, emotional, quality and feeling content can be found in the organic unity of use function and integral form. Designers shall pay attention to the practice of sustainable architecture design to strengthen the emotional relationship between human and spatial environment; and our sustainable schemes shall try to look for the greatest common divisor of nature and human, to realize the emotional spatial environment in the invitation from nature to habitat, and to create more integral poetic and emotional scenes based on the essential connotation of sustainable humanization.

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10. LANDSCAPE AND URBAN DESIGN FOR SUSTAINABILITY



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TOWARD SUSTAINABLE CITIES THROUGH FUTURISTIC DESIGN MODEL: A CONSUMERISTIC SOCIETY PERSPECTIVE

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ABSTRACT

It is undoubtedly impossible to discuss sustainable design without taking into account the tempting world of consumption and the desire for variety and new products. In this study, by collecting data from observations, it is attempted to first investigate the challenge of “citizens as consumers” and then study into the places which are specially designed for the use and benefit of the upper-class citizens. In the current study which has a minimalistic approach, we researchers try to suggest a sustainable model for urban design and even lifestyle to minimize objectification of urban spaces and to present a prototype of future cities.

Key words: Urban Design, Public Places, Sustainability, Consumerist Society

1. INTRODUCTION

Consumption and consumerist matters are not only correlated to object systems and individuals chronically consume objects, spaces and places in the city context. Authors, tried to recommend a model for urban design, which is going to neutralize consuming thirst in Iran and worldwide. Truly, in the current postmodern societies, which approach, style and finally life style can handle and rescue this chronic dissatisfaction of consuming.

2. CITY AND CONSUMERIST SOCIETY

Clarke (2003) believed that, the core of urban life is consumerism, in fact it reshapes the identity and urban design. It is not surprising that “consumption” is not as a right or pleasure, it defined as a citizen’s assignment in a consumerist society and also an automatic task (Clarke, 2003), and if we dig into its causality, we will find that people consume because they want “new things” chronically (Baudrillard, 1998). Why do we keep wanting new things? Boredom with familiar things stems from certain aspects of our neural networks. Brain recognizes a lack of this variance once we get used to having it. Variances or changes are necessary for people to recognize stimuli. This is why we often find ourselves after we have owned something for a while. Whether you buy a ring that costs \$100, \$500 or \$3,000, the level of happiness that you’ll feel is basically the same. Your smile is not going to be five times larger. There are emotional limitations. Your dissatisfaction runs, and you reach out for something else (Sasaki, 2017).

According to Barthes’s assertion as a theorist (1976), having new one is not only into fashion matters, it is a base of all critics and also our assessment of the universe. “A new thing” is a value (Barthes, 1976). It is needed to mention, that consumerist matter in this present article, is extended to consumption of public places and in general to consumption of urban spaces.

3. DEMOCRACY AND SOCIAL GAP IN CITY

In this article, regardless of age and sexuality component, we will pay attention to other components; economic-social gap. In comparison to other fields of art, architecture has the most nearest intrinsic relation with economy, so that in the commissions forms and value of lands, has almost immediate connection with economy. It is not unlikely, in the big cities turn up liberal democracy, since these cities are some places, in which multinational companies and government bureaucracy exist much more than any other cities. Urbanism architectural facilities and abilities are dominated simply by advanced capitalism (Elliott, 2010). On the other hand, transformations happen in the center of folklore (Wilson, 2003). For substantiation of a fair conversation in liberal democracy; firstly, it is needed to fight with inequalities in the materialistic privileges and powers. In this way, indeed collective praxis will be achieved. The question is; how these two grads encounter with place and space elements in the city context, in fact if it goes observing with philosophical approach of consumerist society, how each grad (poor and rich) consume time and space in the same city context. For the first world people, it is a name given to rich and wealthy people; a space loses its limiting feature in both reality and virtual world. On the contrary, for the second world people, meaning poor people, who are structurally considered as surplusage, real spaces immediately block. To recapitulate, first world people live at the present time and the others do not. Furthermore, the second world people live in the slow, inflexible and inaccessible spaces, in which time has blocked. Their time is empty, boring and extra. They are not able to control the space. A postmodern city is a city where predisposed for only satisfaction of first world people (Clarke, 2003).

4. CITY AND SUSTAINABILITY

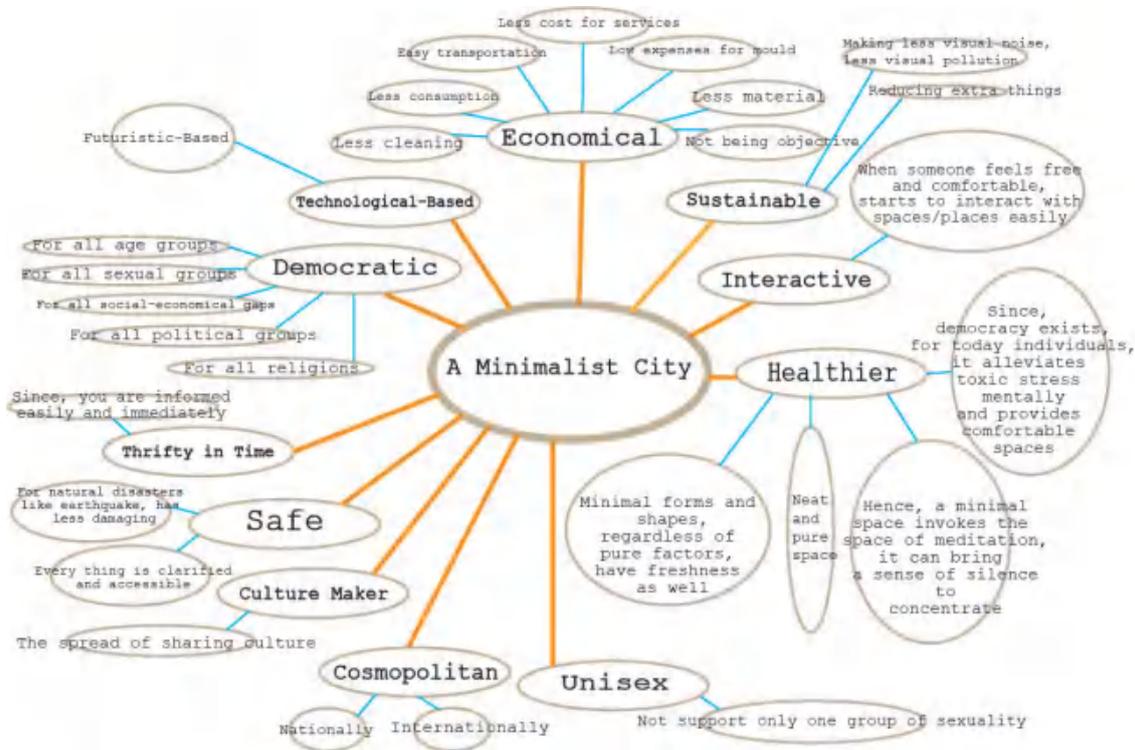
A 21st Century postmodern city must be a sustainable city (Terlinden, 2012). When sustainability in the city has been proposed, researchers mostly have been focused on green materials and creating artificial spaces for making a city sustainable, while at first and foremost it must have to probe in the consumption world. If we observe consumption world in a large scale in current big cities, we will find that there are a lot of magnificent shopping places with splendid names as: Arcade, Galleria, Passage etc. Where its design just to demonstrate capitalism; in which firstly has been designed for consuming not for staying into it, and finally not growing and enjoying (Terlinden, 2012).

5. METHOD

In this descriptive study, authors with minimalism approach observed and conveyed public spaces, and if you would ask; why minimalism?! Because regarding the challenge of this article “the pattern of consuming less” is look like “minimalism pattern” in eliminating extra things.

6.RESULTS

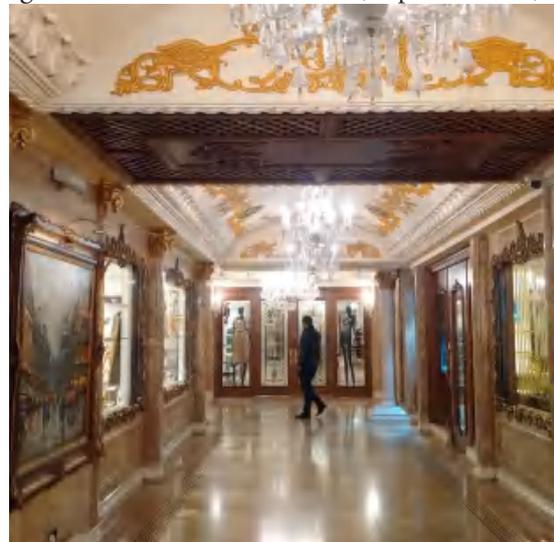
As it can be seen in the brainstorming (figure 1), it has shown that minimalist urban design approach can be a response for sustainability of a city. This model can eliminate and blur the lines and boundaries of sexuality, age, social gaps etc. The notable point of this present results is that minimalist urban design even in a visual perspective is less consuming; since it prevents of visual pollution (Loreta Cercleux, 2016). We have emphasized visual pollution, be-



cause minimalism approach eliminates all the negative visual signs as showing off power and capitalism in some levels. Figures 2 and 3 are some samples of commercial-shopping towers in the north Tehran (Capital of Iran) in which



[Figure 2] Commercial-shopping towers in the north Tehran (Capital of Iran)



[Figure 3] Inside of commercial-shopping towers in the north Tehran (Capital of Iran)

there are some cafes and restaurants. The other beneficial point of minimalistic urban design is that; this approach in design with creating less visual frictions, keeps factor of “fresh and new” well.

[Figure 1, 2 and 3 is cited about here]

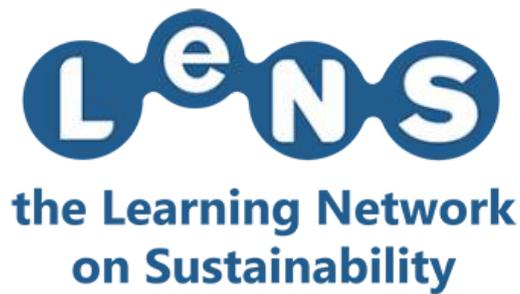
[Figure 1] Brainstorming (source: authors, adapted from Sasaki.F 2017)

7.CONCLUSION

In this research, authors with the help of minimalism have suggested a sustainable model for today consumerist societies. In the right to the place, some organizations must eliminate capitalism as powers through cities in order to serve user friendly cities for all. Minimalism urban design is neutral, democratic, less consuming through creating less visual noise, cost lower and bringing high flexibility of spaces can be a beneficial model for today urban design. However, solution for decreasing consuming is not out of consumption but without any doubt it needs changing life style as well by means of creating new culture for “minimalism life style” and living simply in a compact way, what for sure needs to afford some other experts in other fields to be truly happened.

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STUDY ON SUSTAINABLE DESIGN OF RAINWATER LANDSCAPE IN EXISTING URBAN RESIDENTIAL COMMUNITY

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ABSTRACT

With the rapid development of Chinese cities and the increase of hardstand areas, the existing urban residential communities are faced with serious problems such as flood disaster and water pollution, the engineering measures adopted in China in the past are to the disadvantage of environmental protection and sustainable development of ecology. By consulting relevant documents and combining with practical cases, taking the existing communities in Qian'an City of China as an example, analysis the problems of existing communities with current situation. Starting from the perspective of the landscape and using the technical measures of the Sponge City to carry out the landscape renovation design, this thesis puts forward the sustainable design strategy of landscape in the existing urban residential communities. In order to provide reference for landscape reconstruction design of other cities in the north of China, and furthermore, to promote the sustainable development of the whole social environment.

Key words: Sustainable design; Rainwater landscape; Existing urban residential community; Ecological view.

INTRODUCTION

Due to the fact that people’s activities deviate from the law of ecological development, environmental pollution, waste of resources and other phenomena become more and more serious, which put off the sustainable development of urban landscape. Therefore, we should reflect on how to maintain harmonious coexistence and development with nature. Carson’s *Silent Spring* reveals that humans are punished by nature for destroying the environment, making people aware of the importance of natural environment. McHarg also proposed in *Design with Nature*, that landscape design should take the sustainable development of natural ecology as the guiding principle. In ancient Chinese philosophy, it is always emphasized to conform to nature, respect nature, and live in harmony with nature, that is, the idea of “the unity of nature and man”, which contains the meaning of sustainable development. This paper aims to solve the rainwater problem of existing urban residential community in northern China by applying sustainable design strategies such as natural ecological methods, Sponge City technical measures etc., in order to restore the circulation process of natural system, to achieve the harmony and unity of human, society and nature, and to promote the effective utilization of resources the sustainable development of the whole social environment.

1. PROBLEMS AND RESEARCH STATUS OF URBAN RAINWATER LANDSCAPE IN CHINA

The development of Chinese cities is always at the cost of the environment, the urban fabric that can absorb and storage water has been replaced directly by hard roads, undermining the ability of cities to cope with the natural flood cycle. The existing urban residential communities refers to the communities built in recent years, with many obvious problems such as high development intensity, high building density and large water consumption [1]. There is a large area of hard ground in the existing urban residential community, a lack of green space, a large amount of rainwater runoff, which can easily lead waterlogging phenomenon in the residential community during rainy season, and cause water shortage during dry season. According to relevant data, 154 cities in China suffered from waterlogging in 2015, affecting 255 people and causing losses of nearly 8.1 billion RMB, causing great hardship to people’s lives. At the same time, the increase of hard ground leads to the lack of green area, which makes the landscape environment of the city worse and worse, and cannot meet the leisure and entertainment needs of people.

In 1987, in *Our Common Future*, the United Nations Commission on Environment and Development defined “sustainable development” as “development that meets the needs of the present generation without jeopardizing the ability of future generations to meet their needs” [2], then sustainable design can be seen as a way to solve the relationship between man and nature from the perspective of overall interests. The sustainable development of cities cannot be separated from good water resources and water ecology. Other developed countries have studied the management of urban rainwater as early as in the 19th century, and carried out natural retention, infiltration, collection and reuse of rainwater, thus creating a good landscape effect, and realizing the sustainable utilization of rainwater resources. In the 1990s, China began to study the management of urban rainwater and other aspects. The concept of sponge city in 2014 was just suitable to solve the landscape problem of the city, and China carried out a pilot project of Sponge City construction in many cities. Qiu Xingbao, chairman of the China Urban Science Research Association, gave the definition of Sponge City in his paper “The connotation, ways and prospects of Sponge City (LID)” [3], Sponge City refers to a city like a sponge and has flexibility in adapting to environmental changes and coping with natural disasters. China should absorb more excellent foreign practical experiences, and according to the actual situation in China, create rainwater landscape treatment measures that are consistent with national circumstances.

2. PRACTICE AND APPLICATION OF SUSTAINABLE DESIGN OF URBAN RAINWATER LANDSCAPE

Country	Time	Rainwater Management measures	Function
The United States	1970s	The Best Management measures BMPs	Reduce non-point source pollution of rainwater through source control and treatment
The United States	1990s	The Low Impact Development model LID	Maintain the same hydrological characteristics after urban development as before, and reduce the damage to natural environment.
Australia	1990s	Water Sensitive Urban Design WSUD	The functions from three aspects: rainfall and flood control, water quality control and rainwater reuse.
Japan	1980	Rainwater Infiltration plan	The use of a large area of permeable materials to increase urban rainwater infiltration rate.
Germany	1996	Decentralized Rainwater Management DRWM	Collect rainwater by using roof rainwater system, purify and recycle rainwater.
Britain	1999	Sustainable Urban Drainage System SUDS	Establish good water circulation and drainage system, and carry out sustainable management of groundwater and surface water.

China	2014	Sponge City theory	When it rains, it will absorb water, store water, seep water and purify water. When necessary, the stored water will be “released” and used.
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[Table 2.1] Management Facilities and Functions of Rainwater

Foreign rainwater management measures emphasize the maintenance and promotion of urban natural hydrological processes by protecting landscapes and utilizing natural landscape ecological measures, and pay attention to the symbiosis between urban landscape environment and construction and development [4]. The practice of urban water resources utilization and management in the United States, Japan, Australia and Europe started earlier and produced many excellent cases. These management measures of rainwater have provided a good reference for the promotion and development of Sponge City in China.

2.1.Source control of rainwater resources

The concept of Low-Impact Development(LID)technology is mainly based on the improvement model and design principles put forward by unreasonable land development and utilization in the United States. The natural hydrological process is taken as the design concept in High Point community of Seattle, USA, and the problem of rainwater is solved from the source by using ecological design method. Water permeable pavement is used in the site to reduce surface runoff and relieve drainage pressure of urban pipe network, set up a rain garden to handle excessive rainwater. Roof drainage system and water pipes are used to bring rainwater to ground greenery, reduce ground erosion, and also add interest for the residential landscape design [5]. The current land development intensity in China is large and the ecological environment is more sensitive, the LID technology in the United States provides theoretical guidance for the landscape design of rainwater in the existing urban residential communities in China, which can promote the sustainable development of ecological environment in China, and maintain the urban hydrological environment.



[Figure 2.1] Plot Roof Rainwater Scattered Layout



[Figure 2.2] Residential Area Roof Rainwater Scattered row



[Figure 2.3] Plot Glassed Swale

Source: SVR design company

2.2.Promote recycling of rainwater resources

The Sustainable Urban Drainage System(SUDS)in Britain mainly through source control, rainwater transportation and rainwater collection system, some legal systems have been formulated to form the integrated management system for rainwater collection and utilization. The Agilent community in Britain installed a buffer storage tank for a variety of integrated development projects. During torrential rain, the water tank provides water storage function, after the rain, the water tank can be controlled by water valves, so that the water storage can be slowly discharged into the soil, and through certain treatment, all water tanks are placed underground, thus not affecting the design of any above-ground space and can effectively use rainwater resources [6]. This measure has guided the application of impounding reservoir in China’s Sponge City theory which is used to collect the surplus rainwater and avoid waste of water resources.



[Figure 2.4] Community Surrounding Environment Map



[Figure 2.5] Total Plan Map



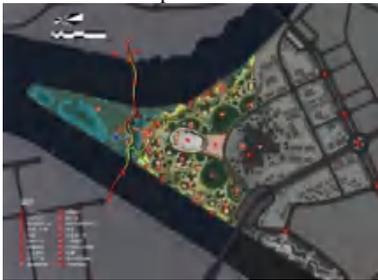
[Figure 2.6] Site Effect Map

Source: EMA architects office

2.3.Create Multi-functional elastic landscape

In 2015, Chinese President Xi Jinping proposed at the meeting to build a sponge city with “natural accumulation, natural penetration, and natural purification”, and requested to protect nature, conform to nature, and solve the problem of urban rainwater with the concept of sustainable development. The design of the Yanweizhou Park in Jin-

hua City, Zhejiang Province was guided by the concept of “making friends with floods” and adopted a design strategy of water elasticity, which uses submerged terraced planting to provide alternative engineering flood-resistant hard revetments, combining flood prevention with ecological conservation and recreation [7]. Through minimum engineering methods, the original vegetation was reserved. The urban park is used as an ecological infrastructure, and it is combined with the protection and utilization of water resources to realize ecological, social and cultural flexibility of the landscape.



[Figure 2.7] Yanwei State Park Plan



[Figure 2.8] Aerial view of Yanwei State Park



[Figure 2.9] Yanwei State Park Recreation ground

Source: <https://www.turenscape.com/en/home/index.html>

3. SUSTAINABLE DESIGN OF RAINWATER LANDSCAPE IN EXISTING URBAN RESIDENTIAL COMMUNITIES OF QIAN'AN CITY, CHINA

There are few studies on rainwater landscape of residential communities in China, and a lot of landscape measures have been widely used in parks. The Shanghai World Expo Houtan Park, Zhejiang Jinhua Yanweizhou Park, Haerbin Qunli Rain Flood Park etc, designed by Professor Yu Kongjian of Peking University, have all adopted technical measures of Sponge City. In my opinion, these measures are also applicable in existing urban residential communities. Applying Sponge City measures to the rainwater landscape design of the existing urban residential community, in accordance with climatic and hydrological conditions in different areas, and adapting to local conditions, will help to solve the flood problem, promote the recycling of rainwater resources, and improve landscape quality of the community.

3.1 Background analysis of existing residential communities in Qian'an City

Qian'an City is located in the north of China, the climate is warm temperate sub-humid continental monsoon climate with four distinct seasons, and the dominant wind direction in summer is southeast wind and in winter north-west wind. Rainfall is concentrated and most of the rainfall occurs from June to September, occupying more than 80% of the annual rainfall. Every summer there are heavy rains or continuous rains, which is easy to cause floods. According to the data of feasibility research, the average rainfall in Qian'an City is 672.4 mm, maximum annual rainfall 1070.9 mm (1959), and minimum rainfall 393.4 mm (1982). In the meantime, Qian'an City is also lack of water, due to groundwater overexploitation, resulting in the imbalance between supply and demand of water resources.

3.2 Rainwater landscape design method of existing residential community in Qian'an City

In the landscape design of rainwater in the existing residential community of Qian'an City, the key of solving the landscape environment and rainwater problem in the community is to change the traditional transformation mode of the existing urban residential community. Mainly based on the concept of Sponge City, use the control principle of “Infiltration, stagnation, storage, purification, use, drainage”, increase green facilities and reduce grey facilities. In accordance with the actual needs of residents, measures such as Permeable pavement, Sunken green space, Grassy ditch, Rain garden etc., are adopted to ensure the infiltration of rainwater and reduce the accumulation of water on the road. To carry out the construction of Sponge facilities and upgrading of landscape upgrading at the same time, and to provide a beautiful and convenient living environment for the residents, as well as promote the recycling of rainwater resources.

1). Using permeable pavement to ensure the infiltration of rainwater

Due to the large proportion of hard ground area in the existing residential community in Qian'an City, rainwater cannot infiltrate in time when rainstorm comes, resulting in accumulation of water on road surface and affecting people's travel. In the designing process of residential community, permeable paving is adopted to control rainwater from source to reduce the formation of rainwater runoff, and make rainwater naturally infiltrate, maximize the retention of rainwater and replenish groundwater resources in a timely manner.

2). Collect surplus rainwater by using sunken green space

The landscape effect of the original site of the existing residential community in Qian'an City is not good and the height difference is not handled properly, resulting in uneven land in the community. In the low-lying area of the residential community, a sunken green space is set up to collect excess rainwater on the road surface and reduce the non-point source pollution of rainwater. At the same time, enrich landform by filling and digging and increase

water space for residents and children. This helps to improve people's living conditions and strengthen communication between each other, and it also plays an important role in promoting the construction of ecological civilization.

3). Transmission of rainwater by planting grass ditch

It is quite common that there is less green area in the existing residential community in Qian'an City, and the overall environmental quality is not adequate enough, and cannot meet people's spiritual needs. Planting grass ditch in the community not only increases green space of the area but also can be used to collect and transport runoff rainwater, and then transport rainwater to green spaces and gardens to supply water for the landscape. Planting grass ditch can be well combined with other single facilities, urban rainwater drainage systems and over-standard rainwater runoff drainage systems. The combination plays a more important role in transporting rainwater, promoting the effective use of water resources and maintaining ecosystem balance.

4). Set up a rain garden to purify and store rainwater

There is not enough leisure space in the existing community to provide a good place for residents for entertainment and communication. Setting up rain gardens can help to enrich landscape types in the site, collect and purify rainwater. Using landscape treatment to combine these facilities with rainwater landscape measures and leisure seats can be designed at the edge of the rain garden to provide people with a place to rest, not only can control environmental pollution but also has the function of aesthetic recreation and the recycling of rainwater is realized.

4. SUSTAINABLE DESIGN STRATEGY OF RAINWATER LANDSCAPE IN EXISTING URBAN RESIDENTIAL COMMUNITIES

4.1 Guided by Sponge City theory

Sponge city is realized through low-impact development technology. Follow the basic principles of ecology, maintain the hydrological characteristics before and after land development and coordinate the relationship between nature and people. Sponge facility is an ecological infrastructure based on landscape and natural processes. Rainwater landscape design is carried on with the facilities of Permeable pavement, Roof garden, Rain garden, Planting grass ditch, Sunken green space, Artificial wetland, Ecological pond etc. Use "sponge" to create an ecological residential community with elasticity, natural accumulation, natural infiltration and natural purification, making the existing community with leisure function and full of vitality, and making the city a suitable place for people to live.

4.2 Use natural ecology method

The purpose of sustainable design is to restore the cycle process of natural system, achieving the purpose of protecting nature and conserving resources. In the landscape design of rainwater in the existing community, it is necessary to combine the present situation of the site environment and take ecological priority as the principle, make full use of the process of natural circulation system to collect, purify and reuse rainwater resources, and reduce the impact of human activities on the site, maintain the natural state of the landscape within the existing community and maintain the original benign water cycle. The sustainable ecological rainwater landscape design can not only reduce flood disaster in the existing community, but also adjust the microclimate of the whole city and alleviating urban heat island effect.

4.3 People-oriented and adapt to local conditions

The sustainable design of rainwater landscape in the existing urban residential community should be people-oriented, taking into consideration of people's needs for leisure activities, in accordance with the standard of people's habits and user-friendly, make the natural ecological restoration and cultural ecological reconstruction organic combination. The ancient Chinese gardening scientist Ji Cheng proposed in the Yuan Ye that "made by human beings, but like a masterpiece of nature". He proposed to respect the natural characteristics of the site and adapt measurements to local conditions. In the design of rainwater landscape in the existing community, various technical indicators shall be determined in accordance with the current situation of the site and by choosing appropriate sponge facilities. Environmental protection materials and clean energy shall be used to promote the recycling of waste, and to achieve the goal of low impact development with minimal cost.

4.4 Strengthen community management

For a long time, laying emphasis on construction while neglecting management has been an important reason for restricting the sustainable development of residential areas. In the design of the rainwater landscape in the existing urban residential community, we should draw lessons from foreign excellent theoretical and practical cases, strengthen social propaganda and education, let residents participate in community landscape design of rainwater and improve people's awareness of water saving. The government should improve relevant laws and regulations, adopt sewage discharge charge system and collection and reward system of rainwater, enhance residents' sense of responsibility and realize nationwide coordination of rainwater resource management. Only with this, can we achieve ecological sustainability of real urban rainwater resources.

5. CONCLUSION

The sustainable design of rainwater landscape in the existing urban residential community is a kind of ecological design strategy for the deterioration of the urban environment, which requires human activities to conform to the laws of the natural environment and people should live in harmony with nature. Through sustainable design methods and strategies such as technological facilities of Sponge City and natural ecological measures, rainwater landscape problems in the existing residential community of Qian'an City, China, have been well solved. And it has increased rainwater infiltration rate and reduced non-point source pollution caused by surface runoff. Improved the landscape quality of the community and integrated rainwater recycling of the existing urban residential community with the landscape and humanization. "Sustainable design" is undoubtedly an inevitable way and a fundamental strategy for human beings to achieve sustainable development. With the continuous progress of human society, people gradually realize the importance of protecting the environment. In the landscape design of rainwater, the strategies of "sponge" elastic design, ecological design and humanized design should be comprehensively applied to solve urban rainwater problem effectively and maintain the balance of ecosystem. Create a beautiful living environment for people to achieve "return to nature" and wish of coordinated development of natural environment, and achieve the sustainable development of the urban environment as a whole.

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DESIGN FOR PUBLIC TOILETS: CHALLENGES AND CONTRIBUTION TO THE REESTABLISHMENT OF PUBLIC VALUE

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ABSTRACT

Historic centres of worldwide cities are confronting huge conflicts between different groups, including Beijing. In the past four decades, the urbanization of Chinese cities has been through three stages. In this current stage, facing the pressure of excessive tourism, some municipal policy converts the priority to the local residents' appeal.

In this background, the redesign and improvement of the public toilets in Beijing historic centre confronts dual challenges. On one hand, due to the poor construction of the sewage system in this area, the public toilet is a basic service to the everyday life of the local residents, which requires highly professional design capability. On the other hand, the public toilet in the historic centre is supposed to be the public facility for other related groups, however, this requirement is not perceived by the local administration and the residents.

Therefore, how to define the public value of the public toilet would be the main question, in order to answer this question, in depth design research is proposed, and the design for public communication is defined to be a key of this project.

Key Words: design for public, service design, design research, public communication

1. THE TOILET REVOLUTION AS A BACKGROUND

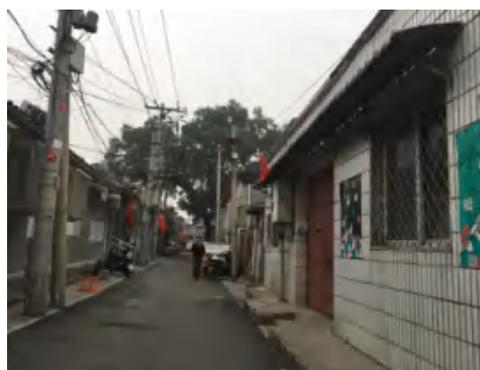
In China, “the toilet revolution” is widely promoted and implemented in different regions. The main target of this mission is popularizing the hygiene toilet in rural area and the tourism destination, and it is considered to be a strategic project to improve the residential environment quality and a trigger of rural revitalization.

Considering the huge gap between urban and rural, east and west, the toilet revolution could be defined to be the effort to balance the economic and societal development in China. No matter how the new technology and material are introduced, it is conceivable that how design could be involved into this project: providing appropriate and affordable products, facilities, and space as the solution to meet the basic human needs, which can be conducted with a classic design process established since last century.

However, the design of the public toilet in the historic centre of Beijing, revealed some fundamental challenges in this society, which is even commonly found in other societies in this era of transaction.

Beijing, the capital of China, is the political and cultural centre of the country, and has a history dating back three millennia. Furthermore, it is one of the most populous cities in the world. In 2017, the statistic showed that the inhabitant of Beijing Municipal was about 21.7 million. Comparing the 2.08 million residents in 1949, the rapid expansion of the urban area of Beijing was a microcosm of the whole country.

During the Cultural Revolution period, millions of people flocked into the new capital, including the historic centre. Till the early 1990s, the extremely poor inhabitant environment had become a main challenge to the municipal government. Meanwhile, both of the market and the academic recognized the unique value of this area. On the side of academic, to preserve or even conserve the historical feature was a part of maintaining the identity of the region and the nation. On the side of the business, the historic area would be a main attraction to the newly booming tourism market. Amid all of the different interests and appeals, with more than 2/3 hutongs demolished and recon-



structed, the historic centre now is a complex of domestic, business and culture.

[Figure 1] the existing hutong area (purple colored) in the historic center of Beijing

[Figure 2] a hutong in the historic center of Beijing

The toilet issue became the very epitome of the common tragedy of this area. Due to the extremely complicated ownership of the residences (public, private, unidentified), the sewage has not yet been constructed since Ming Dynasty (A.D.1368-A.D.1644). Professional workers would help the family to remove and transport the human excrement everyday till 1980s. Defined as a main public service to the local residents, public toilets were constructed to improve the residents' living condition. From dry latrine to flushing toilet, the sanitation department made more and more efforts to resolve the problem, however, in many years, this public service got the lowest satisfaction from both of the residents and the passengers.

2. HUMAN CENTERED DESIGN OF THE PUBLIC TOILET

The design group was engaged into the public toilet reconstruction project by providing integrated solution of this public facility, including the technology selection, space design, architecture design, product design, etc. However, during the design process, the sanitation department found they were under huge pressure of the local residents. The residents required to be informed why the toilets need to be redesigned and reconstructed, how the new design can improve the present service, whether their demands could be satisfied, whether it is possible to provide more toilets, etc. Therefore, first time in the history of the Municipal sanitation department, the project of public communication and user survey was proposed to the design team.

The first challenge comes from the fragile public trust to the public sector. From the perspective of the sanitation department, they took the huge responsibility of maintaining the urban environment quality, while achieved a very low public recognition. Meanwhile, from the residents' point of view, they deserve better public service as the tax payer, however, the current situation is far from their demands. Being the residents in the most expensive area of the capital, their living condition is much poorer than some undeveloped rural area. Even though basically the public toilets are with water flush, they are smelly, cold in the winter, cramped, difficult to



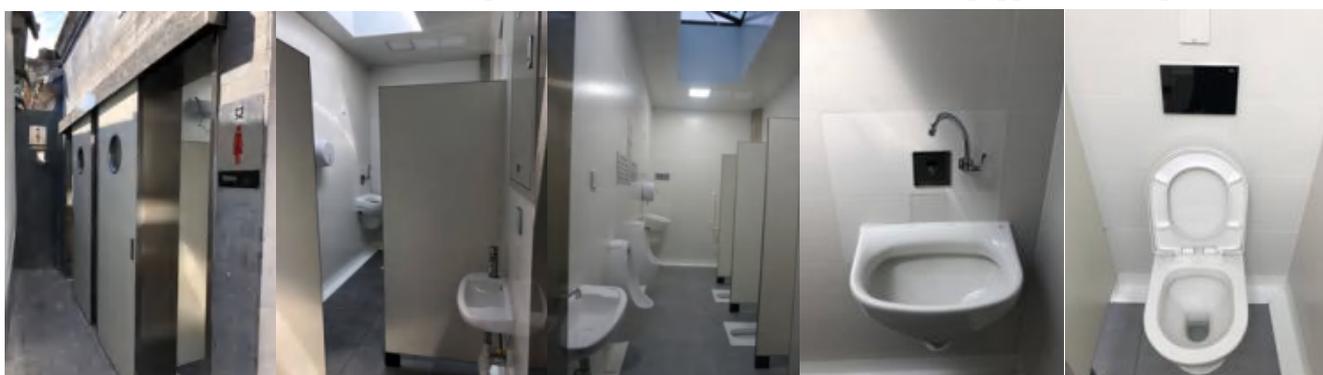
use for children and elderly. Comparing with the modernized commercial zone near at hand, the complexity of social inequity is self-evident.

[Figure 3] a courtyard in hutong of Beijing

[Figure 4] Wangfujing Avenue, the completely reconstructed zone in the historic centre

Intensive design research was carried out when the project was launched including field research and group meeting. In general, the group meeting would be organized by the specific community committee in the meeting room. Due to the long-term ignorance of the residents' opinion, almost every meeting was ended unpleasantly. Even severed the local residents every day for decades, it was the first time for the sanitary department to face their clients directly.

With the support of local resident volunteers, in-depth interviews and user study were conducted by the design group. The reconstruction design of public toilet is highly user centered. Every toilet was designed with highly compact layout in order to improve the capacity as well as keep the privacy. Different technology and material were applied to control the smell and maintain the temperature. Western style toilet and alarm bell were installed to guarantee the safe of the elderly and disable. Specifically, an additional wash basin was equipped in every public toilet in



this area, because the residents still need a urinal during the night, and they are used to clean the urinal in the public toilet every morning.

[Figure 5-9] the detail of a redesigned public toilet in Jiaozi Hutong

3. THE PUBLIC COMMUNICATION OF THE PUBLIC TOILET RECONSTRUCTION DESIGN

According to the plan, 1,325 public toilets would be redesigned and reconstructed from 2018 to 2021, nearly half million residents would be involved. Before the pilot projects stage, design research has been conducted and a very small percentage of the residents got the information of the reconstruction program. In order to expand the public communication, the design group proposed some ideas.

First, the online communication was denied to be the optimal option. The general survey found, the majority of the local residents in the historic center is elderly. The young generation has moved out to look for better living space when they grow up. Even though some young people would be attracted by the traditional lifestyle and find a residence here, their presence in the public issue is inadequate. Therefore, the permeability of the online service is quite low comparing with the average level. On the other hand, it will need a process to develop an online application, while the public communication of this project cannot be compromised by the new developing demands.

Secondly, without the support of the new technology, the community center was considered to be the key of this public communication. Community center, being the bottom level unit of the administration system, mainly responsible for the everyday life related public service, including social assurance, population registration, social welfare, etc. Implementation of the public policies is the main function of the personnel and the place. For most of the



community center staff, the unidirectional propaganda was the general way of policy promotion. The idea and the



method of interact with the residents become a new idea and skill to learn.

Figure 10] the information board of the toilet redesign

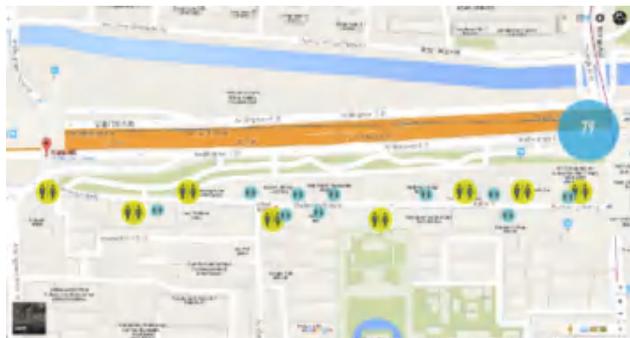
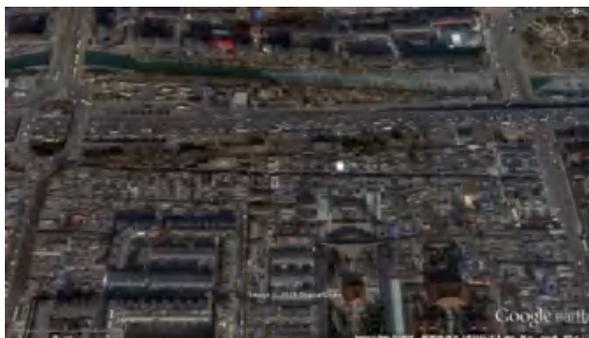
Figure 11] face-to-face survey with the information board in hutong

Figure 12] the poster on the introduction of the redesign diffused to the community centres

4. FROM USER-CENTERED DESIGN, TO COMMUNITY BASED DESIGN, TO DESIGN FOR PUBLIC

The informal partnership between the design team, the sanitation department and the community center was the unexpected innovation during the design process. The public communication channel was developed slowly based on this collaboration. With the adequate user study and detailed introduction of the design, more and more local residents came to the design team and the community center to propose their idea and demands of the toilet. On the other hand, as the service provider, the sanitation department got their chance to explain the limitation of the public service, for example, why it is not possible to construct more new toilets or expand the area of existing public toilets.

However, the real complexity and challenge emerged at this stage. As the research showed, the historic center is a mixture of residence, historic monumental sites, and commercial zone. So far all of the work focused on the demands of the local residents, afterwards, to build a communication channel between the residents, the designer and



the public service sector. The question is, whether the local residents would be the only user to be investigated? If not, whether there is contradiction between different users? Whether is necessary and possible to balance the different demands?

Figure 13] the satellite map of Wudaoying Hutong

[Figure 14] the public toilets in Wudaoying Hutong, are public toilets, are in-house toilets of restaurants and cafes

The field research explored the intensive relationship between the residents and others, including the tourists and the business. Similar with other famous tourism destinations, the crowded tourists now are considered to be rather a threat to the local lifestyle than a visible and stable income.

The field research showed that in some spots of the historic center, the numbers of visitors are far more than the local residents. Less than one tens of the commercial places are able to provide in-house toilets for their guests. In this situation, to balance the demands of residents and the visitors would be a huge challenge. For example, even though the majority of the residents are elderly, the equipment for infants and children are provided in the toilets when it is possible. All of public toilets are both offline and online positioned to make them easily located.

The second difficulty is the defining of the quality of the janitor's room. All of the public toilets are maintained by the workers of the sanitation department. Given they will work from 6 AM to 10 PM, and every one of whom would take care of more than two toilets, they will be provided a small room in the relatively spacious toilets. In this reconstruction design, besides the application of the energy-efficient technology, the air condition is also equipped to deal with the hot summer. In general, the janitors are migrant workers with very low payment. The improvement



of the living space of janitors became a stimulus to some of the local residents. The deeply rooted sense of superiority to the migrant workers would be shaken. When this comprehensive social relationship perceived by the design team, great effort was made to control the exterior and interior appearance delicately. Plain, simple, high consistent with the residential environment is defined to be best result of this project.

[Figure 15] a janitor's room in a public toilet of Beijing

[Figure 16] the exterior of a newly reconstructed public toilet

5. DESIGN THE RELATIONSHIP, SHAPING THE PUBLIC

With the active and widely public communication, the reconstruction design was highly recognized by the local residents and the visitors. In the next stage, the design team proposed new target to the sanitation department and the community center: the design of the relationship, including the relationship between the residents and the public service provider, the residents and the sanitation worker, the old and new residents in the area, and the residents and the tourists, etc.

Obviously, it is too much ambitious to transform or improve all these fundamental conflicts with such a small and specific project. While it is the nature characteristic and advantage of a public service project to improve the publicness, which has not yet been recognized by the administrative sector.

With the open market policy of more than four decades, the public management system has been through a rapid transformation in many regions, especially in the eastern coastal area. However, as the national capital, Beijing is highly political and the administrative system maintains the communist tradition with quite a degree. On the



contrary, the openness and fluidity of the internet society brought unprecedented challenges to the public service sector. Despite the increasing budget invested into the service, it is more and more difficult to improve the satisfaction of the citizen. Under this circumstance, the design intervention should not be limited into the solution itself. The further step aiming the sustainability and the iteration of the public service should be proposed to the public service departments.

[Figure 17] a mini exhibition on toilet in hutong

[Figure 18] a professional exhibition on toilet to be introduced into hutong

From conflict, to negotiate, to compromise, the engagement of the local residents is a way to connect them and the public service departments. The further step would be focused on the sanitation workers. In our society, the sanitation workers, especially who take care of the toilets, hold very low social status and poorly paid. Even though some of them could make a connection with the local residents due to their long term service, but in general, much respect they gain, less maintenance work would be needed, meanwhile, higher user satisfaction can be achieved. “The public sector and citizens making better use of each other’s assets and resources to achieve better outcomes or improved efficiency” (Bovaird, B. , Loeffler, E., 2012). To humanize the neglected workers, and promote a new relationship and culture in a relatively traditional community, would be much more beyond the toilet design itself. In fact, it would be the key of the sustainability of the public service as well as the reduction of the social conflict.

Considering the natural publicness (Haque, 2001) and the high density of the public toilets, they are the best media to like the area and the tourists. The historic center, even though protected by very strict regulation of landscape conservation, it is in the process of capitalized gentrification. The tourists are attracted not only by the historic monuments, but also the chic café, bar and stores. In fact, few of the tourists would concern with the real life of the existing residential area. Whether there is a way to reveal the past, present the current and discuss the future of this area? Nevertheless, the public toilets would not be the perfect place to start a connection between the local and the outside, they still provide this opportunity. Improving the publicness is supposed to be the responsibility of all of the public spaces.

6. DESIGN FOR PUBLIC: A NEW PHILOSOPHY OF DESIGN

With the rapid dissemination of design thinking, the user-centered design is more and more accepted beyond the design professionals, including the public administration sector. An inevitable question is, when there is conflict between the different users, how to achieve a balance or compromising among the group of people. With this concern, more and more researchers proposed community-based design and management (Winschiers-Theophilus, H., Bidwell, N., Blake, E., 2012). But more fundamentally, what community is in the current society? Whether a neighborhood equals community? When the idea of pre-modern and modern coexist in the same group of people, what would be the common interest for them? All these questions cannot be answered by being recognized by the designers step by step. Therefore, design for public, rather than community-based design, is the real question confronted.

In fact, the public philosophy is the emerging topic in the past decade (Sandel, 2005, , 2009), as a response to the worldwide social transaction. Different with the democracy crisis in western societies, the challenge in China, is to pull back from the omnipotent governance while maintaining the capacity of providing public goods (2017). In this case, both individual and group need to learn how to compromise with others when the public resource is limited. At the same time, the new lesson for the public service provider is having the consciousness of engaging rather than steering (Denhardt, J., Denhardt, R, 2003). Facing this dual challenge, the designer needs to figure out the way of communication, connection, and visioning. It is rather a new philosophy than capacity.

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7. 2017 21



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DESIGNING COMMUNITY THROUGH URBAN GARDENING

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ABSTRACT

Huertos MX is a project that searches all current urban, personal, scholar and institutional gardens in Mexico. To make this possible, technology was the way to go. We use mobile technology and geo localization in our mobile application, which helps our users locate people and institutions that share a common goal: sustainability. By doing this, we are creating a national movement to build a network where people can communicate and share anything they want.

Key Words: urban gardening, mobile application, community, design

1. INTRODUCTION

In an era where sharing information through the Internet is a must and a sustainable life is becoming a global goal, is it possible to integrate technology, design and urban gardening? This is the main question that pushed a thesis work from an academic work into an emerging national social program. Huertos MX was born to create a national state of mind on the importance of a sustainable and cooperative community where people could be able to communicate and share experiences, tips or even to make a business out of their urban garden.

2. CREATION OF THE PROJECT

Huertos MX began as an academic project, which had the initial goal of looking into the soft skills and benefits that a school garden could bring to students. After months of research and local visits to urban gardens through Mexico City, the project's investigation was getting slower by the minute as the research was done by one person and responses from urban gardens were being sent after weeks of initial contact.

In November 2016, the project hit one of its biggest milestones, as Huertos MX's focus changed from the educational benefits of urban gardening in schools to an even bigger subject: the project would focus on the results of unifying urban gardening and technology through design. The tool that was able to marry these two concepts was geo location. Through the utilization of GPS technology, people interested in communicating with other urban gardeners could be able to locate each other in a map built by precisely them. This instant documentation of gardens through the city could only be done through a solid and participative community who shared common interests as well as an organized platform.

3. THE MOBILE APPLICATION

In order to achieve the project's primary goal, an alliance was necessary. A partnership with a mobile application development company was built, in a two-way benefit agreement. MyAction® is a virtual system and platform that can be used to guard and secure pictures, users and real time locations. Through the website and application built by the MyAction® team, HuertosMX could be able to filter information, manage users and consult on the uploaded pictures through their Software As A Service (SAAS) software.

Both teams agreed on the construction of a minimum viable product, which contained the required basic functions needed for the project as well as some specifics. The functionality of the first mobile application build consisted on 3 main items:

User identification.

Users should be able to register themselves and sign in through a valid email account. Validation of identity and password restoration were linked to it.

Garden registration on community map.

The project's essence is the social construction of a communitarian map with constant actualization. Users may register their, or even other gardener's, garden and continue to upload information or consult with it through the "follow up" function. This function provides the opportunity to urban gardeners to create a documentation of their garden through time, as well as third party gardeners to consult on their favorite localization's growth.

Garden categorization

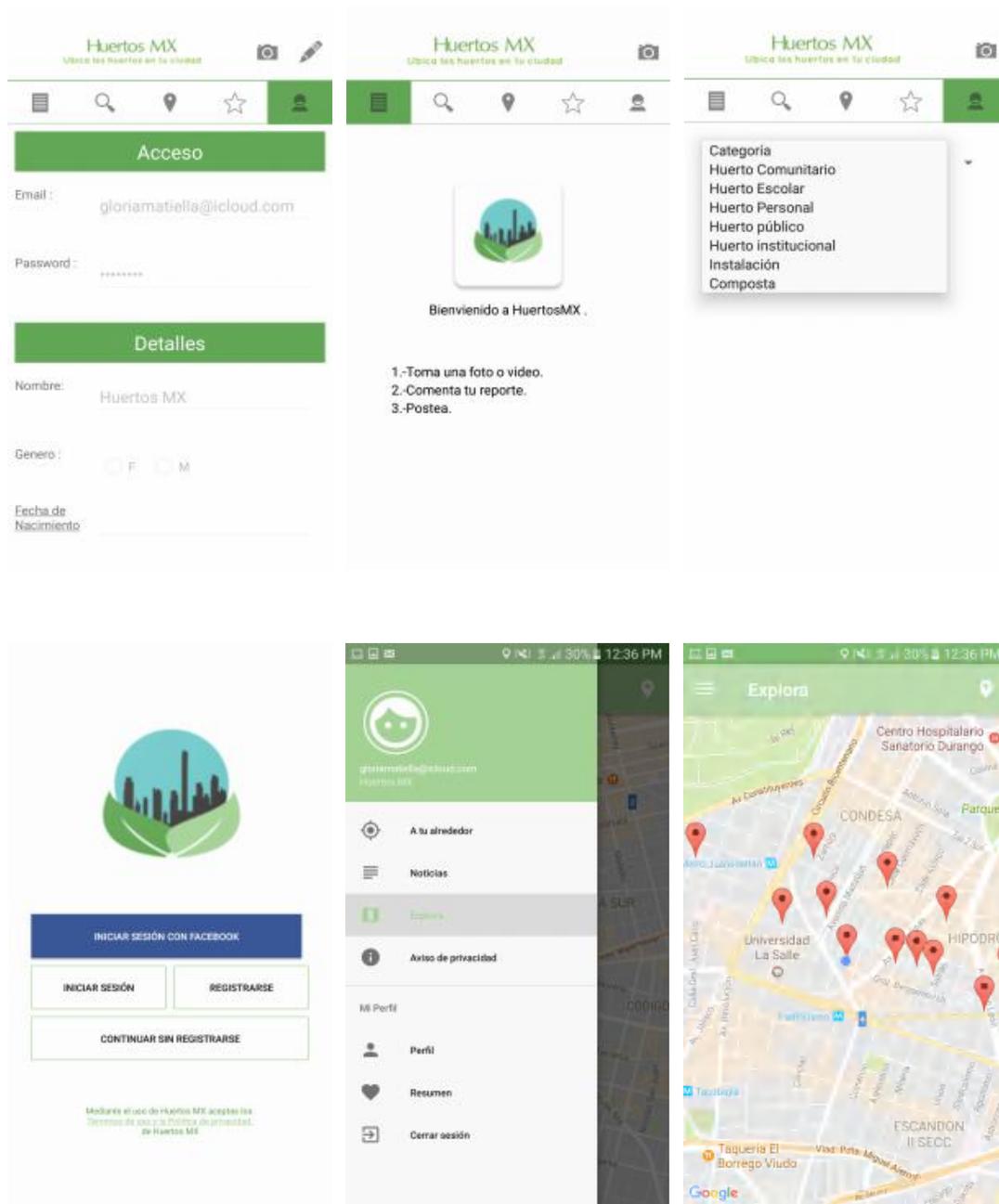
The mobile application needed to be designed in function to the objectives of the project; therefore the classification of urban gardens into specific categories was necessary. Each picture of the urban gardens registered in the mobile application should be integrated into one of the following seven categories:

- House garden: Gardens created and sustained in private households.
- School garden: Gardens installed in academic facilities.
- Public garden: Urban gardens with free entrance to public (generally preserved by government funds)
- Community garden: Gardens sustained by social organizations or NGO's support.
- Institutional garden: Gardening projects installed in private organizations such as hospitals, enterprises, etc.
- Installations: Gardens created and installed in third party locations by local companies.
- Compost: Companies or projects dedicated to the sell of organic waste for gardens.

3.1. Mobile application evolution

The following images illustrate the applications' evolution through time, from 2016 to 2017.

In November 2017 the last and final version of the mobile application was launched, which involved aesthetic changes as well as functionality adjustments. The main new features included a new section in the main menu, which directed users to Huertos MX's blog, Facebook sign in option was included and a friendlier navigation through the map of gardens was implemented.



[Figures 1, 2 and 3]. Sign in page, Landing page and Garden categories for first version of Huertos MX's mobile application
 [Figures 4, 5 and 6]. New sign in page, New menu options and Urban gardens registered in map by zone

4. THE COMMUNITY

Huertos MX's goal is to create community through a common interest: gardening. Therefore, it was necessary to organize social events that could bring gardeners together and exchange experiences, knowledge, create alliances and more. In March 2017 Huertos MX and three other organizations planned the first local meet up for gardeners. Cultiva Ciudad, Octágono, Olaki and Huertos Mx created an agenda for over 100 urban gardeners who were asked to register their projects in the mobile application in order to assist to the event.

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A second gathering was planned, this time, as an alliance between Centro Uiveristy and Huertos MX. The purpose was to invite urban gardeners from Mexico City into a seed and compost trade. The invitation was sent to

the previous March gathering as well to other members of the mobile application database. The attendance was significantly reduced as it was planned for 50 gardeners at the most. Qualitative results were as positive as expected as



all-25 attendees created a bond and had personal dialogue experience.

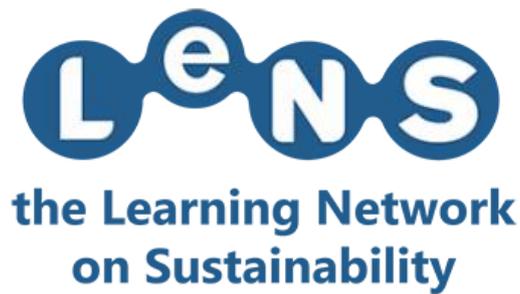
[Figure 7]. "Save the date" designed poster for the gathering.

[Figure 8]. Members of Huertos MX community trading seeds.

The principal communication line between gardeners of the newly created community of Huertos MX has been social media, especially Facebook and Instagram. Both platforms were fed with informational content on instructions for user registration, picture upload, map usage and call outs between gardeners for seed trade. Through instant messages in both platforms users were able to direct their questions and get responses about functionality of the application, contact with other gardeners and advice for their garden maintenance. Community members have had private meetings after being contacted through Huertos MX project which has led to friendships, alliances and gardening interaction since its foundation building with time a sustainable network of gardeners who are highly interested in keeping contact and feeding the mapping of urban gardening projects in Mexico.

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EXPLORING FOG HARVESTING IN EUROPE: CHARACTERISTICS AND GUIDELINES FOR A SUSTAINABLE CITY MODEL

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ABSTRACT

Water availability affects the economy, social relations and environmental security in regions. As groundwater supplies are diminishing, and global water demand is increasing (United Nations, 2015), new nature-based technological solutions are highly desirable. Recently, the water scarcity crisis is also starting to affect Europe. In order to relieve the stress on traditional fresh water resources, fog-collection technologies stand as a promising alternative solution. Thus, this study developed the Nebula Project to maximize the ecology of system boundary processes and offer fog harvesting as sustainable opportunities in the Switzerland Alps and Northern Italian region. The project is used to inform policymakers understand tailor nature-based sustainable solutions in cities, based on their unique geography, climatic conditions, and social characteristics. Active involvement of citizens is fundamental for the functioning of those systems, especially if combined with promotion strategies, data gathering systems and gamification processes.

Key Words: fog harvesting, urban metabolism, water consumption awareness and education platform

1. INTRODUCTION

The increased risk of a global water drought has already been well documented by a series of authors (Wada et al., 2011; WWAP, 2015). Climate changes are exacerbating these conditions through indirect effects on the whole hydrological cycle (Gleeson et al., 2012). Although water scarcity has different causes according to the region's environment and state of economic development, there is no unique solution for this crisis but a set of measures and practices, from the policy level to physical interventions. Without a change in water resource management, 68% of the world's population will be living with medium to high water stress levels (Pfister et al., 2009).

While Europe is regarded as having sufficient water resources, water scarcity and drought is an increasingly frequent phenomenon, as many Mediterranean countries (included Spain and Italy) are yearly using up 20% or more of their long-term supplies, with impacts on hydropower, agriculture, manufacture and tourism (Arnell, 2004). Unfortunately, even regions traditionally known as water-abundant, are now being affected, more specifically around the northern Italian and Swiss Alps, which now face water availability fluctuations due to raising temperatures, glaciers melting and changes in the seasonal distribution of precipitations (Blanc and Schadler, 2014).

As the world's demand for fresh water is growing, collecting water from fog masses could represent an alternative solution to help relieve the stress on conventional, over-exploited water sources (Domen et al., 2014).

1.1. Fog water harvesting and the SDGs

Equity and sustainable development in fog collection is essential. The United Nations Sustainable Development Goal 6 (SDGs), and Goal 14 (UN, 2015), are calling for access to safe water, sanitation and water under the sea for all by the year 2030. The goals support the efforts in water scarce countries and regions to go beyond conventional resources and tap unconventional water supplies to narrow the water demand supply gap. Among average water resources, the potentiality to collect water from the air, such as Fog Harvesting (FH), is by far an unexplored science. Fog water collection is a low maintenance and sustainable option that can supply fresh drinking water to communities where fog is in abundance (Fernandez, 2018) already implemented around the world (Batisha, 2015).

Despite technology development and demonstrated benefits, there are certain challenges to fog collecting, including the lack of supportive policies, educational expertise, community involvement and awareness, especially in developed countries. To supply this void, this study investigates two European regions to assess potential fog water harvesting application scenarios: the Swiss Plateau (Switzerland) and Po Valley (Italy). Moreover, it proposes a solution to adapt these nature-based mechanism solutions to semi-urban environments not only to provide an additional source of water in these regions, but to promote sustainable development education on water behaviours and water conservation awareness using Information and Communication Technology (ICT) platform and machine learning.

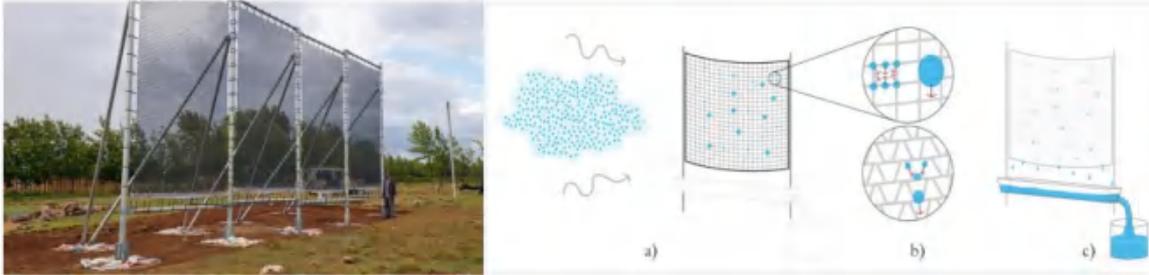
2. A GUIDE TO FOG CHARACTERISTICS AND COLLECTION

Fog is a low-lying cloud (Schemenauer and Cereceda, 1994) that forms when sufficient air humidity meets temperatures slightly close to the dew point, as water molecules group around condensation nuclei, commonly present in the atmospheric air (Vipul et al., 2016). A common meteorological phenomenon of valleys, islands, hills and mountains of temperate climates, fog can be found around the world in many different ecosystems - many of whom rely on fog moisture to exist (Fessehaye, 2013). Despite forming through different processes, only a handful of fog types are currently known as suitable for water harvesting. In particular, advection fog occurs when warm air masses from the ocean meets colder, humid continental air masses. Orographic fog tends to be formed when air masses move upwards on mountains, meeting a colder temperature. Radiation fog: forms under calm weather conditions, when temperature inversion in valleys and water bodies condense an already highly humid air into fog.

Topography is a major influence on fog onset and formation, as it might facilitate fog formation in one place and difficult in the other, within few kilometres apart. Although it is not easy to predict fog formation, some site evaluations and methods do exist and were proposed by several authors, including Schemenauer, Cereceda and Osses (2015). Besides topography, other indicators documented as impacting fog harvesting performance are: global and local wind patterns, Liquid Water Content (LWC), temperature range, relief, altitude, distance from coastline and crestline and upwind locations. Wind is the leading factor in traditional water collection.

A large number of FH projects worldwide have used advection and orographic fog for water collection, for different purposes (Batisha, 2015). These devices are constituted by a frame and a strained, porous mesh that intercepts air water droplets. As the wind moves fog moves through the mesh Fig.1(a), some of its water droplets get caught on its surface, merging into larger drops (b) that falls to a gutter through gravity, being directed to a reservoir for storage or treatment (c) (Morichi, 2017). In the Chugungo FH project in Chile, the LFC yielded an average of 3L/day per m² of mesh area. (Schemenauer, Cereceda and Osses, 2015). In Oman, magnitudes of 30L/m²/day were achieved, and in a particular day, it amounted for 70 L/m²/day. Cost-wise, an LFC can be very cheap to buy and build, but its price may vary according to the materials used: a 1m² collec-

tor can cost around 300 USD if made of aluminum. In a project conceived for Eritrea, 20 LFC costed a total of 28.193 USD (Vision Eritrea Financial Report, 2008).



[Figure 1] (left) Fog collectors in Tanzania; (a-c) Scheme of fog collection process (right). (www.aqualonis.com; Morichi, 2017)

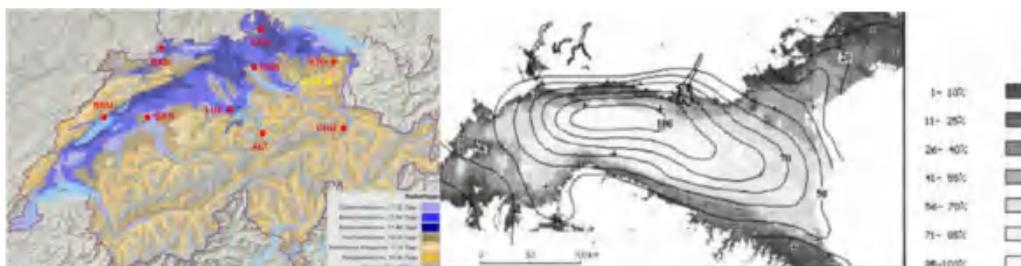
3. METHOD

Cities are faced with the challenges of traditional and outdated methodological water management monitoring tools as cities continue to grow in size, density and complexity. First, the study aims to use available open source public and private water consumption data from the area of Switzerland and Italian Alps communities to develop a data driven water management ICT platform network. The Nebula Project, four phase study, employs computational methods and machine learning algorithms (artificial neural networks, random forest) to improve the performance by mechanizing the acquisition of knowledge from experience. In addition, the Project provides a sequence of phases from the identification of hot-spot opportunity areas within specific characteristics and boundaries, climatic assessment analysis, educational and awareness campaign, real-time data methods, a community reward-based system, and system distribution approach (see Figure 3).

4. FOG-INTENSE HOTSPOTS IN EUROPE: THE CASE STUDY OF SWITZERLAND AND ITALY

Although advection fog is widely preferred as the ideal fog for water collection through standard fog harvesting techniques (Schemenauer, Cereceda and Osses, 2015), radiation fog appears to be more consistent, predictable (Scherrer and Appenzeller, 2014) and uniform compared to advection fog. Strongly present in Europe, particularly in the Po Valley (Fuzzi, 1993; Mariani, 2008) and the Swiss Plateau (Wanner, 1979; Bendix, 2002; Scherrer and Appenzeller, 2014), this fog type often shrouds vast portions of these regions for many hours, starting from early evening and persisting until late morning (Bendix, 2002; Mariani, 2008). The lack of strong winds (Mariani, 2008) in the region is a major obstacle for traditional FH systems. Despite requiring an innovative approach to tackle the issue, the potential of water production is very consistent. At the spatial scale, satellite imagery maps on Fog Low Stratus (FLS days) have been produced, by comparing spatial daily observations with local station data (Cermak et al., 2009). In Italy, a number of fog harvesting projects have already been proposed in the Po Valley (Calixto, 2018; Morichi, 2018). According to Bendix, (1994), fog is often the subject due to the large amount of toxic smog phenomenon found in cities, which is a major environmental hazard to be considered during the implementation and intervention of fog harvesting.

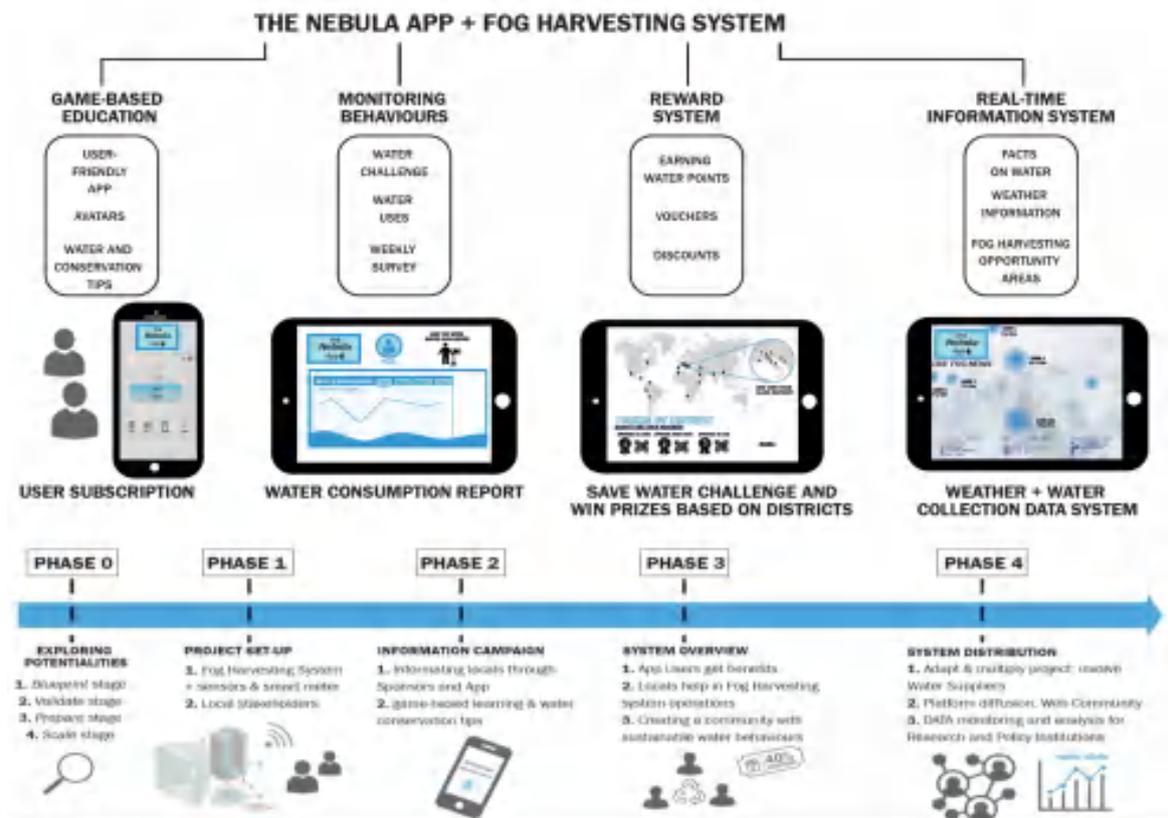
Both Italy and Switzerland are faced with water availability threats. In Italy, it has become increasingly difficult to meet water demands, in particular in summer season, with subsequent economic damage to agriculture (Swedish Commission, 2007). The country is expected to experience a 25% increase in water stress in the present century and a reduced availability of resources affecting drinking water supply, irrigation and hydropower generation in the Po Valley. This will lead to an increased soil dryness and increased frequency of droughts in the areas of plains (Wada et al., 2011). In Switzerland, most alpine glaciers will have disappeared by 2090 if current temperature trends are not inverted (Schaeffli et al., 2018). Precipitation in the Alpine region of the country is likely to suffer distribution unbalance, as summertime rain is expected to decrease by 60% and to increase in winter. Also, concern is directed towards water-sensitive regions like Valais, Ticino or the Central Plateau, where the unclear effects of climate change drags concern about water shortages (Blanc and Schadler, 2014).



[Figure 2] (left) Map of fog in Switzerland (Credits: MeteoSwiss, 2017) and (right) fog incidence in the Po Valley, north of Italy. (Credits: Bendix, 1994)

4.1 The Nebula Project

This study developed the Nebula Project, a water management smart systems awareness communication ICT system + App smartphone platform, shown in Figure 3. The platform promotes sustainable urban water use and conservation, using practical suggestions and advocacy using real-time data and machine learning techniques -- connection to a virtual community. The smart meter allows water management and monitoring, the gamification process involves users (citizens, local governments, universities, companies, industries, institutions) and provides them with data, tools, consumption behavioural tips, educational kits, conservation advice, recover strategies, mitigation and fog harvesting opportunities. Platform users have the opportunity to participate in water reduction programs and receive rewarding prizes that can be used or exchange with other users within their community. Users that are interested to implement and employ the Nebula Project in their community, the system provides a replicable set of guidelines: (i) blueprint, (ii) validate, (iii) prepare, and (iv) scale. The blueprint stage provides a thorough climatic, socio-economic, policy, and topographic analysis investigation to identify the platform's feasibility within a specific environment and indicator conditions. The validate stage provides an evaluation assessment on fog harvesting hot spot opportunity areas based on short/long term fog and humidity presence. The prepare stage prepares a feasibility network diffusion model with required sensors, server, and satellite imagery data to prototype using a radius fog buffer scan with specific implementation and monitoring criteria. The scale stage is the final stage where the collaboration of public/private stakeholders takes place and users scale the network to their needs. Moreover, a combined use of ICTs with human interaction enhances public exposure to environment messages. The platform provides an excellent way to educate users about the environmental impacts of their actions and provide them with the tools needed to conserve and preserve water (i.e. home, school, work, and school).



[Figure 3] The Nebula Project: (top) Water Awareness Gamification Platform Scheme; Progress timeline for Platform scaling-u (bottom) (Gloria Morichi)

5. CONCLUSION

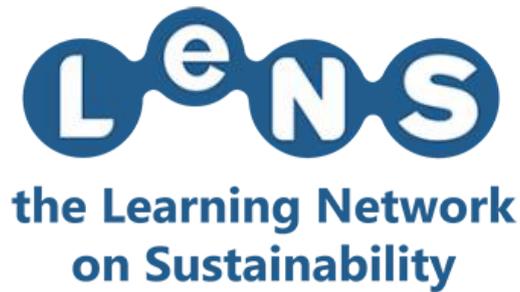
In contrast, to current data models, mainly based on physical principles, the machine learning approach platform model focuses more on the macro-description of the behaviour of the system, calculating the association of the outputs with the system inputs. Increasing levels of automation related to pattern recognition and statistical inference to improve the performance of water management by evaluating and analysing regularities in training data. Second, using gamification approaches to engage an array of stakeholders by means of a cooperative network to develop a smart water management tool though gamification can develop awareness on the consumption behaviours.

Identifying FH opportunity areas using real time data, and monitoring lifestyle patterns by developing an ICT platform using machine-learning technique provide water utilities an effective tool for the monitoring of water management and promote and optimize water efficiency. The platform uses gamification user friendly criteria to attract all types of users from children, elderly, people with disabilities, students and academics and many more. The *Neb-*

ula Project would not only help relieving local water stress but also, with active involvement of citizens, contribute monitor their water-related behaviour and correct unsustainable lifestyles with gamification processes and pay-back reward systems. Smart water management tools through natural resources monitoring, alternative resource evaluation and education campaigns are fundamental for cities to help achieving the SDGs.

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CHARACTERIZATION OF TWO URBAN FARMS IN THE CUAUHEMOC BOROUGH OF MEXICO CITY

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ABSTRACT

Agricultural practices in cities have evolved to what is commonly described today as urban agriculture (UA). The term is often used ambiguously and can encompass a wide variety of agricultural practices that are carried out within the city, which can generate confusion and doubts about the real scope of UA. The claimed benefits sometimes portray UA as a sort of urban activity that is capable of providing a long list of benefits. However, cases have been made that critique some of the claims and numbers reported on UA. Also, as interests in AU grows, a better understanding of how UA cases operate would allow better design, planning an operation of urban farms. For these reasons, a more methodical, in depth characterization of cases should be considered. This paper proposes a methodical characterization based on the multiple functions and dimensions of UA based on the results of two case studies.

1. INTRODUCTION

Agricultural practices in cities have evolved to what is commonly described today as urban agriculture (UA). The term is often used ambiguously and can encompass a wide variety of agricultural practices that are carried out within the city, which can generate confusion and doubts about the real scope of UA. The claimed benefits sometimes portray UA as a sort of urban activity that is capable of providing a long list of benefits such as improving food security, social integration and biodiversity; reducing soil erosion and air pollution; providing environmental education, urban beautification and community building; among others (Duchemin, Wegmuller, and Legault 2009; Viljoen 2005; Viljoen and Bohn 2014; L. J. Mougeot 2006; Haberman et al. 2014). Notwithstanding and as it has been identified by various researchers, some of the information generated about UA is unreliable and often of unclear definitions and methodologies (Zezza and Tasciotti 2010; Badami and Ramankutty 2015; Ellis, Sumberg, and Anglia 1998; Martellozzo, Federico; Landry, J; Plouffe, D; Rowhani, P; Ramankutty 2014). For example, many articles on UA, cite 1996 UNDP documents, claim that close to 800 million people worldwide practice some sort of UA and about 150 million generate income from it. However, according to that same document, the information is based on experiences, observations and extrapolations that are not often explained in many AU research documents that cite this data. Another issue is that many documents fail to differentiate between urban and periurban agriculture which can have very different forms of operation, motives and results (Badami and Ramankutty 2015; Zezza and Tasciotti 2010). An so, UA requires more in-depth and methodical research at a local level in order to better grasp its scope, benefits and challenges. For this reason, and as the number of cases of urban agriculture increases worldwide, researchers, advocates and experts on the topic should make an effort to classify and characterize cases in a way that will result in better and more reliable information. The present article presents a proposal for the characterization of two urban farms in the Cuauhtemoc borough: Huerto Tlatelolco and Huerto de las Niñas y los Niños.

2. METHODOLOGY

From 2017 to 2018 various cases of urban agriculture in Mexico City were characterized through social science based research methods that made use of interviews, documented conversations and participatory observation that are founded in social sciences. The activities of the urban farmers were documented and analyzed in order to describe the specific ideas and visions of what cities should be according to their experiences. In addition to this analysis, a more pragmatic characterization of each farm's dimensions and functions was accomplished based on the presumption that urban agriculture is a multidimensional and multifunctional urban phenomenon that, according to case studies around the world, can be used as a multi-dimensional tool for social development (L. J. A. Mougeot 2005, 2000; L. J. Mougeot 2006; Viljoen and Bohn 2014; Pourias, Aubry, and Duchemin 2016; Duchemin, Wegmuller, and Legault 2009). Based on the previous ideas, each of the urban farms was evaluated in terms of the following functions: 1) educative, 2) social integration, 3) environmental, 4) food security, 5) health, 6) leisure, 7) economic and 8) urban planning. And also, each urban farm was described in terms of the following dimensions: 1) activities, 2) location, 3) spatial characteristics, 4) products and 5) target audience. This was done by designing and using a series of templates and scales for evaluating the different types of urban agriculture through field studies. Each farms dimensions were described qualitatively and their functions were evaluated in terms of the types of activities, their intention and periodicity as it will be discussed further in the results section of this article.

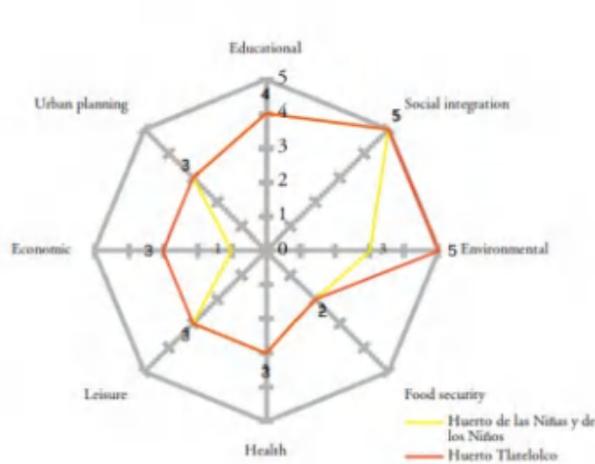
3. RESULTS

3.1. Multi-Functional Characterization

The following graph shows a comparison of the functions provided in each of the characterized cases. Their functionalities were evaluated on a scale from 1 – 5 that is explained in Figure 1. Functions were evaluated in terms of the the amount of activities that contributed to each function, the intentions behind each activity and the periodicity of each activity. For example, a farm that engages in organic waste composting is an example of an activity that contributes to the *environmental* function. If the activity is well planned and periodic, it would receive a valuation of 5 points on the scale used. However, if the same activity, composting, was sporadic it would receive a score of 4 points. The evaluation scale and results are explained further in the following figure.

As shown in the graphic, there are minor differences in the functions that each of the urban farms provides. In particular, Huerto Tlatelolco has a better economic function due to the fact that it does not depend directly on government funding. However, it still has a low rating of three because it depends on other NGO activities that are not directly related to the activities of the farm. The environmental function is also greater in the Huerto Tlatelolco because there are more activities and periodicity in this category. For instance, Huerto Tlatelolco has a much more structured and periodic operation of their composting sites and they have a rainwater capture system, while Huerto de las Niñas y los Niños does not. It is worth noting that the intention of this characterization is not to consider differences as strengths or weaknesses; the intention is to contemplate functionality when designing, planning or operating urban farms. For example, an educative farm located inside an elementary school will probably have a rating

of 0 for economic functions. This does not mean it is a weakness; it is a cue for the farm operators to take this into consideration when designing and planning their farm. Additionally, different functions will likely require different



Scale Evaluation

1	There are little or no activities that contribute to this function.
2	There are some circumstantial activities that contribute to this function.
3	There are sporadic planned activities that contribute to this function.
4	There are periodic planned activities that contribute to this function.
5	There are planned activities fundamental to the urban farm that contribute to this function.

	Huerto de las Niñas y de los Niños	Huerto Tlatelolco
Educational	4	4
Urban planning	3	3
Economic	1	3
Leisure	3	3
Health	3	3
Food security	2	2
Environmental	3	5
Social integration	5	5

policies as well. Non-profit and for-profit farms will probably also have different ratings and hence should be taken into consideration when writing and applying public policies.

[Figure 1] Functional Evaluation of the urban farms

3.2. Multi-Dimensional Characterization

The following table shows a comparison of the results of the dimensional characterization between Huerto Tlatelolco and Huerto de las Niñas y los Niños.

[Table 1] Dimensional Characterization comparison

	Huerto de las Niñas y de los Niños	Huerto Tlatelolco
Economic activities	No substantial economic activities support the garden. The garden does not require much but it depends on the local government to operate. Note: 2019 the garden will be required to finance itself.	Produce and local products are marketed in the garden itself and in other local produce markets in the city. Produce is also sold directly to different restaurants. They offer courses, gastronomic events and training sessions. Rely heavily on volunteerism and donations.
Funding	Community and governmental collaboration on public land	Privately operated by an NGO on public land
Organization	Insurgentes Norte 694, San Simón Tlalnahuac neighborhood, Cuauhtemoc borough	Paseo de La Reforma Norte 742, Tlatelolco neighborhood, Cuauhtemoc borough
Location	Previously unused median strip on Insurgentes Avenue. It is below a pedestrian bridge at a public transportation station. It can only be accessed through the pedestrian bridge.	It is located on the footprint of the Oaxaca Tower, which was demolished due to damage during the 1985 earthquake. It is easily accessible and visible from Reforma Avenue and public transportation.
Urbanization level	Very high	Very high
Area description	4500 m ² divided into 3 productive areas, with 22 cultivation beds, 3 multiple use spaces, 1 greenhouse, 4 water tanks, an improvised warehouse, 2 composting area and a shed for tool storage.	1500 m ² with 180 m ² of cultivation beds, 500 m ² of fruit trees, palapa for courses, greenhouse and an improvised area of offices and seed bank.
Primary production	Produces approximately 5 kg / m ² per harvest. The variety of produce is high due to the "Adopt a plot" program. Volunteers decide what to produce on plots ranging from 1 to 5 m ²	The cultivation beds have an annual production of approximately 1 ton and an "edible forest" of fruit trees produced 500 kg in 2017.
Secondary production	No secondary products are offered. Although among the users there is an exchange and sale of secondary products that they learn to produce in the urban farm.	No secondary products are offered. Although among the users there is an exchange and sale of secondary products that they learn to produce in the urban farm.
Tertiary production	There is a variety of courses and workshops. During the months of May to August 2018, approximately 700 sessions of urban agriculture, nutrition, and ecology workshops were offered, among other related topics.	More than 3800 people have had some sort of contact through courses, workshops, community events, school visits and volunteering. Courses range from \$700.00 to \$2,000.00 MXN. Events are usually free, some have costs ranging from \$80.00 to \$200.00 MXN
Destination/Target	Primary products are mainly for self-consumption although volunteers are asked to donate 10% of their production of vegetables and seeds. Courses and workshops are free and open to the general public.	The products are offered to the general public, they are also sold directly to restaurants. The courses, workshops and events are open to the general public and some have a cost that vary from \$ 150.00 to \$ 2,000.00
Collaborations	Continuous collaboration with researchers, activists and local governmental officials.	They collaborate directly with government officials, several local and international companies and universities.

As with the functional characterization, there are some minor dimensional differences between both urban farms. Although, the differences are minimal on paper, they can mean substantial differences in terms of their planning, design and policy application. For example, the destination, or final consumer for their products are different, since Huerto Tlatelolco engages local markets, while Huerto de las Niñas y los Niños does not. In operative terms, this is essential to planning because farms that sell their produce in local markets will differ in production and distribution strategies than those that only consume produce internally.

Another example that there are substantial differences that influence the operation of each farm is their location. Huerto Tlatelolco is located in very visible and accessible area while Huerto de las Niñas y los Niños is not.

This is crucial for design since a farm that is not as visible requires a design that compensates for this limitation.

3.3. Sustainable worldviews of the urban farmers

Urban farmers tend to re-evaluate the relationships between 1) the city and its inhabitants, 2) nature and 3) food production, distribution and consumption. For urban farmers, the relationship between rural/urban is challenged. Their perspectives are more in tune with ideals and objectives related to sustainability. This may seem minor, but another interesting result is that urban farmers also tend to be active in issues regarding the city. Urban farmers come from very diverse backgrounds, and tend to be vocal about their views of what the city should be. Participants range in age group and education levels, however, they all share a certain worldview that shares many points with more ecological and sustainable urban lifestyles and ideals. This is important since it leads to the idea that the urban farmer is a recent urban identity that is beginning to shape and influence urban configurations and policies. Which can be clearly seen in the politics and programs present in many cities worldwide. It is also important because the views of urban farmers challenge the idea of a modern city. The idea of producing food inside the limits of an urban settlement seems to be more congruent with postindustrial / postmodern visions of what a city is or should be. This is important from the urban design/planning perspective because, these views of the city are more often than not, incompatible with contemporary urban planning.

4. CONCLUSIONS

The Urban Farms Law of Mexico City only classifies UA projects in terms of public and private operations, however and as suggested in this research, there are other characteristics that should be taken into consideration when making policies and/or assigning budgets. Results from the characterization and interviews show that urban farms 1) exist for very different reasons, 2) have different dimensions, 3) operate under very different circumstances 4) have very different motivations and 5) provide different functions in an urban setting. Thus its dimensions and functions vary in Mexico City and its metropolitan area.

Each farm varies from city to city not only spatially and physically but socially, culturally and historically. The social, cultural and historical characteristics determine a great deal of how each urban farm is configured. For instance, many cases in southern Mexico City, such as the chinampas of Xochimilco, are still deeply influenced by prehispanic activities. This differs greatly with the urban farms mentioned in this article. Even both examples mentioned in this article are influenced by this. In spite of the fact that all urban farmers seem to share similar ideals and worldviews, their socioeconomic backgrounds, without a doubt influence each farm's design and operation.

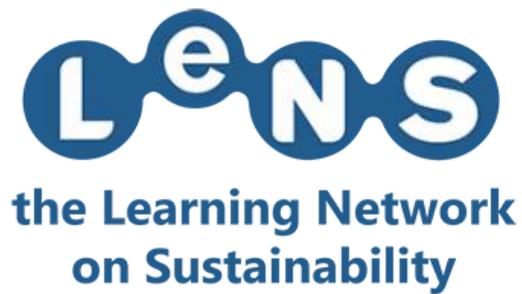
Although the cases analyzed have very little impact on food security, both have the potential to serve other important functions. These contributions are directly related to sustainability in urban settings. Urban farms such as the cases analyzed can be planned, designed and used as tools for social development in public and private settings such as public parks, private rooftops and schools. Results suggest that well planned and designed, urban farms such as these can contribute to various of the different aspects to make cities more sustainable. Many of the functions of the farms align well with many international objectives and standards regarding sustainability such as the United Nation's 2030 Agenda and the World Bank's Performance Standards. Also, a lot can be learned and leveraged from urban farms such as Huerto Tlatelolco and Huerto de las Niñas y los Niños. The worldviews of urban farmers contain ideals and visions for more sustainable cities that urban planners and designers should pay closer attention to, because they can provide important insights as to how planning and design can somehow contribute to the sustainability of communities and cities.

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THE CHALLENGES OF USING PUBLIC LAND SUSTAINABLY IN MEXICO FOR OUTDOORS RECREATION: CAN SERVICE DESIGN HELP BRIDGE THE GAP?

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ABSTRACT

Keywords:

Design, Sustainable tourism, Conservation, Public land

1. PURPOSE: THE MAIN PURPOSE OF THE PAPER SHOULD BE PRESENTED

This paper explores the case study of the Mexican Iztaccíhuatl-Popocatepetl National Park and its interactions with its visitors. The fact that there is a structural void in how the park operates creates an area of opportunity for service design strategies to be developed and implemented hand-in-hand with park users, service providers, local community members and social organizations. This paper analyses the history, causes and social and cultural implications of creating this solutions through service design in order to reconnect the population with the importance of the park, thus, fostering a more sustainable lifestyle for individual users and promoting a conservation of the park.

2. RESEARCH PROBLEM/GOALS

The research towards understanding the history and current situation of the park and its users has had the goal of visualizing what the interactions between multiple stakeholders are like and what they entail. The challenges of this research have been, among others, the remoteness of the area, the decentralization of current stakeholders and lack of accessibility to historical documents and evidence to build a record and profile of the case study. Working with plural sectors (public, private, social) has proved challenging since many of these stakeholders are adamant to work with projects that try to build new strategies towards conservation and building an outdoors community. Many of the goals, however, have been reached or are close to being reached.

3. THEORETICAL BACKGROUND AND CONTRIBUTION

The author's background, an intersection of design, entrepreneurship, project management and outdoors and wilderness training and skills, have allowed the project to grow and advance in the past 10 months. Along with these skills, the strategic partners such as NGOs, local community service providers, local historians and public sector advisors have contributed to build a panoramic view of the current situation and create a solid argument for how service design can affect positive change and foster better practices for sustainable tourism in the park.

4. RESEARCH METHODOLOGY

The methodology for the research on this topic has been a combination of field, archival and public access document retrieval. The constant contact with on-site users, providers and residents has led to many insights that highlight and strengthen the hypothesis that a service design platform can help foster sustainable tourism practices in the area. Meanwhile, the discovery and retrieval of historic material such as documents and photographs have allowed to create a structured visualization of the history of the space and its stakeholders, leading to a better understanding of the current situation of uninformed users and ill-equipped service providers.

5. RESULTS AND ANALYSIS

The results and further analysis of this research and feedback of hypothesis and proposals, through a keep it simple, make it happen design approach have allowed the author, in collaboration with his colleagues, to reach a Minimum Viable Product and prototype a digitally-based solution that adds value to both the users, service providers and the park itself by allowing a higher accessibility to information on the use and expectations a visitor to the park can have, and how this fosters conservation and sustainability through specific actions.

6. IMPACTS ON SUSTAINABILITY

The implementation of this platform will lead to a higher local economy impact by visitors to the park, better prepared users with higher awareness of the importance of the park and its ecosystem to the environment and their individual lives and health, as well as the fostering of a more inclusive outdoors community in Central Mexico, making outdoor activities more accessible for other demographics beyond the higher-class population and foreign tourists. This platform, called Tribu, is also designed to be scalable and replicable, in order to be implemented in other public lands with the same potential to be both a place of preservation and recreation, which do not need to be mutually exclusive. Thus, the impact on sustainability is potentially very high, by using service design digital solutions developed through design methods in order to foster an interaction between users and public, natural spaces.

It's a clear day in Mexico City, a metropolis of over 20 million people. From the 35th floor of the Torre Reforma Latino -one of the city's highest skyscrapers- the valley of the city seems obvious. From here the horizon is a chain of hills running from southeast clockwise to the northern tip, illuminated by the telecom towers on top of the Sierra of Guadalupe. In the distance, to the southeast, peeking through the incoming clouds the outline of the Popocatepetl and Iztaccíhuatl volcanoes peek like a postcard scene, overlooking the city.

These volcanoes are a fundamental part of the prehispanic, colonial and modern history of central Mexico.

They have influenced the weather for centuries, they divided the Great City of Tenochtitlán from the eastern establishments of Cholula, Tlaxcala and Tajín, all the way to the Gulf of Mexico. During the Spanish Conquest, Hernán Cortés and his army trekked the same path between both mountains, the same path native communities had used for centuries, but still, the current road leading to the saddle between Popo and Izta bears the Conquistador's name.

The communities around the volcano are still alive and kicking. They have a spiritual and cultural lifestyle and worldview deeply rooted in the volcanoes and its history, legends and heritage. For centuries they have fed of its soil, drank from its springs and glacier streams and protect it vehemently. Many of them are incorporated into municipalities like Amecameca, Mexico State, where the per capita GDP is \$1520.80 USD and the daily minimum wage is \$2.95 USD. ¹ Today, Doña Toñita and her husband Don José Carmen, serve tacos, quesadillas and tlacoyos to families, cyclists, bikers and other visitors that drive up the 23 kilometer road to Paso de Cortés from Amecameca, Mexico State. They have driven up to the small shack made of wood every day, of every week, 365 days a year, for 45 years. They are locals from San Pedro Nexapa, the last town on the way up to the volcanoes, serving hand-made food with local ingredients they prepare at home and reheat on the brick and steel stove top in the wooden hut off the side of the road. A visitor can expect to pay \$1 USD for a taco, quesadilla or tlacoyo, and \$.75 USD for a half-liter soda. ²

Like Doña Toñita and Don José Carmen, many of the locals from these communities make a living from selling food and services to visitors to the mountains, many others are farmers or handle cattle. Most corn farmers still use horses to plow the land and it is common to see decades-old pickup trucks -some with US license plates, brought back by returning migrants- hauling hay and harvest. In contrast, many of the visitors to the park are middle-class families from Mexico City, Cuernavaca (Morelos) and Puebla (Puebla), the biggest neighboring valleys and cities around the mountains, coming to enjoy the scenic views and food the volcanoes offer. Some others are foreign travelers or students studying abroad, hoping to catch a weekend or day trip to the lesser-known Mexican outdoor landmarks, and another group, which seems to be growing steadily, are the new wave of mountaineers looking to summit the 5230 meter-high summit of Iztaccíhuatl.

These visitors pack a plethora of gear. Boots, crampons, lightweight tents, rainproof jackets, ropes, harnesses and many other gadgets that seem to come right out from an REI or MEC catalogue. Some are descendants and pupils of the old school of Mexican mountaineering and climbing. Ever since the first -recorded- ascent of the Popocatepetl in 1519 by Diego de Ordaz, one of Hernán Cortés' men³, many people have sought to reach the top of both Popocatepetl and Iztaccíhuatl. When President Lázaro Cárdenas signed an executive order rendering the mountains a national park in 1935, many alpine clubs and independent explorers followed suit, and gave birth to a regional and national climbing community that also sought out the peaks of nearby Pico de Orizaba (Citlaltépetl), Nevado de Toluca (Xinantécatl) and Malinche (Malintzin).

THE “NATIONAL PARK”

To this day, every weekend, specially during the peaks' snowy season, thousands of people flock to the trailhead seeking the perfect Instagram shot, many unofficial and seemingly unregulated tour companies have started operating in the area offering -and sometimes guaranteeing- getting thrill-seeking visitors to the summit. The parking lot at Paso de Cortés welcomes visitors to the “Iztaccíhuatl-Popocatepetl National Park” and is at times full with buses, vans and family SUVs carrying all types of gear.

Many urban dwellers venture into the park without fully understanding its size, location, services, regulations and challenges. Some get lost on the way or endure an hours-long logistical maze of public transportation to Paso de Cortés, others opt to pay for tours offered by small companies based in the city.

The thousands of dollars people pay for these sometimes unreliable and uncertified tours², along with the individual equipment and gear that more seasoned mountaineers own and use, create a stark contrast with the lifestyle of locals further down the road. It is a very illustrative example of the contrasts and social and economic gaps that plague Mexico on many levels, here exemplified in outdoors recreation, the public lands where these activities take place and the people who live there and those who use it as a weekend attraction.

The term “national park” has different perceptions around the world. In most western countries it depicts images and memories of panoramic scenes of the outdoors, people engaging in outdoor activities, it is related to a culture's history and heritage through its geographical context and environment. In the United States for example, the term has evolved from Theodore Roosevelt's initial decrees into both a quintessential American family experience and a place for outcasts to form tribes of climbers and backpackers (as depicted in Peter Mortimer and Nick Rosen's 2014 film *Valley Uprising*) to having the National Park System partner with Accenture to design and create a better user experience for park visitors through digital strategies¹. These are examples of the evolution in the management of natural protected areas and the interaction the public has with them. The Accenture NPS case is one of many that argue in favor of education and regulation, proving that user recreation and public land conservation are not mutually exclusive. It demonstrates how designing a service is much more effective than prohibiting the use of these places for the sake of conservation.

THE CASE FOR MEXICO

Mexico has over 62 million acres of public land designated as natural reserves by the CONANP (Comisión Nacional de Áreas Naturales Protegidas “National Commission of Protected Natural Areas”). This land is divided into 9 regions and 43 subregions, of which 12 are considered National Parks. These parks, are part of the 67 national parks in Mexico. However, the CONANP catalogues them alongside other area designations such as “Sanctuaries”, “Natural Reserves”, “Natural Resource Protection Areas”, “Natural Monuments” and “Biosphere Reserves”. This adds up to a total of 182 “Natural Protected Areas”.

However, these areas, the CONANP itself and its parent federal agency; the SEMARNAT (Secretaría de Medio Ambiente y Recursos Naturales “Secretary of Environment and Natural Resources”) fail to communicate to the population what each of these titles mean, or the difference between them (Section 9 , Chapter 1, Article 46), beyond the scope of this piece of legislation. Even though the Federal Environmental Law (Ley General del Equilibrio Ecológico y la Protección al Ambiente), and its Rulebook (Reglamento de la Ley General del Equilibrio Ecológico y la Protección al Ambiente) state that there is a “Natural Protected Area System” (Title 3, Chapter 1, Article 37), and states that the “ecosystems are heritage and assets of society”, “its elements should be used in a way that ensures optimal and sustained productivity, compatible with its balance and integrity” and that “authorities and private citizens are to assume responsibility for ecological balance” (Chapter 3, Article 15), there is however, no mention as to the tools and resources to make this information accessible, nor any communication and education strategy for the general population. This leads to a lack of a real, effective national park system, and the effects of this organizational anomaly. These symptoms can be seen throughout the interaction of the Izta-Popo National Park (now Iztaccíhuatl-Popocatepetl Natural Protected Area) and its visitors/users.

A survey conducted by earlier this year to recurring visitors to the park revealed that only 12.1% of users are fully aware of the areas rules, regulations and general use information, while 17.2% said they had little-to-no information or knowledge about this information. The majority of 37.9% came in the middle (3 on a scale of 5) on how well informed they are about the ways they can use the national park, its rules and regulations.

In contrast, potential visitors who have never been to the park, where asked if they know of its existence, only 44.7% answered that they do, and 54% revealed that they have not visited the park due to lack of information.

These results might be surprising considering the historic, cultural and environmental presence of the volcanoes that make up the park, however, even if a landmark such as this exists in the collective social identity of the population, it does not necessarily mean there is an interaction happening. This begs the question, should there be an interaction? If so, how should it happen? What should it look and feel like? What should it entail?

BUILDING AN OUTDOORS COMMUNITY

The argument to be made is yes, there should be an interaction. These natural areas are not only witnesses and main characters in our history, culture and environment, but they are a window and space to be enjoyed, to be used as a therapeutic tool into the values we hold closest to our individual and collective identities and philosophies.

The contrast of having one of the world’s most populated cities less than 100 kilometers away from these thousand of acres of preserved land highlights the need for urban dwellers to reconnect with the natural environment. The activities that visitors are able to engage in within the park are not only recreational and promote health on an individual level, but also represent a strategy and resource to enlighten the public and raise awareness about the importance of preserving these spaces in a plural, collective level.

By allowing, regulating, and inviting the public to engage in these activities, a sense of belonging can be created, leading to a mindset of conservation not through prohibition or discouraging of visiting, but through relating with the space and what it represents.

In this sense, it must then be defined how this interaction should happen. What are the parameters of users visiting the park in order to exercise their right to use public land in a recreational way, while not creating a further environmental impact? Case in point: The main trekking route to the summit of Iztaccíhuatl, the Joya-Portillos route is a roughly 6.8km route starting at La Joya basecamp (accessible by car most of the year) at around 3,800 meters above sea level and finishing at the summit at 5,220 meters above sea level. This is undoubtedly one of the most challenging trails in the park, with a gain of over 1000 meters in less than 7 kilometers. This trail is also one of the most used, and is currently over capacity on most weekends.

Situations like this lead to the current challenge: How can we reach a balanced and sustainable UX model for the park where accessibility, belonging through being [in the park] and conservation coexist to foster an outdoor culture?

Enter service design. By using hybrid design and business development methodologies, a digital platform called Tribu is designed and developed. Tribu is the result of 9 months of research in the field at the National Park, as well as interviews with a number of stakeholders: Current park administrators, the former park director, different park users (hikers, trailrunners, climbers), rescue workers and outdoor journalists. Through mapping the stakeholders needs, activities and impacts and cross-referencing that data with the historical research and conservation needs, as well as benchmark projects and policies, the blueprint for Tribu was sketched.

Tribu was ideated as an information platform that could transform organically into a product-service system.

The requirements were set up in the following way:

- Inform potential users of the existence, history and available activities in the park.
- Inform current and potential users of the best practices to follow during their interaction with the area on both safety and conservation levels.
- Create a catalogue of designated trails for different users (hiking, running, cycling, motorized off-road vehicles) in order to avoid erosion of off-trail areas and user overlap that could lead to accidents and confrontations.
- Create a catalogue of locally-owned and operated hospitality services such as food stands, restaurants, lodging and other sports and activities to boost the local tourism industry and economy.
- Quick links to emergency services contacts (park rangers, rescue groups)

Following these objectives, the second part of the field research was launched. This entailed constant visits to the park, geo-mapping and tracking trails, talking with local vendors through community outreach techniques and learning what their business and service needs were, how they operate and how they can improve said operations.

Afterward, with this data, the decision had to be made of what the best initial platform or Minimum Viable Product would be. The ambitiousness and volume of the project, along with its potential add-ons and expansions kept growing. It was determined that the first, easiest and most organic step would be to create a simple yet intuitive and aesthetically attractive website to concentrate the first batch of data and make it available to the public.

Through the following 2 months, the interface design was sketched, tested and modified to have a cohesive brand identity, intuitive layout and modular design in order to expand content in the future. This involved a cross-disciplinary work with remote teams (Mexico City, Toluca, Mexico and San Antonio, Texas) among industrial designers (the author and co-developer of the project), graphic designer Aldo Barradas (consulting on the project) and programmer Arianna Haradon. A second part of the pilot was the design and fabrication of small memorabilia products to create simple line of merchandise, again using local designers and fabricators to sell them at different local vendor points within the park. These products consist of:

3 models of textile toys depicting park wildlife, offered in two different sizes. These products resulted from the collaboration

MVP Result and Potential Impact

The result of this research, data and design has been uploaded to the website www.tribuoutdoors.mx. The site is still in construction, as funds for the content creation and programming are limited, however, the plan to continue to curate and upload content is underway and gaining traction with users and potential collaborators. By continuing this project, the potential of reaching new and existing users can grow at a steady rate through content creation and event organization with local stakeholders (trail cleaning, workshops and courses hosted by local service providers).

The potential impact of Tribu can be defined on three levels:

Environmental Conservation:

Through the education of current and potential users we can foster better practices and responsible use of the park, such as trail maintenance, zero-waste interactions and leave-no-trace habits. This can be managed through constant information output on both social media and in-real-life events in the park. Educated users equal park preservation.

Social Engagement and Community Strengthening:

By giving current and potential park visitors an information bank and channel through which to learn, prepare and raise awareness of the park and its heritage, Tribu can become a tool to strengthen community bonds and social fabric. Through transparent, trust-based interactions, the antagonism of urban dwellers visiting the park with the local population skepticism of outsiders can be minimized and ideally eradicated.

LOCAL ECONOMIC BOOST

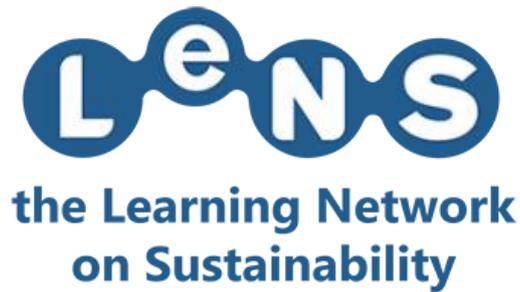
These interactions do not only support the strengthening of the social fabric, but also boost the local economy by fostering the consumption of local goods. Food (prepared on the spot by local families and vendors), drinks, guide services, lodging, fishing and transportation within the park are part of the offer the local economic stakeholders can provide by the creation of a services and products catalogue within the Tribu platform. This creates an influx of cash while exercising an environmentally sustainable business practice. Instead of selling plastic toys, the local trade can be based on services and food, creating a renewable source of income.

Service design and social innovation methodologies have guided this process. The team behind Tribu as well as the local allies created, are still tackling the challenges of funding, logistics and content creation in order to scale, replicate and make Tribu a self-sustainable platform. The potential to scale the platform to other parks and delve deeper into more services and applications (both physical and digital) exists very clearly, since the research and objectives are also based on the SEMARNAT Natural Protected Area Plan. Both this paper and Tribu are a small but clear example of the benefits that can arise from using research, engaging stakeholders and implementing social innovation and sustainability-oriented methodologies in order to create a better interaction between users, public land and the local population, thus creating awareness about the environment and generating a healthy outdoors culture

and community.

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INTERCITY RELATIONSHIPS WITHIN URBAN AGGLOMERATION AND THEIR IMPACTS ON URBAN ECONOMIC DEVELOPMENT IN THE CASE OF GUANGDONG-HONG KONG-MACAU GREATER BAY AREA, CHINA

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ABSTRACT

Urban agglomerations play an increasingly significant role in the process of regional and national participation in international labour division and competition. how to understand cities' positions within urban agglomeration, and how to promote economic development through complementarity-ness is a significant or worthwhile research subject. This thesis took 11 cities from Guangdong-Hong Kong-Macau Greater Bay Area, one of the most developed urban agglomerations in China as a case to clarify the characteristics of urban relationships and their impacts on urban economic development. First, it measured and analysed the influencing paths of intercity relationships on urban economic which were based on urban aggregation and diffusion effects, urban economic network and industrial division of labour. Second, it judged intercity relationship as either competition or complementarity according to the quantitative outcomes of the relationships of three industrial sectors. Finally, this thesis tested and evaluated the impacts of intercity competition on urban economic development.

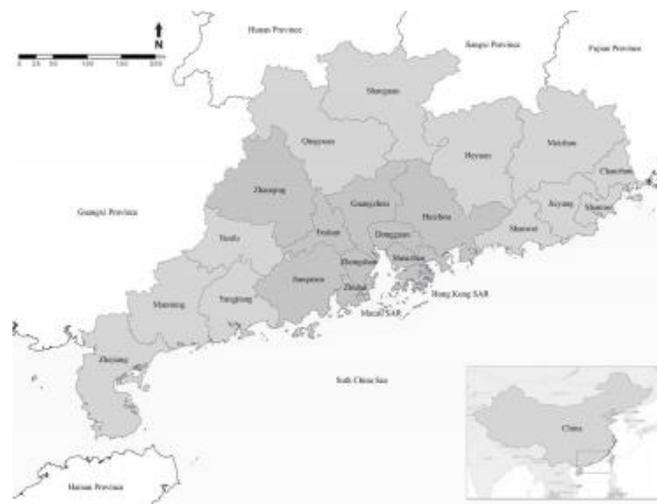
Key Words: Urban agglomeration, competition, complementarity, urban economic development

1. INTRODUCTION

1.1 Background

Urban agglomeration is the results of flows of production factors and industrial division of labours among cities within a specific geographic area (Sevtsuk and Mekonnen, 2012). In the context of economic globalization and regional integration, urban agglomerations have become an important spatial unit that representing a country's participation in international competition and complementarity (Alderson and Beckfield, 2004). The development of urban agglomerations is conducive to the optimal allocation of resources within the region (Meijers, 2005). However, cities mostly ignore the interests of the other cities to attract capital, business, talent and investment, thus promoting their own economic development. This often leads to regional problems such as industry contradiction, function duplication, and uneven development levels among cities (Goetz and Kayser, 1993). Therefore, how to recognize cities' position within the urban agglomeration, and how to promote economic development through complementarity is a significant research subject.

Eleven cities from Guangdong-Hong Kong-Greater Bay Area (see Figure 1), one of the most developed urban agglomerations in China, are the study samples of this research. These eleven cities show a clear hierarchy in terms of political position, economic development level, comparative advantages and industrial characteristics (Zhang, Lin, et al., 2017). Since 1980s, based on their own comparative advantages, a strong network of competition and complementarity has formed among these cities (Sit, 1998). However, in the meanwhile, several factors have also led to fierce disorder competition and unscientific complementary behaviours among these cities (Yang, 2006). First, due to Hong Kong, Macau, and mainland cities from PRD enjoy three different administrative systems, currency systems and economic systems, the complementary obstacles between these three regions always exist. Second, due to the lack of scientific regional development guidance, cities tend to develop the similar high-valued industries, even in the case they do not have the comparative advantages (Zhang and Kloosterman, 2016). This leads to geographic



niche overlaps and functional niche overlaps among cities.

[Figure 1] Location of Guangdong-Hong Kong-Macau Greater Bay

1.2 Research question and objectives

This thesis takes GBA as a case to analyse intercity relationships among cities, as well as measure the impacts of intercity competition and complementarity on urban economic development. The specific objectives were:

- a). To analyse the influence paths of intercity relationships on urban economic development from three perspectives: spatial economic distribution, urban economic network, and industrial division of labour.
- b). To measure to what extent which city compete or complement with each other in terms of three sectors of industries.
- c). To examine and evaluate the impacts of intercity competition and complementarity on urban economic development.
- d). To propose policy recommendations on dealing with intercity relationships for policy-makers.
- e). Based on the research objects, the main research question is:
- f). What are the characteristics of intercity relationships among cities within urban agglomeration and their impacts on urban economic development in the case of Guangdong-Hong Kong-Macau Greater Bay?
- g). It includes three sub-research questions:
- h). What are the influencing paths of intercity relationships on urban economics in cities within GBA?
- i). To what extent do cities compete or complement with each other in terms of different industrial sectors

within GBA?

- j). What are the impacts between intercity competition/complementary relationships and urban economic development within GBA?

1.3 Research significance

This thesis contributes to academic research and policy recommendations to GBA as well as the other urban agglomerations. As for scientific significance, it researches intercity geo-economic relationships, thus contributing to theoretical development in economic geography. In focusing on urban agglomerations that play increasingly significant role in promoting national and regional economic development as well as competitiveness, this study offers new insights to measure the extent of intercity competition and complementarity. As for policy relevance, the evaluation of geo-economic relationships, which may have influencing effects on urban economic development, contributes necessary ingredients needed for appropriate economic strategies.

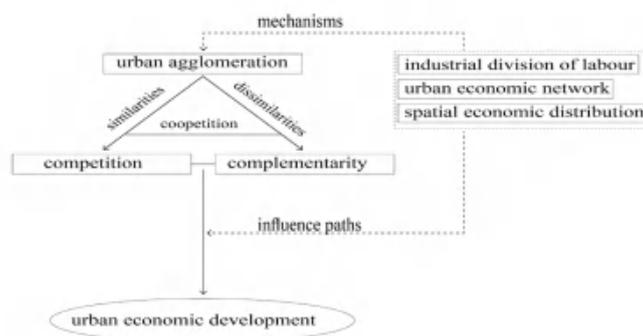
2. RESEARCH GAPS AND CONCEPTUAL FRAMEWORK

The research gaps on impacts of intercity relationships on urban economic development are as following:

First, a great deal of empirical research have been done from the perspectives of intercity economic relations and the functional division of labour within the urban agglomeration(Frenken and Boschma, 2007). However, the existing research is limited and few are on judgment criteria of intercity relations(Wheeler and Beatley, 2014).

Second, many factors affect urban economic development(Van der Ploeg and Poelhekke, 2008). Except for factors such as capital, technology, the development of surrounding cities, especially those within the same urban agglomeration, also makes a significant impact. However, only a few literatures reviewed concerned the impacts of the surrounding cities on the development of itself(Wall, Burger, et al., 2011). Also, most of the studies on intercity competition and complementary relationships have applied qualitative methods. Quantitative research is limited.

Third, the generation of intercity relationships and their impact on urban economic development requires paths, but there have been few relevant researches focusing on these important paths(Wall and Stavropoulos, 2016). These research gap appeal for the need to establish a new theoretical framework to understand the impacts of inter-



city relationships on urban economic development and more explanations on the influencing paths.

[Figure 2] Conceptual Framework

As was illustrated in the conceptual framework (see Figure 2), regional industrial labour division, urban economic network, and the aggregation and diffusion effects of core cities would contribute to the emergence of urban agglomeration. The similarities between cities would lead to the emergence of competitive relationships, while the dissimilarity between cities would cause the emergence of complementarity relationship, which was defined as 'cooperation'. The impacts of intercity relationship on urban economic development need certain paths. After reviewing the literature, this thesis believed that three factors, which promoted the formation of intercity relationships among cities, were also the influence paths for the impact of intercity relationships on urban economic development. After this, based on the quality of urban economic development, the impact of intercity competition and complementarity on urban economic development was assessed.

Based on the conceptual framework, this thesis was implemented in three analytical steps: Part A focused on quantitative measurements of intercity competition and complementarity relationship among cities; Part B focused on quantitative analysis and qualitative description of the influencing paths and mechanisms of intercity on urban economic development; and Part C focused on verification of whether intercity competition make influence on urban economic development.

3. RESEARCH METHODS

The dependent variable in this research is the level of urban economic development, which is represented by PGDP of each city. Different independent variables are used to proxy the levels of intercity competition and complementary relationships, respectively. For inter-city competition, the percentage of FDI to GDP is used as an independent

variable. The percentage of cargo volume in GDP is used to proxy inter-city complementarity. Beyond these two variables being used to proxy intercity competition and complementary relationships, thus considered as influencing factors on urban economic development, several other variables (unemployment rate, urbanization rate, and Engel coefficient) were used as control variables. In addition, in order to clarify the influencing paths of intercity relationships on urban economic development, economic spatial distribution, industrial location division of labour, and urban network were analysed.

[Table 1] Operationalization of sub-questions

Specific research question	Concepts	Variables	Indicators	Data collection methods and sources	Data analysis methods
What are the influencing paths of intercity relationships on urban economic development in cities within GBA?	Industrial location division of labour	Industrial structure similarities	Industrial relational degree of three sectors of eleven cities, GBA and China (%)	Secondary data including gross domestic product of three sectors of industries of 11 cities, GBA and China from 2010 to 2015: -Yearbooks of 11 cities - Statistical beaus websites	Location-entropy grey relational analysis at MathCad
	City economic network	The attractiveness between cities, centralities	The degree of attractiveness of two cities (number), city centralities (number)	Secondary data including total population of 11 cities, highway distance between each two cities: -Yearbooks of 11 cities -Google Map	Urban gravity model at MathCad and Ucient
	Economic aggregation and diffusion	Economic spatial distribution	Global Moran' I (number) Local Moran' I (number)	Secondary data including PGDP of 130 districts in eleven cities: - Yearbooks of 11 cities	Global Moran's I, Abselin Local Moran's I at ArcGIS and Geoda
To what extent do cities compete or complement with each other in terms of three sectors of industries within GBA?	Regional competition network Regional complementary network	Percentage of GDP of three sectoral industries in GDP	Degree of intercity competition in three industrial sectors Degree of intercity complementarity in three industrial sectors	Secondary data including add values of three sectors of industries in eleven cities from 2000 to 2016: -Yearbooks of 11 cities - Statistical beaus website	Dendrinos-Sonis model and SUR estimation at excel and Stata

What is the relation between intercity competition/complementary relationships and urban economic development?	Urban economic development	The levels of urban economic development	Total value of gross domestic production per capita (number)	Secondary data including PGDP of 11 cities from 2010 to 2015: - Yearbooks of 11 cities	Panel regression models at Stata (Spatial Durbin Model)
	Competition	External investments	Percentage of FDI to GDP (%)	Secondary data including the amount of FDI and DI of eleven cities from 2010 to 2015: - Yearbooks of 11 cities - World Bank Database	
	Complementary	Cargo capacity	-Percentage of Cargo volume in GDP (%)	Secondary data including the amount of total cargo volume of eleven cities from 2010 to 2015: Website of Ministry of Transportation of China	
	Labour source	Labour source	Employment rate (%)	Secondary data of the number of employers of eleven cities, total population from 2010 to 2015: - Yearbooks of 11 cities	
	Urbanization rate	Urbanization rate	The percentage of non-agricultural population to total population (%)	Secondary data of the amount of non-agricultural population, total population from 2010 to 2015: - Yearbooks of 11 cities	
	Engel coefficient	Engel coefficient	The percentage of food expenditures to total consumer spending (%)	Secondary data of the amount of food expenditures from 2010 to 2015: - Yearbooks of 11 cities	

4. RESEARCH FINDINGS

Synthesizing all the analysis mentioned, the answer to the three sub research questions could be summarized as follows:

4.1 Economic spatial distribution

Based on the research results of economic spatial distribution, we can conclude that the economic spatial pattern within GBA shows a concentrated state. The Global Moran's I index rose from 0.176142 in 2005 to 0.278832 in 2015. However, in the meanwhile, the outcomes of Local Moran's I indicates that the imbalance of economic development within GBA is obvious. It can be seen from the Lisa maps that the economically developed regions are concentrated around the estuary of the Pearl River, although it shows a tendency to expand to the surrounding areas. Economically less developed areas gather in the northern and eastern parts of GBA. This also indicates that the aggregation effect of the core cities is stronger than the diffusion effect.

4.2 Urban economic network

Based on the research results on the urban economic network conducted by social network analysis method, we can draw that the economic spatial structure of GBA has gradually changed from a hierarchical structure to a multi-polar centre network. To be specific, the core cities of GBA have changed from Hong Kong and Macau to Hong Kong, Guangzhou, Shenzhen and Macau. All the numerical values of economic linkages between each two cities calculated by urban gravity model are increasing yearly. This indicates that the cooperative relationship among cities is constantly improving, and the urban economic linkages tend to be spatially balanced. In the meanwhile, the calculating results on network centrality show that network centralization trend has slightly declined from 19.65% in 2005 to 17.95% in 2015. it indicates that although the core cities' superior positions within GBA are still obvious, the other cities also play constantly more significant roles within the urban network. However, the results of cohesive subgroup analysis show that the urban economic network still relies too much on the diffusion effects and the betweenness functions of the core cities.

4.3 Industrial division of labour

The calculation of industrial location quotient indicates that retails, accommodation and food service, and financial industry occupied the largest economic share in GBA, while agriculture and construction accounted for the lowest. The outcomes of the grey correlation degree of each city shows that Guangzhou, Shenzhen and Dongguan enjoy a

more competition relationship with other cities, which is caused by their large economic scale. The grey correlation degree of each industry shows that cities show a great competition relationship with each other in terms of real estate, construction, and transportation/storage.

4.4 Intercity quantitative competition and complementary relationships

Intercity relationship is defined as being either competition or complementary. Combined with D-S model, by using SUR method and taking Guangzhou as the reference city, this thesis measures the competition or complementary relationships of three sectors of industries among cities. Based on the outcomes of intercity industrial relationships, conclusions on intercity relationships can be drawn:

Cities with similar industrial comparative advantages are more likely to have a competition relationship, while cities enjoy a 'supplement-demands' relationships tend to complement with each other. In terms of primary industry, the main agricultural product export cities, Zhaoqing, Jiangmen and Huizhou compete with each other. In the same time, they enjoy a complementary relationship with agricultural product import cities, such as Guangzhou and Shenzhen. Cities with more developed secondary industry, Dongguan, Foshan and Zhongshan, show more complementary relationships with other cities. When these cities develop their own secondary industry, they also drive the development of secondary industry of the surrounding cities. When it comes to the tertiary industry, cities show a fierce competition relationship. In recent years, each city has implemented industrial upgrading policies and focuses on developing tertiary industry. It results in industrial homogeneity among cities. Overall, the division of labour in primary industry and secondary industry among cities is clear, while the contradiction of the division of labour in tertiary industry exists obviously.

When it comes to the core cities in GBA, Guangzhou shows a strong diffusion effect on the other cities, while Shenzhen does not. It can be seen from the results that there are industrial synergies between Guangzhou and most other cities. But Shenzhen only shows a complementary relationship with other cities in terms of secondary industry. Especially when it comes to the tertiary industry, Shenzhen shows competition relationship with all the other cities except for Hong Kong. Strengthening the aggregative effects of the core cities plays a significant role in the development of urban agglomeration. But excessive unequal policy support which neglects the development of the other regions will perform a negative impact on the urban cluster in the long term. The complementary relationships between Hong Kong/Macau and the mainland cities in PRD is weak. Due to the political and economic institutional reasons, these three independent market systems differ from each other in terms of economic, administrative, fiscal and currency systems. As two relatively independent economies, the complementary relationship between Hong Kong/Macau and the other nine mainland cities from PRD is much weaker than that between cities from PRD and other mainland cities. Although various policies have been proposed in promoting collaboration between Hong Kong/Macau and PRD, rigid institutional constraints and administrative differences are still the major obstacles to the cooperation bottlenecks and the slow progress of cooperation policies.

4.5 Impacts of intercity relationships on urban economic development

Based on the OLS regression results of econometric quantitative model for intercity competition and intercity complementarity, we can conclude that to an extent, intercity competition relationship has a positive effect on local urban economic development. However, the spill-over effect on the economic development of the other cities is negative. That is, excessive intercity competition will limit the economic development of other cities. In the meanwhile, intercity complementary relationship has a positive effect on both the local economic development and the economic development of other cities. The spill-over effect on the other cities is positive. In addition, residents' consumption level, urbanization level and employment rates will also affect urban economic development to varying degrees.

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URBAN-RURAL NETWORK TOOL FOR DESIGNING SYSTEMS THAT SUCCESSFULLY INTEGRATE COMPANIES AND COMMUNITIES TOWARDS SUSTAINABILITY AND RESILIENCE

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ABSTRACT

Based on the current state of affairs in relation to climate change and other environmental threats, it is now clear that our social, economic, and environmental systems are not prepared to respond effectively to these ever-increasing changes. One main reason for this, is that these systems often operate whether in centralized, or fragmented ways, failing to integrate urban and rural populations and their activities, leveraging on each other strengths in face of these issues. In response to this, the Urban-Rural Network Tool was designed and implemented in Lima-Peru. The results obtained from such experience, suggest that urban-rural networked systems, which are multi-layer, and risk-preventive, present favorable conditions for resilience and long-term scalable sustainability.

Key Words: Systems Design Tool, Sustainability and Resilience, Urban-Rural, Companies and Communities

1. INTRODUCTION

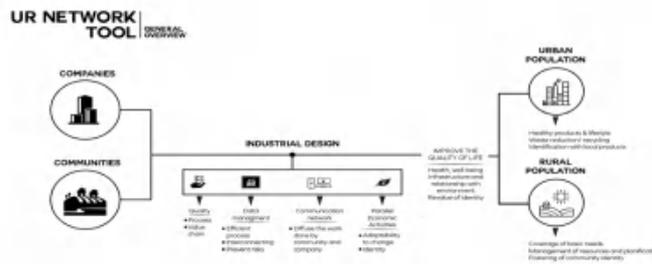
In Peru, the sudden change in sea currents and the raise of its temperature, a phenomenon known as El Niño, causes torrential rains followed by landslides, floods, the spread of plagues, and the loss of lives. All of this is caused by a semi-seasonal change of weather. However, the country's systems are not prepared for this, from housing to the effectiveness of government action. In the rural area, the price of several foods considerably rises as farmers lose their lands, and entire rural communities are even displaced. In the city, businesses in the short term are affected by the rising cost of primary goods. Over time, be it because of trend or true change of conscience, consumers are increasingly concerned about the origin of their products and their impact over local producers and the environment. As new small businesses are formed to satisfy this demand, old established companies are constantly searching for ways into this emerging market. Although it is not easy to develop a successful business model that articulates lasting relationships between companies and rural communities. Currently there are companies that are interested in investing, or that already have relationships with communities, but usually it is from an external, superficial approach, one-sided relationships, mainly for economic incentives (tax deductions) and social advertisement.

It is now clear the great vulnerability of our current system. The lack of a proper organization leaves the already fragile rural communities in a more vulnerable condition, and businesses with no clear incentives for cooperation. At the advent of climate change, this scenario could evolve into even greater consequences. Because of this, the creation of a methodological and conceptual tool for the design and development of a system that integrates companies and communities was argued as a possible solution for overcoming such issues. If an urban-rural enterprise is to be successful and sustainable it is necessary for the community and the company to be equally involved. This means establishing mutually beneficial goals and working together towards them. Also, the creation of a mutually supporting infrastructure will be crucial for adapting to ever-more challenging scenarios due to climate change, especially in the context of rural settings.

2. URBAN-RURAL NETWORK TOOL

The design of this methodological tool is based on the combined knowledge from the fields of Industrial Design and STS (Science, Technology and Society Studies). From Design, a Human Centered Design conceptual approach was employed, with the Double Diamond Methodology (British Design Council, 2005) as the basic structure for its development. Additionally, from STS, Susan Leigh Star's (1999) concept of *Infrastructure* was employed, which consists of a broader understanding of the term, encompassing not only material and technical aspects of it, but also its sociological and cultural implications and ways of manifestation. Taking from this premise we defined Infrastructure within Systems Design as a fundamentally relational element which provides support within a system, whose materiality exists in relation to the products and services organized in it by the actors involved. This definition opens a whole range of possibilities for the Design field. By conceiving infrastructure itself as an object of design (i.e. an element meant to be designed), similar to the treatment currently given to products and services. Infrastructure then, becomes a third main element to be designed within Systems Design, being the one that articulates products and services within a system, holding them together, as well as allowing for their smooth functioning.

Finally, going one step further, by employing Bruno Latour's concept of "Amodernity" used in Actor-Network Theory (1993), could be seen that, beyond the socio-technical quality of infrastructure as explained by Leigh Star, lies as well a socio-natural condition. From this lens, we could acknowledge its implications over people as well as, (simultaneously) over nature, and the environment. Thus, infrastructure in design could be approached as well as an active element within the system, causing real impact over people and the environment. Under this methodological and conceptual framework, the Urban-Rural Network Tool was developed as a means to tackle large scale organizational issues, social concerns, and environmental threats. As such, the tool structure involves four opportunity areas:



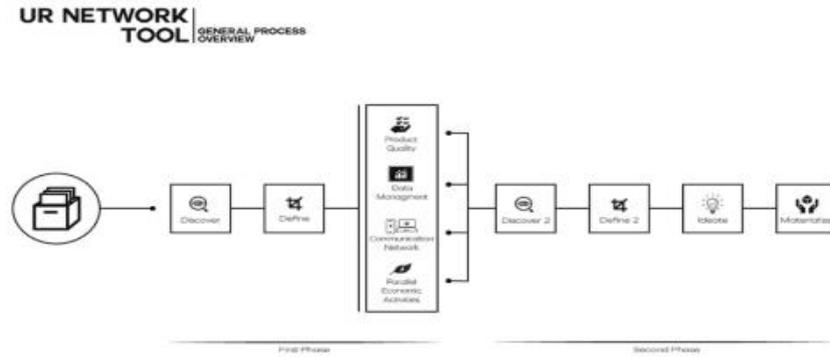
Product Quality, Data Management, Communication Network, and Parallel Economic Activities (see Figure 1).

[Figure 1] General Overview Graph

The general process is made up of two major phases (see Figure 2):

- The first phase is a general review and analysis of the company, the business model, the community and their relationship. It starts with discovering all main issues affecting the system within the four opportunity areas, and then, organize, and synthesize that data to generate a brief for each of these areas.
- In the second phase we expand our understanding of these areas, deepen into the previously identified major

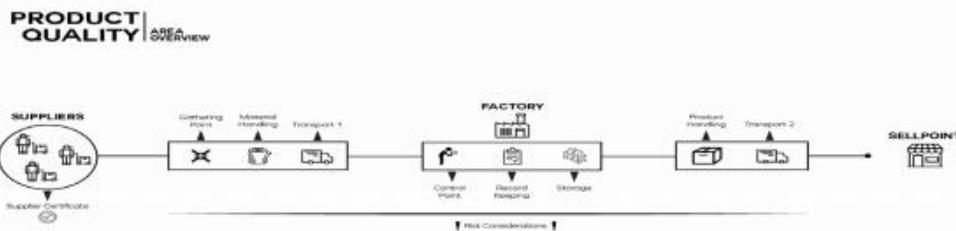
issues, generate possible ideas for solution, test and improve them, while progressively implementing them into the real context.



[Figure 2] General Process Graph

2.1. Product Quality

The goal of this area is to ensure that the product quality is up to the regulatory and business standards and meets/exceeds the consumer’s expectations. In order to understand the scope and makeup of the area we have to look at the value chain of the business model. Product Quality starts even before the suppliers deliver the goods to the company. At this stage, suppliers should meet as well sustainable standards of quality and production, such as organic procedures, low-emission, zero-waste, and others. Since the supplier of the primary good is the rural community, the company has to work with them to achieve this goal. Then, to mobilize the raw materials to the factory/company, factors like gathering points, transportation networks and material handling should be considered. Inside the factory, besides the transformative operations of the raw material, also appear control points, record keeping and storage. Finally, in the distribution stage, distribution channels and product handling as well as final sell points should be

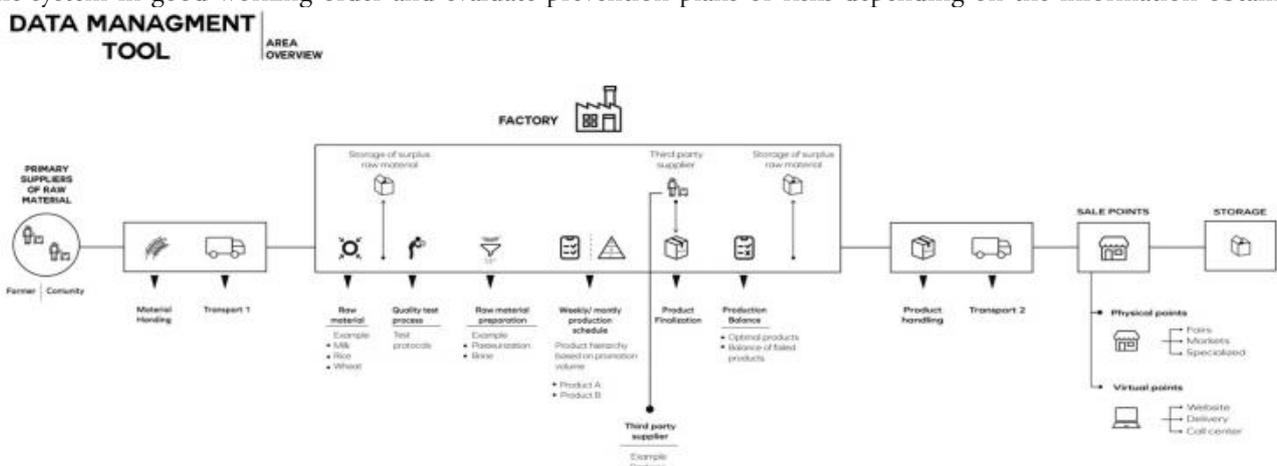


defined (see Figure 3).

[Figure 3] Product Quality Area Overview Graph

2.2. Data Management

The aim of this area is to structure the company’s processes to improve the flow of information flow between the internal and external areas. This structure will allow, in case of vulnerable situations (e.g. a natural disaster), to keep the system in good working order and evaluate prevention plans or risks depending on the information obtained



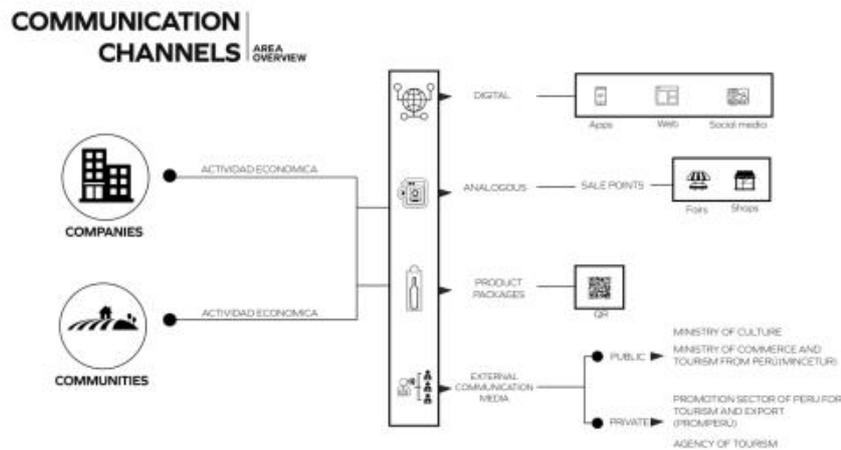
from the system itself (see Figure 4).

[Figure 4] Data Management Area Overview Graph

2.3. Communication Network

The goal of this area is to generate a brand identity that supports the company and the rural community, which could be used as broadcast channel for requesting aid from urban populations (mainly the company’s consumers) in the event of a natural disaster affecting the system. It is important to understand that the broadcast channels are

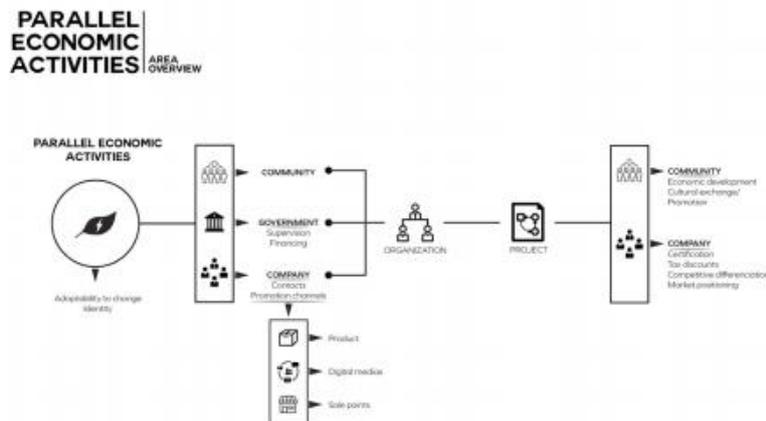
a fundamental part of the tool because they materialize the means by which the company is able to promote, maintain, and develop the collaborative projects with the rural community while making their collaboration visible to mass urban consumers. The products and services generated by the company and the rural community are promoted in such a way that the consumers can easily understand the whole production process, valuing the work of the local producers and the support given to them by the company. Such communication network generates added value and market differentiation to the company, and, in the event of a natural disaster affecting the rural localities, people in urban areas can be quickly informed, allowing the support to arrive on time (see Figure 5).



[Figure 5] Communication Network Area Overview Graph

2.4. Parallel Economic Activities

The goal of this area is to develop or redefine the infrastructure of an economic activity parallel to the main one already performed between the company and the rural community. This activity would be aimed towards supporting other systems like health or education for the rural community. This area contemplates the three entities that will be involved in all the process: the community who will be the principal beneficiary; the company who supports the proposal through subsidizing, motivating, promoting the results; and the government or consultancy who will be in charge of supervision. As this new economic activity rises, it is necessary to create a specific organization responsible for the administration, logistics and other activities that will be important to ensure the continuity of the project. As a result, the new parallel economic activity will benefit the community and company at individual and collective scales (see Figure 6).



[Figure 6] Parallel Economic Activities Area Overview Graph

3. VALIDATION

The Urban-Rural Network Tool was used to develop an integrated system for a dairy products company based in rural Lima called “Vacas Felices” which sells its processed products through different sell points throughout the Lima Metropolitan Area. This company has as milk providers families of farmers from the neighboring localities. The project development and main implementation lasted the entire 2017, while in 2018, periodical follow ups were made to keep track of their developments. Results show remarkably positive responses from both the rural community and the company, translated into direct benefits for the rural environment, the improvement of more sustainable behaviors and the creation of consciousness within consumers in urban Lima. Improvements in each of the four areas, allowed for 1) more competitive products increasing sells while reducing environmental impact, 2) significant improvement of trust relationships between farmers and the company thanks to more transparent and or-

ganized procedures and data management, 3) consumers in urban areas much better informed about the company's activities in collaboration with the local farmers, as well as an increment on the amount of people adopting more sustainable lifestyles through the company's promotional campaigns, and finally, 4) the creation of a new economic activity for the community, framed as "Experiential Organic Tourism" for people living in urban Lima to be able to visit the community for some days and experience an organic way of living, which, besides generating an additional source of income for the community and added value to the image of the company, also influences the young locals by making them more aware of the value their community has, which increases the possibility for them of staying and continuing with its development, ensuring its long-term sustainability.

4. DISCUSSION

From this initial experience, it could be proved that, in order to be truly effective in a long-term view, the system cannot be at odds with the environment and the context in which it exists. The tool focuses on this by contemplating multiple contextual factors such as the creation of sustainable processes inside the company (organic procedures, waste management, fewer emissions), the preservation of the rural communities' natural environment, the improvement of the relationships between the parties based on their installed practices, the promotion of a sustainable culture and lifestyle among consumers, and the redefinition of a business model which now works as a network, enabling and articulating additional economic activities based on the principles of circular and distributed economy. These factors were deemed as critical in that they collectively ensure the longevity of the community-company relationship, minimize its impact on the environment, and promote a sustainable lifestyle on the general public. Looking towards the following steps, at a larger global scale, this tool is initially framed as an academic resource for other design schools and organizations within the LeNS network, to be used by them in order to improve their own contexts and share the results with the network. The Urban-Rural Network Tool is meant to be used and replicated in any context with a similar setting where companies and rural communities are working or could work together, its final goal is to foment good practices and, by doing so, create economic stability and sustainability, even in adverse conditions. Finally, in a long-term perspective, the impact of the tool is expected to increase progressively as the model is applied and replicated in more contexts worldwide, gradually changing current practices towards more sustainable ones.

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SOCIAL INEQUITY IN PUBLIC TRANSPORT INFRASTRUCTURE & ITS IMPACT ON A CITY'S SUSTAINABILITY

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ABSTRACT

Popular narratives on sustainable development of transport infrastructure focus predominantly on how successfully designed transit stops are an important tool to improve social inclusion and urban mobility. This approach to sustainable development treats social inclusion as a consequence of sustainable development and looks at social inclusion as a rights issue, where everyone irrespective of gender, age, disability etc. has a right to public transport facilities. This paper proposes an alternative way of understanding social inclusion with respect to sustainability. Rather than treating inclusion as a consequence of sustainable development, it seeks to position inclusive approaches in spatial design as pathways and enablers of more sustainable cities in the global south. This approach also presents social inclusion as an opportunity-provider for sustainability as opposed to popular narratives that present it as an opportunity created by sustainable development.

Through the context of the Mass Rapid Transport System (MRTS) stations in Chennai, the paper shall address this method in two parts -

1) Through existing narratives of social exclusion while navigating through a Chennai MRTS station - The space is dissected and examined to elucidate its contribution to social exclusion of people with different identities, in its socio-economic and political context. The resultant exclusion discourages them from using particular modes of public transport.

2) Establishing connections between the discussed social exclusion and overall usage of public transport in a city. This is followed by a brief discussion on how eliminating this exclusion can lead to increased sustainability.

1. INTRODUCTION

The United Nations development program has identified “Gender Equality” as a Sustainable Development Goal (SDG). The text on the United Nations Development Program website addresses this Goal in two ways (“Goal 5: Gender equality | UNDP”, 2019): -

- 1). It recognizes the potential of gender equality as an accelerant for sustainable development by stating that “It has been proven time and again that empowering women and girls has a multiplier effect, and helps drive economic growth and development.” This approach places social inclusion & gender equality as a cause for sustainable development.
- 2). It also recognizes gender equality as a rights issue and aims to ensure that there is an end to discrimination against women and girls everywhere as a consequence of sustainable development. Sexual violence and exploitation, the unequal division of unpaid care and domestic work, and discrimination in public office, all remain huge barriers. This approach places social inclusion & gender equality as a consequence sustainable development.

Despite both approaches described as methods to achieve the SDG, popular narratives on sustainable development focus predominantly on the latter method.

The UN environment program blog narrates the story of a young mother from an economically underprivileged household who has to traverse the horrors of threat of sexual harassment, fear (and possibilities) of abduction and long painful walks in the sun on a regular basis. She has to go through this mentally and physically gruelling journey almost every day in order to access the public transport facilities from the stop nearest to her home, to commute to and back from her place of work. (“Driving Gender in India’s Public Transport Policy”, 2019) My masters’ design thesis (submitted to University of Sheffield, Oct 2017) followed similar narratives of young women, street vendors, older people who had difficulties walking etc. to elucidate the exclusion they were subject to, in and around a public local train station in Kasturba Nagar, Chennai.

The MRTS or the Mass Rapid Transport System in Chennai was started as an ambitious project about 20 years ago. (Prabhakar, 2019) While the train lines are still up and running from day to day, only 25% of the projected number of people use them. Due to large initial investment of capital, lack of good design and minimal maintenance efforts, they have turned into vast vacant spaces that exclude a large portion of the society due to their lack of facilities for the disabled, unhygienic public toilet facilities and lack of safety for women after dark. (“Chennai Mass Rapid Transit System”, 2019)

2. SPATIAL EXCLUSION & DESIGN IN THE MRTS

As Henri Lefebvre points out in his seminal work “Right to the City”, an individual’s right to the city includes the rights of ages and sexes, rights of conditions, right to work, to culture, to rest, to health, to housing etc. (Lefebvre, Kofman and Lebas, 1996). Spatial exclusion can be defined as a violation of these rights. In order to understand the various degrees of exclusion, it’s important to acknowledge the fact that exclusion is not binary (e.g. restricted access, fear created by space/society etc. despite being allowed physical access to space) and varies from person to person based on their identity. (Soja, 2014)

Method Employed – Narratives (constructed by assimilating outcomes of various methods of observation)

The method employed to explore and understand exclusion in the MRTS station and the gradation of oppression through space and time was constructing narratives - narratives of imaginary individuals (based on real people) who traverse the space and to understand their resultant experience. As a result, not one but many subjective positions and kinds of experience were generated and understood. As journeys in space had to be understood with and within timeframes, the element of temporality got added to the analysis.

Fear Created in/By Space as Exclusion

In “Discrimination By Design”, Leslie Weisman elaborates on “The Spatial Caste System” i.e. how space and society (physical and metaphysical space) create a dichotomization of space which makes one group of people more powerful than another in it. (Weisman, 1994) She also writes in detail on the cognitive impact on spatial perception in women due to fear of sexual harassment. Fear of personal safety can hinder day to day activities and an individual’s ability to live peacefully in society. (Minton, 2009) Therefore, by our very definition and understanding of it, fear plays an important role in creating the feeling exclusion. As Leslie Weisman writes, “If the fear of sexual harassment on the street causes women stress, the fear of rape keeps women off streets at night, away from public parks and dangerous parts of town, and unconsciously afraid of half the human race.” (Weisman, 1994)

The MRTS station studied, due to its opaque walls and lack of sufficient lighting, has become a space that inspires fear in women at night. During the night, the design of the station creates dark pockets of spaces within it making it conducive to criminal activities like sexual harassment. (figure 1) Also, there is a lack of natural surveillance in these spaces because of policies that restrict movement of people within and through them. For example, despite the actual platform being on the first floor of the station, access to the ground floor is also restricted to users of the platform/those who possess a ticket, street vendors aren’t allowed to sell or trade on the ground floor.

Exclusion of the Disabled

In 2013, the Berkeley Prize Essay competition was held under the theme of “The Architect and The Accessible City” which invited essays that spoke about how disabled people experienced space and transforming that experience ... The winner of the prize-winning essay, Sophia Bannert wrote (about the city of Lincoln):

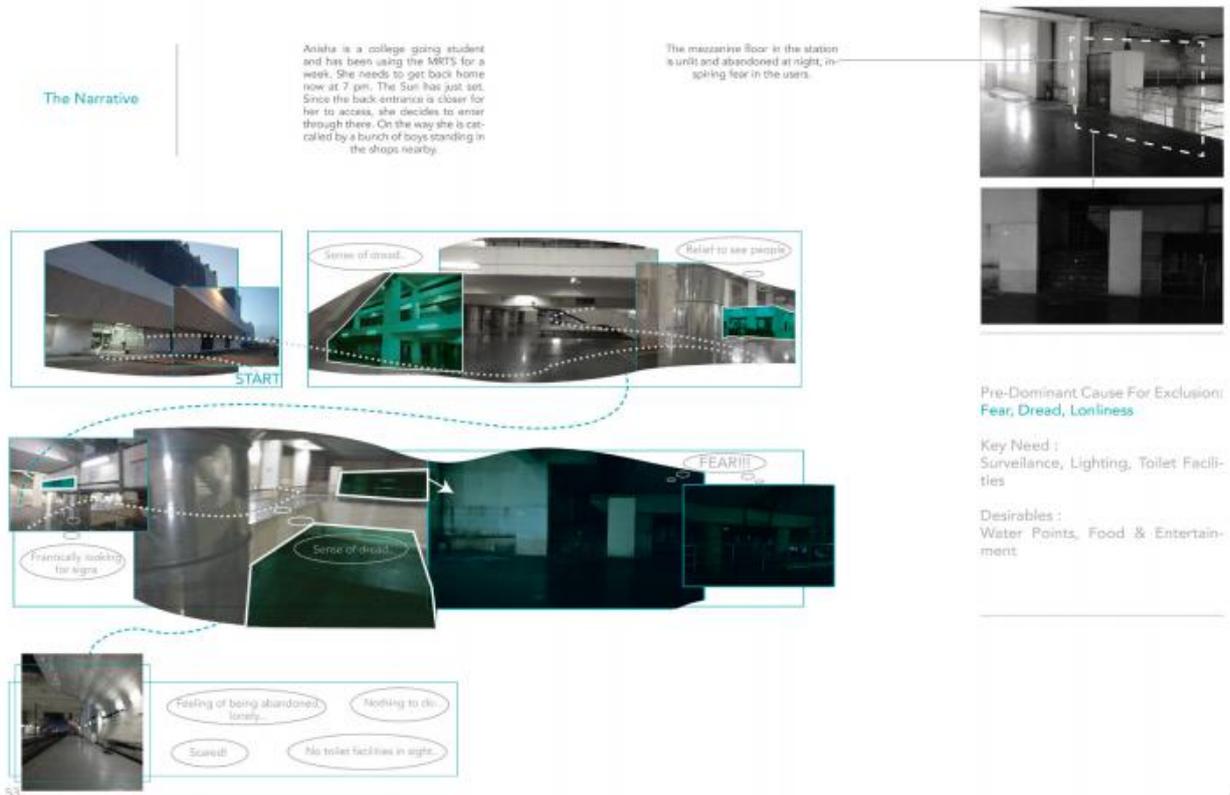
“Jarred into an utterly complex version of what I formerly knew as reality, my eyes begin scrutinizing and dissecting the cobbled street surface ahead into zones which I can and cannot access.... Whilst battling physical obstructions, I myself have become one. If the pavements were widened, perhaps disabled citizens wouldn't be seen as causing an obstruction.” (Bannert, 2013)

My aunt has limited mobility in her city as she suffers from arthritis. Everyday functions like climbing a set of stairs that feel like second nature to me, are a herculean task for her. Due to lack of facilities for disabled access in public transport infrastructure in her city, she is forced to commute within the city only by car and is entirely dependent on a member of the family to drive her around. The only impression she has, of the local train stations is their unimpressive facades, as she cannot use the monumental staircases inside of them (that are only means of access to trains in these stations).

Proposal for integration of the MRTS station into the Metro Rail Network

Currently, there is a proposal for the MRTS to be taken over by the Chennai Metro Rail Limited after which all MRTS stations would be air-conditioned and the costs of the tickets would be escalated to match that of the Metro network (Kaveri – The News Minute, 2019). Currently the costs of using the MRTS lines range between 5 INR to 30 INR per individual per trip. (Indian Rail Info by TravelKhana, 2019) However, the metro ticket prices range from a minimum of 10 INR to as high as 60 INR per trip (Kaveri – The News Minute, 2019). This move has raised concerns of gentrification of the MRTS network.

Conversion of the MRTS stations into metro stations would also usher in security infrastructure such as security cameras and baggage scanning devices inside the MRTS stations. In Ground Control, Anna Minton provides evidence to support her claim that “an unintended consequence of extra security including intruder alarms and other security measures, was to raise concerns over safety and security.” (Minton, 2019) CCTVs, the role of police in urban areas, security guards and walls that segregate an area to “secure” it from another inspires fear of “strangers”. These strangers are mostly likely to be people who harbour the same fear of other strangers. Therefore, the widespread feeling of fear is partly caused by unfamiliarity with other members of the public. And closed segregated spaces, increase this sense of fear. In the case of the MRTS stations, converting them into metro stations might induce a feeling of safety from sexual harassment/theft because of security infrastructure such as CCTV cameras. However, in the process of this conversion, they are at a risk of being alienated from their immediate surroundings further due to probable reinforcement of the opacity of their walls and stricter regulations for entry. These measures could inspire a fear of “strangers” (street vendors, the economically more underprivileged) in these spaces further widening the so-



cio-economic divide in the city.

[Figure 1] Cognitive map of a young woman using the MRTS station at night – Map constructed based on multiple narratives of young women (18-30 years



old) who've used the station to commute.

[Figures 2 & 3] Pictures of the MRTS stations depicting the opaque walls and lack of disabled access

3. REFLECTIONS & NEW POSSIBILITIES

A policy brief called “Women and Transport in Indian Cities” published by ITDP India (Shah, Vyas, Viswanath & Gadepalli, 2017) elucidates that women are subjected to forced immobility due to fear of sexual harassment in public transport and related infrastructure. Whereas, pressures such as need to work for an income, commute to place of work and economic status lead to forced mobility through public transport. This implies that unless subjected to forced mobility in public transport due to economic situations, most women at particular times of the day, would opt for “safer” modes of private transport. Aforementioned narratives also indicate that this is the likely possibility in case of people with restricted physiological mobility due to disability or age.

Popular narratives on gender aspects of public transport such as the UN environment article referred to previously (“Driving Gender in India’s Public Transport Policy”, 2019), place women and disabled persons as victims of developments that aren’t inclusive. While the argument that fundamental rights to urban mobility and transport are crucial to design and plan cities, it puts the users it discusses in a disempowered position. This approach also fails to discuss the possibilities, both economic and environmental, that arise when the stations are designed to be inclusive.

In my masters’ thesis, based on interviews and surveys conducted among 28 women who used the MRTS stations, only 4 reported that they used the MRTS regularly (at least once a week). However, 22 women reported to have places they regularly visit along the MRTS route. 13 out of the 28 women reported to having felt a threat to their safety in the stations at some point of time. Due to subsidised ticket costs, economically while the MRTS line was favourable to travel, exclusion caused by fear prevents women from traveling through the MRTS line more regularly. Thus, gender-inclusive design and policies have the potential to increase the number of women using the train line at least 3 fold. In 2011, the number of women commuting by trains to work in Chennai was only one fourth of the total number of people commuting to work via rail. (Census 2011)

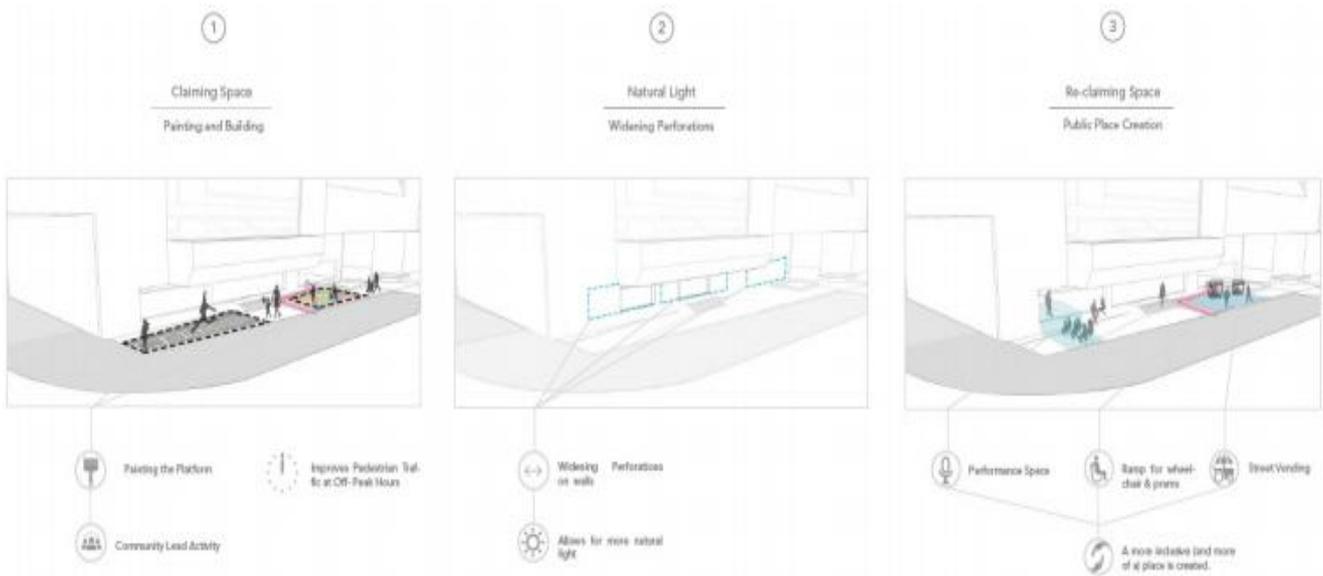
If the stations and trains were to be made more gender inclusive in design and policy, this will lead to an increase in revenue for MRTS stations that can facilitate their maintenance and upgradation. With regard to environmentally sustainability, this would lead to use of public transport over private modes of transport by women, reducing fuel emissions. With regard to social sustainability, this would also lead to the MRTS lines being used by different economic sections of the society as opposed to the gentrification that would be caused by integration of the MRTS with the metro rail network. In stark contrast to the character of exclusion that the proposed conversion would bring, spatial strategies to improve natural surveillance (Jacobs, 2016) such as opening up the walls on the ground floor, constructive use of spaces on the mezzanine and policies allowing free movement or vending in the ground floor can facilitate the creation of safer spaces and bring in revenue for maintenance of the stations.

4. REFLECTIONS ON MODE OF STUDY - MICRO VS MACRO UNDERSTANDING

While literature on public transport infrastructure and sustainability outlines the need to cluster and concentrate residential zones around lines of public transport (Tonkiss, 2015) or orienting public transport networks to connect various points in the city frequented by women (Jarvis, Kantor and Cloke, 2009), a micro-level understanding of the physicality of this infrastructure can provide an insight into social exclusion posed by transport infrastructure within

its physical boundaries leading to failures in sustainable development. Parallels can be drawn to Petcou and Petrescu (2015)'s successful and holistic approach to resilience and social sustainability perceiving it from a neighbourhood scale. This approach takes into consideration the narratives of diverse stakeholders.

Studying spatial inequalities can point to gaps in our understanding of spaces and their use. Rather than un-



derstanding exclusion and inequality as issues predominantly pertaining to rights or as outcomes of development, understanding the potential and possibilities of social inclusion in sustainable development can incentivise the creation of socially inclusive and environmentally sustainable public infrastructure.

[Figure 4] Solution proposed in thesis for changing the spatiality of the MRTS station to make it more inclusive.

5. LIMITATIONS OF APPROACH & DISCUSSION

Consciously integrating pro-social inclusion approaches into spatial design processes can improve the use of public transport and related infrastructure. Consequently, robust use of public transport by people every day, will result in a decrease in use of private transportation. Understanding the opportunities presented by social inclusion for development can lead to more sustainable cities. However, this approach to social inclusion must be incorporated hand-in-hand with the understanding of social inclusion as a rights' issue. Including groups of people such as women and elderly in public transit stops can increase revenue, incentivising this inclusion. Where there is a danger of increase in revenue being seen as the only incentive worthy of generating inclusion, this incentive can overshadow the need to preserve every individual's rights. This overshadowing can lead to the rights of individuals who aren't in majority, to get lost in the process of democratic design that favours the collective majority. In such cases, to approach sustainable development as a pathway to inclusion (the popular approach) can be beneficial for the public.

Therefore, perceiving and addressing sustainable development and spatial inclusion as both cause and consequence of each other can lead to more robust and holistic approaches of spatial design in public transit stations.

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A TOOLKIT: FOSTERING A PARTICIPATORY STUDY OF SUSTAINABLE PAVEMENT DEVELOPMENT

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ABSTRACT

Walking is a popular transport means for seniors doing daily errands, and pedestrian pavements play a key role in influencing the quality of older people's walking. Walking experience of older pedestrians and their perspectives to the outdoor environment are crucial in planning and designing pavements. However, their walking experience and perspective on the pavement are less involved in the process of urban development. A participatory toolkit is created providing a chance for older people to share their walking experience and to indicate their opinions of the pavement in a group study conducted by researchers who develop the pedestrian environment. The tool allows users to identify hazardous factors of the pavement, seek the impact of pavement hazards, and improve the pavement using recommendations. Based on the outputs of the toolkit, the researchers can have a better understanding of the relationship between pavements and elderly people and create an age-friendly pedestrian environment.

Key Words: sustainable development, pavement, older adult, toolkit

1. INTRODUCTION

Walking is the most satisfying, environmental and age-friendly transport means for sustainable advancement (Kim, Choi, & Kim, 2011; Mateo-Babiano, 2016). It is also regarded as the most effective mode of travelling for older people who live in cities and want to be less reliant on driving (Fisk et al., 2009). However, the condition of built environments and environmental barriers can affect the safety and quality of older people's walking (Achuthan, Titheridge, & Mackett, 2010; Rackliff, 2013). Furthermore, behavioural changes on the walking pattern of older pedestrians are associated with the hazardous appearance on walking paths (Caetano et al., 2016; Kovacs, 2005). Many guidelines, such as Manual for Streets (DfT, 2007) and Pedestrian Comfort Guidance for London (Iversen, 2010), have come out recommendations and guidance on building and designing the pavement to deal with the risk of falling and to promote walking in pedestrians. Even so, the walking experience of older pedestrians and their comments on pavements are not fully regarded by road engineers or design teams. Older adults consume much more time in local neighbourhoods, thus, it is vital to understand their concerns when building walkable environments for them (Grant, Edwards, Sveistrup, Andrew, & Egan, 2010). Therefore, we designed a map-based toolkit providing a participative process for older pedestrians to share their perceptions and walking patterns and generate ideas with researchers, namely urban planners, environment designer, and construction consultants, in the process of developing the pavement. Meanwhile, the tool enables the researchers to explore issues of the pavement and their impact on older people's walking.

2. A PARTICIPATORY STUDY TOOLKIT

The tool enables researchers (e.g. urban designers) to conduct a study to identify hazardous factors of the pavement in specific locations, investigate the adverse effect of the pavement factors, exploring behavioural changes of older adults (study participants) caused by the pavement hazards, and propose recommendations to improve the pavement environment. Shih et al. (2009) found that more ideas could be generated between people when they share their individual opinions in a group. Therefore, the study will be done with a group of older adults. People older than 60 are usually defined as elders (Un.org, n.d.), and a mini group is easier to organise and to make participants feel more comfortable in a concentrate discussion (Krueger & Casey, 2015). So, there has to be a maximum of six participants in the study and they have to be aged over 60 and fit to walking.

The content of the toolkit was created based on the findings of our empirical study (Yin & Pei, 2018). As to the outcomes, it categorised 16 pavement hazards, namely uneven pavements, overgrown plants, slippery barriers, broken pavements, moving objects, temporary obstacles, poorly maintained or designed street amenities, manhole and drain covers, parked vehicles, construction, narrow pavements, absence of the pavement, shopkeeper's goods, confusing paving patterns, tactile paving areas, and changes in ground levels, such as steps and slopes. These pavement hazards could increase the risk of falling and physical burdens to older pedestrians and limit their walking and view. Additionally, they could trigger particular changes in the walking behaviour of older adults. There were 13 behavioural varies have been classified based on the study results and they were adopting cautious steps, stepping around, adjusting paces, walking slowly, giving way, stopping walking, walking on the outside of the pavement, walking in the street, crossing road to the opposite pavement, lowering one's head, raising one's legs higher, facing oncoming traffic, and swerving one's body. To deal with the hazards and build an age-friendly environment, pavements could be developed by improving the pavement quality, providing pedestrianized pavements, well-maintaining street amenities, and avoiding pavement obstructions.

2.1. Components of the toolkit

Figure 1 shows that the toolkit has five components: (1) code badges, (2) user instruction, (3) a card pack, (4) survey cards, and (5) a recording card.

Code badges: there are six code badges, and each of them uses a unique number, such as 1, 2, or 3 to represent a study participant. The code badges allow participants' identity to be confidential and help to avoid participants giving answers repeatedly in group exercises.

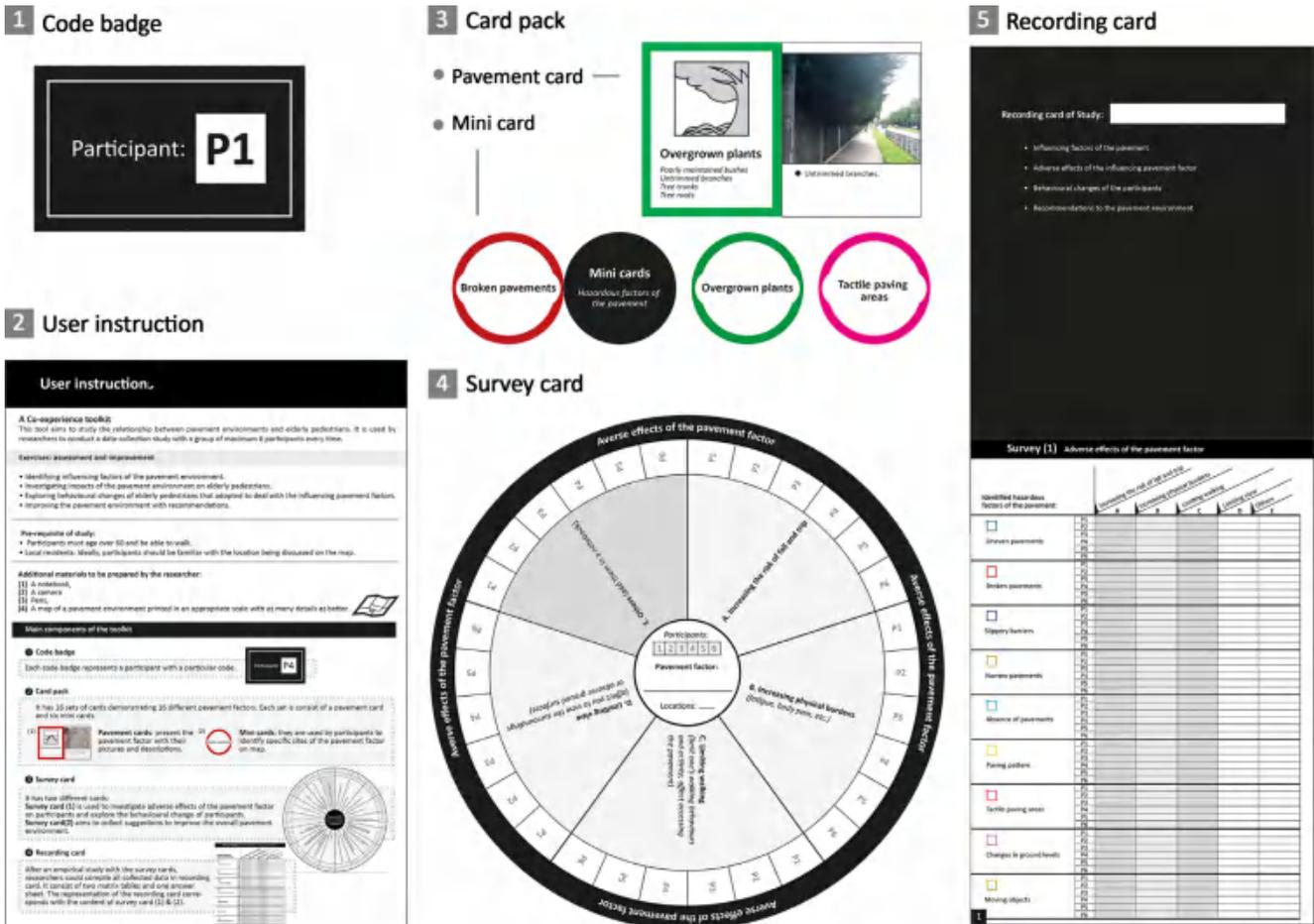
User instruction: the user instruction introduces the aim, objectives, target users, practices, and components of the toolkit, and provides a step-by-step guide for using the toolkit.

Card pack: the card pack incorporates 16 pavement cards and 96 mini cards. Each pavement card corresponds with six mini cards representing one of the pavement hazards found in our empirical study. The pavement card box are not only used to expand users' ideas, but also employed by participants to preliminarily identify hazards of a

pavement environment.

Survey cards: the survey cards constitute 16 copies of survey card 1 and a copy of survey card 2 that are used to explore the relationship between each pavement hazard and older pedestrians (study participants). Survey card 1 was made to explore the physical and behavioural impact of each pavement problem on study participants, and survey card 2 allows the participants to suggest improvements to the pavement environment using the recommendations constructed in the empirical study. The survey cards were made into a pie chart to ensure that all users to read them from different angles. Each segment of survey card 1 displays an adverse effect of the pavement hazard or a behavioural factor triggered by it, and each segment of survey card 2 offers a recommendation to the pavement. The outer ring of each division split into six individually showing one of the participant codes that allows participants to give an answer by ticking their code. Also, both of the survey cards provide an option of ‘Others’ allowing participants to add extra findings in addition to the provided content.

Recording card: the recording card has three matrices, and all their column headers is a list of the 16 pavement hazards while their row headers respectively are the impact of the pavement hazards, behavioural changes of participants, and improvements to the pavement. Each row of the matrices was divided into six divisions for researchers to



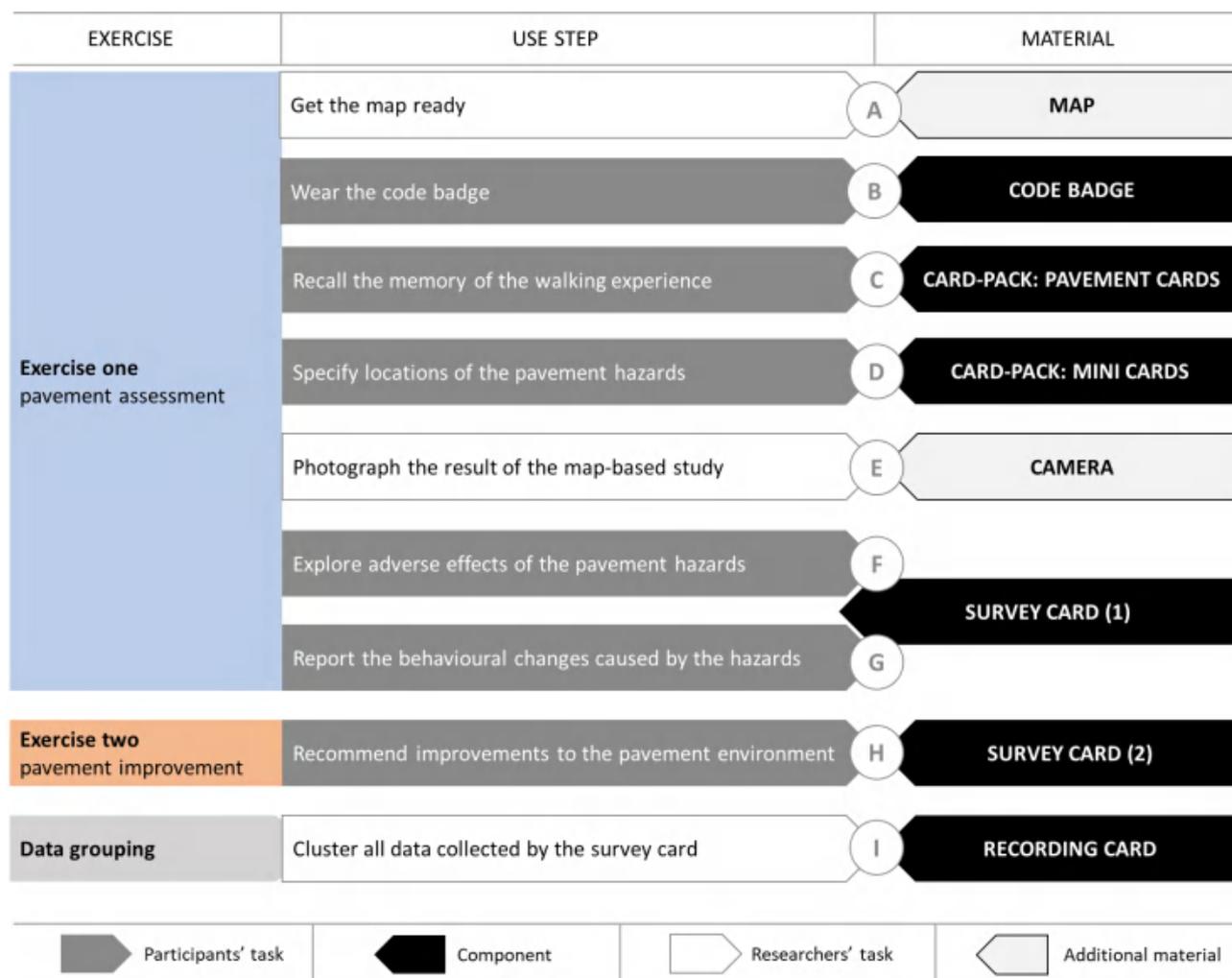
group data while to distinguish different participants’ answer to the same category.

[Figure 1] The participatory study toolkit

2.2. Use of the toolkit

To use the tool, researchers must first prepare a map and bring a camera to photograph results of the map-based assessment. At the beginning of the study, researchers need to introduce all components of the toolkit to participants and teach them to use the tool and assign a code badge to each participant. Next, participants use the card pack to conduct a brainstorming session on problems with the pavement. Following this, researchers can start to assess the pavement environment by asking participants to demonstrate hazards that exist in the context using relevant pavement card boxes. Then, researchers collect these identified card boxes and take out mini cards from them, and participants use the mini cards to locate the hazards on the map. Afterwards, researchers photograph the result of participants use the mini cards to locate the hazards on the map. Afterwards, researchers photograph the result of the map-based exercise so that they can quickly record the exact locations of the pavement hazards and continue to review the results after the study. In the following step, researchers use a copy of survey card 1 to further explore one of the identified pavement hazards only with the participants who have referred this issue on the map. Before the data collection, researchers need to indicate the identified pavement issue on the centre of survey card 1 so that participants know what factor they need to focus upon. Also, researchers need to write down the code of the participants who pinpoint the problem on the map and the locating number of the hazard on survey card 1. As to partici-

participants' tasks of survey card 1, they need to tick their codes on card segments if they agree with the statement presented by the portion. Each survey card 1 is used to study a pavement hazard identified on the map already. The more pavement issues are analysed, the more copies of survey card 1 will be used. Based on the results of the map-based assessment and survey card 1, participants carry on recommending improvements to the pavement environment on



survey card 2. Finally, researchers cluster all data collected by those survey cards in their recording card.

[Figure 2] Use of the toolkit

3. TESTING OF THE TOOLKIT

As the toolkit would be used to implement a group study within two kinds of users, the feedback from researchers and study participants (older people) could be different according to their standpoints. Therefore, the toolkit was evaluated in two sections conducted separately with elderly participants in workshops and with researchers in an interview-based study to seek their in-depth and diverse views. Workshop is a common method to develop a design tool and to identify users' interests and the impact of a design solution (Rail Safety and Standards and Board, 2008). The workshop aimed to examine if elderly participants could use the toolkit to carry out practices properly in a group activity. Eight senior residents (older than 60 and fit enough to walking) in London were recruited to the workshops and they were divided into groups of four. A map was used for the map-based assessment and it was created based on Google Maps. It displayed a part of the pavement environment in London and it was made in A1 size with the ratio scale of 1:2000 to enable all group members to read it correctly. Interviews allow interviewees' experience and feelings to be expressed and enables their perspectives to be in-depth explored (Kvale, 2003 and Berg, 2007, cited in Alshenqeeti, 2014). The interview-based study was adopted to test if researchers could self-learn the tool and use it to plan a study themselves. Eight researchers were invited from academic and industrial fields and the local authority of Uxbridge to the study. They were sampled for a purpose of diversity (Patton, 2009) and a reason that they acquired relevant knowledge or research interest regarding the content of the toolkit (Creswell & Plano Clark, 2017). The participants comprised four experienced researchers, two younger researchers, a designer, and a councillor. They were professionally engaged in the field of transport environments, travel behaviour, inclusive design, tool design, highway and pavements, neighbourhood maintenance, residential services, or architectural design. In the study, the researchers were asked to simulate a data collection using the tool and to share their user experience

and perspective of the toolkit. In addition to the testing, a questionnaire was used in both workshop and the interview to collect the user feedback concerning the design, information, utility, and outputs of the tool.

3.1. Results and discussion

Data collected by the questionnaires were analysed using statistical analysis (Lavrakas, 2008) to work out response rate to each question. Some qualitative information, such as additional explanations, insights, and narratives of the users, were transcribed and coded and finally grouped into content, design, usability, inputs, outputs, and other comments. In general, the tool was simple and well designed, and it enabled the users to efficiently investigate pavement hazards and their impact in walking among older pedestrians. It assisted the researchers to improve the pavement environment and to understand older pedestrians' walking needs from a new angle. The elderly users indicated that the tool covered almost every factor of their walking behaviour and every aspect of the pavement. These views were well defined and emerged all problems that they had encountered in the real world. The tool also included some facets that the older adults had not thought of or considered before that made them think they had the same responsibility as local councils. The researchers said that the tool provided them a new way to conduct an easy group study with older adults. It helped them to quickly and efficiently get information about hazardous factors of the pavement and barriers to walking. Some of the researchers would introduce the tool to local governments and use the tool to train construction engineers and road designers so that they could be more aware of older pedestrians and, hence to improve the age-friendliness of the pavement environment. The researchers also said that the data collected by the tool was analysable that could be easily transcribed into an assessment report or design guidance or solutions. They would interpret the outcomes with more evidence in their work field, analyse the data using a technical approach, seek insights into the results, and explore pavements in different areas with diverse populations. An expert would improve the travel experience of older people in outdoors based on the behavioural varies identified by the tool.

On the other hand, some users had to take a longer time to learn the toolkit, especially at the beginning of the study, as they were confused about the instruction and the link between each section of the tool. However, the tool worked well for them as soon as they understood the principle. Some operations of survey card 1, such as the recording of the results of the map-based exercise, was less useful to the researchers. Also, the size and layout of the survey cards restricted the elderly participants' action although they indeed promoted the group discussion. In this situation, two participants had to play a leadership role to write down other people's answers to the survey cards. In line with O.Nyumba et al. (2018), they were found to influence the study results especially when the other participants did not stand firm on their opinions or were not active. To avoid the issue, the survey cards needed to be redesigned into a more user-friendly layout with a larger size to enable all participants to be more engaged in the group interaction. Apart from that, grouping data from the survey cards to the recording card was not an effective action as the layout of the two materials were different. In this case, some researchers preferred to use a different approach, such as Excel, to compile data. An interviewee also recommended a digital format for the recording card.

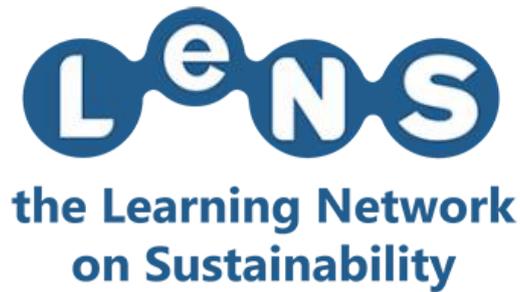
4. CONCLUSION

Wennberg, Phillips, & Ståhl (2017) state that it is crucial to understand older people's knowledge and perspectives to outdoor environments and to include them in the process of shaping their environments. The toolkit gives a chance for older people to participate in urban development and provides a new way for urban planners, environment designers, and local councillors to know about the hazardous impact of poor pavement conditions and better understand the need and experience of walking among older pedestrians. User-involvement studies have been commonly conducted in the environment-development as they could help to mitigate the unnecessary cost and unaccepted design (Kujala, 2003). Collaborating with older people in urban development has a great impact on building a sustainable community and making policies for age-friendly cities (Buffel, Phillipson, & Scharf, 2012). In addition, outdoor infrastructure can be improved based on a better understanding of elderly people's mobility requirements and walking experience and an in-depth investigation of walking hazards in older adults (Ormerod et al., 2015). In future, the toolkit will be modified based on the user feedback so that it better assists target users with the participatory study.

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THE LOGIC OF PLACE-MAKING TOWARDS SUSTAINABLE NEW URBAN AREAS IN HANOI: FROM ZERO TO HERO?

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ABSTRACT

In recent decades, hundreds of master-planned KDTMs (new urban areas) have developed on the urban fringes of expanding cities in Vietnam. They are promoted as a new urban planning concept in the post-reform policies. The governments are very proud of this model as it has solved the problems of housing production and housing supply simultaneously, and at the same time, improving the quality of life, well-managing urban space development, changing the face of the city, attracting investment capital. As a key tool in the housing and urban space development of Hanoi - “from zero to hero” - these projects show the ambition to transform the greenfields to animated KDTMs. Based on the results of the survey on KDTMs in Hanoi, this article discusses the KDTMs’ planning concepts, developing the methods to transform KDTMs into attractive and livable residential neighborhoods, moving toward the sustainable operation of the KDTM model.

Key Words: Place-making, Attractive and livable place, Sustainable neighborhood, KDTM (new urban area)

1. INTRODUCTION: SITUATION AND BACKGROUND OF KDTMS

Since 1986, after Doi moi (renovation), by entering a new phase of economic reform, globalization, metropolization, etc., Vietnam has introduced a new housing development strategy. After starting off the first 7 experiments in 1997-1998, the model of KDTMs (Khu Do Thi Moi - new urban area) has been implemented massively in sub-urban areas of Hanoi: green areas of agricultural production were filled quickly by buildings and became newly living areas of the city (Tran 2014, Tran 2016, Tran 2018). In recent decades, hundreds of master-planned KDTMs have developed on the urban fringes of expanding cities in Vietnam. They are promoted as a new urban planning concept (Tran 2015), a great deal of attention for the urbanization process in the post-Doi moi era (Labbé & Boudreau 2011).

According to Vietnamese housing policies, the model of KDTM creating a modern residential environment under the form of investment package which covers three important factors (National Assembly 2012): “KDTM = Technical infrastructure + Social infrastructure/facilities + Housing,” as a most important shift in the ideology of place-making, with the ambitious strategy to promote the growth of urban space in both quality and quantity, through the synchronized investment method. The governments are very proud of this model as it has solved the problems of housing production and housing supply simultaneously, and at the same time, improving the quality of life, well-managing urban space development, changing the face of the city, attracting investment capital. However, people are quick to respond to this housing model, and the real estate market of KDTM is formed, but are residents really satisfied with the quality of the living environment in KDTM?

It has been argued that the urbanization of Southeast Asian countries can be explained by industrialization and globalization of economic activities (McGee 1998). All activity sectors, population groups and newly developed areas of Hanoi have been vastly reshaped by trends of globalization and competition between world cities, and by planning processes, funding and management decisions (Leducq & Scarwell 2018). However, much of the master planning process in Vietnam is increasingly based more on ideas rooted in physical design (not socio-economic realities): spatial plans for Vietnamese cities remain heavily prescriptive with an emphasis on physical planning (i.e., creating cities “by design”) and on permitted land uses without necessarily taking account of the underlying socio-economic needs or market realities for that same city or area, which may be considerably more complex (World Bank 2011).

KDTMs, like new towns of China, thanks to a strong top-down, state-driven planning, and no organized resistance could be planned and built at a breakneck speed (Tomba 2014). KDTMs, which promote spatial, functional and social segregation within Vietnamese metropolises (Labbé & Boudreau 2011) are disconnected from an existing urban fabric, and developed within a short time-span, provide little authentic cultural and social context for inhabitants. Often a critical mass of an existing social core is required to provide a sense of place, history, context, and belonging - all of which help cities grow and remain resilient in hard times (World Bank 2011). Chang & Huang (2008) offer a cautionary tale of how a “geography of everywhere/nowhere”: an urban environment that looks like anywhere else participates in a fourfold process of “transworldment”, “enworldment”, “unworldment”, and “deworldment”.

KDTMs are hybrid products of government-led, entrepreneur-driven planning and self-organizing space production by the residents (Tran 2015). For market imperfections and shortcomings or manipulation in management, investors only focus on building houses for sale, while public service facilities are often ignored with uncertain promises to “do it later” regardless of planning approved (Trinh 2014). Achieving the vision of lively-safe-sustainable-healthy cities has become a general and urgent desire. Thus the importance of life in public space, particularly the social and cultural opportunities as well as the attractions associated with a lively city will be received attention (Gehl 2010).

[Table 1] Brief information on the surveyed KDTMs

KDTM	Linh Dam	Viet Hung	Van Quan	Ecopark	Times City
Project perspective					
Year of commencement	1997	2005	2004	2009	2011
Distance to the city center (km)	10	10	11	17	6
Area size (ha)	200	210	61	500	36
Population scale (people)	25.000	26.000	14.000	40.000	12.000
Number of surveyors	47	46	56	64	10

This article discusses the KDTMs’ planning concepts: (1) Differences between evaluations and practices - are KDTMs really “attractive and livable”? (2) The current KDTM-making - “from zero to hero”, is that a path to sustainability? (3) Towards a sustainable KDTM model - what makes KDTMs (more) attractive and livable? The foundation of this paper based on desk study for the research questions. We define and form hypothesize the ways of creating an attractive and livable place for KDTMs. We conducted attractivity and livability of the KDTMs in Hanoi (Table 1) with a survey according to 2 groups and with the same content of the questionnaire: 223 residents of KDTMs (selected randomly) and 50 experts (including 29 residents and 21 non-residents of a KDTM) who are working in the areas of expertise in urban planning and architecture of training institutions, research institutes, and

design offices.

2. PLACE-MAKING IN THE FORM OF NEW CITIES ON GREENFIELD LANDS: FROM STARTING POINT OF ZERO

In 2008, Hanoi's boundary had extended to the west to ensure the resource of land for the development of new towns; this has been seen as the "modernization" of the peri-urban area, with a large amount of greenfield and scattered villages, has become "a place full of hope, full of surprises, but also full of anxiety and uncertainty - a rich metaphor for development" (Leaf 2008), and the suburbanization are "interesting" stories in both positive and negative terms in the Vietnamese cities in transition (Gubry et al. 2010). The traditional cities-making in Vietnam based on the spontaneous demand of people without planning; this leads to rampant constructions and disorder in the spatial organization in neighborhood units. The globalization provides the opportunities for the penetration of Western culture and the adaptation of local people. "The cityscape has changed dramatically, with the construction of skyscrapers in new urban areas outside the old city" (Leducq & Scarwell 2018). These investment projects produce a new urban pattern, mainly adopt Western theories and concepts (Labbé & Boudreau 2015), which presents "modernization" to Vietnamese, and many of them have been designed by the foreign planner. Meanwhile, these projects show the ambition to transform the greenfields, "from zero to hero", to residential areas with full facilities, with modern architecture style which are transplanted without thorough considerations of the local context. This development trend leads to a similar image of these projects, in which the modern style of architecture has been widely applied to make a difference with the existing environment and to create communities with a new lifestyle. Like comment of Gehl (2010), modernists rejected the city and city space, shifting their focus to individual buildings and this ideology continue to affect the planning of many new urban areas. If a team of planners was asked to reduce life between buildings radically, they could not find a more effective method than using modernistic planning principles.

The World Bank has warned that rapid development of KDTMs in Vietnam causing an unsustainable environment for investment because of "building too much and too fast" (World Bank 2011).

"Building too much" - a series of KDTM projects are continuously constructed on the Hanoi's peri-urban. Through the advertisement and luxurious perspective of these projects with high-rise building, the developers show their ambition to transform the greenfield into modern, attractive and livable cities, and provide "standardized" living environment. In fact, the over-supply of the housing market has led to the emergence of ghost-KDTM in Hanoi (Tran 2018). Although many citizens could not access to housing, a large amount of vacant housing still exists in KDTM. One interesting fact in the comparison between ghost town in other countries and ghost-KDTM in Vietnam is that: while housing in ghost town could not sell out, housing units in ghost-KDTM transacted multiple times among speculators but have remained largely uninhabited (Jacques, Labbé & Musil 2017).

"Building too fast" - KDTMs gather a large number of residents and creating communities - the "small-societies" inside the "general-society" of the whole city. Instead of gradually generating new social relations such as the relations in the traditional community which based on the relationship of "countrymen fellowship," "kinship," "school fellowship," "colleagues", and "assembly fellowship" (Tran 2018). The developers immediately shape new social relations by organizing residents to live as neighbors in a new community which easily caused conflicts. They want quickly circulate the capital and generate profits through constructing and selling houses as soon as possible.

From these assessments (are also our hypothesis), we have reason to question the sustainability in the development of KDTM. Can these KDTMs, which were industrialized produced, create a livable and attractive living environment?

3. TOWARD SUSTAINABLE KDTMS FROM THE SITUATIONAL KDTMS: DO THEY REALLY BECOME THE HEROS?

- 1). Linh Dam - "awakened the whole South gateway area of Hanoi Capital, which used to be a pond, lake and low - lying field, and this is a potential model for replication in cities across the country."¹ Under another point of view, "this KDTM will no longer have the opportunity to have an integrated service center as the initial expected and therefore it has been transformed into a typical bedroom-town with a population size equivalent to that of a small city, becoming a model of dependent residence, due to its increasing dependence on the outside, a lack of internal resources due to the loss of opportunities to create common space, service activities and in place jobs," Khuat (2016) doubts about the "paradigm," attractiveness and livability of this KDTM.
- 2). Ecopark - "has become a green urban area model of Vietnam and regional countries, is also the beginning of a great journey that the residents can experience the values of community-culture-people."² Ecopark aims to become a symbol city of 5E: (E1) Eco, (E2) Emotion, (E3) Edu-entertainment, (E4) Economic, (E5) Elite, also considered as one of the representative for KDTM mainly aimed at the wealth of segments of urban population (Labbé & Boudreau 2015), creating a trend of "upper strata living", "high-class living," enjoying

¹ <http://hud.com.vn/content/khu-do-thi-kieu-mau-linh-dam-hoang-mai-ha-noi>

² <http://www.ecopark.com.vn/gioi-thieu/tong-quan-du-an>

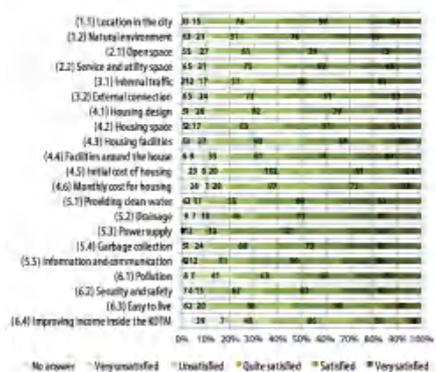
new life. However, behind the luxurious Ecopark are the plights, the difficulties of next-door farmers who are “struggling” when losing cultivated land.³

- 3). Viet Hung - “built project according to the criteria of KDTM model and many social infrastructure works and urban infrastructure works of Viet Hung are completed with high quality and synchronization to serve the needs of people in urban areas.”⁴ In fact, Viet Hung is quite struggling to attract people due to the separation from the city by the Red River. So, this KDTM is broken down to transfer to secondary project owners for deployment and exploitation. In the survey in 2012, this KDTM is highly appreciated and satisfied from the people (Trinh 2014).
- 4). Van Quan - located on the adjacent field of Ha Tay⁵, “completed in just over three years of construction, has quickly attracted people and formed a residential area with high living conditions.” However, this KDTM also received the evaluation of “ messy and sleazy surrounding KDTM,” with complaints of its residents.⁶
- 5). Times City - has been built with “the idea of a modern eco-friendly of Singapore,” “becoming an important factor, awakening the potential, contributing to changing the face of the southern area of the Capital and bringing residents a youthful living space, modern and comfortable.”⁷ This special KDTM⁸ “for the rich” was rebuilt from the land of an old industrial park and caused many controversies, contradictions by the different ways of viewing.

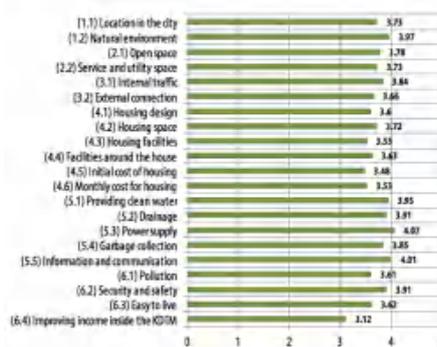
Based on fieldwork and references on ways to create a place for residents, we have established 6 significant factors along with the component indices to evaluate over 5 incremental levels by the residents of KDTM:

- Location and natural conditions: (1.1) Location in the city, (1.2) Natural environment;
- Public spaces: (2.1) Open space, (2.2) Service and utility space;
- Transportation: (3.1) Internal traffic, (3.2) External connection;
- Dwelling: (4.1) Housing design, (4.2) Housing space, (4.3) Housing facilities, (4.4) Facilities around the house, (4.5) Initial cost of housing, (4.6) Monthly cost for housing;
- Technical infrastructures: (5.1) Providing clean water, (5.2) Drainage, (5.3) Power supply, (5.4) Garbage collection, (5.5) Information and communication;
- Living environment: (6.1) Pollution, (6.2) Security and safety, (6.3) Easy to live, (6.4) Improving income inside the KDTM.

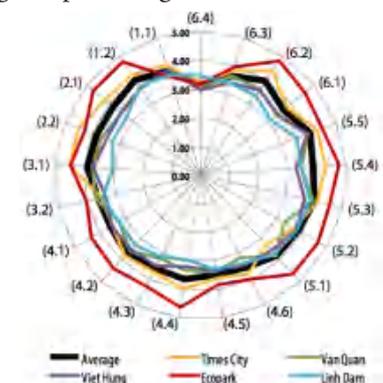
The survey results show that people expressed “very satisfied” the most in 3 factors (i) Natural environment, (ii) Information and communication, (iii) Providing clean water. Meanwhile, the evaluation of the “very satisfied” is lowest in 3 factors that relates to the economic problem which are (i) Improving income inside the KDTM, (ii) Initial cost of housing, (iii) Monthly cost for housing. If grossing-up two positive levels “very satisfied” and “satisfied” then the order will be (i) Power supply, (ii) Information and communication, and (iii) Providing clean water. It is worth noting that 3 factors are rated “very satisfied” and “satisfied” below 50% which are (i) Improving income inside the KDTM, (ii) Initial cost of housing, (iii) Monthly cost for housing. People expressed their attitude “very unhappy” at the factors of (i) Internal traffic, (ii) Facilities around the house, (iii) Drainage, Pollution, Improving income inside the KDTM. If counting on both levels of “very unsatisfied” and “unsatisfied,” the factors: (i) Improving income inside the KDTM, (ii) Pollution, (iii) Facilities around the house have highest percentage.



[Figure 1] The level of satisfaction of the residents about the KDTM they are living



[Figure 2] The average assessment score of the residents on the KDTM they are living



[Figure 3] Comparison of evaluation scores of 5 KDTMs

If converted to calculate the score on a scale of 5, most the factors gain score between 3 and 4, in which, 2 fac-

³ <https://vov.vn/kinh-te/dia-oc/bat-cap-thu-hoi-dat-nong-dan-thanh-thay-kien-804898.vov>

⁴ <http://www.hud.com.vn/content/du-khu-do-thi-moi-viet-hung-long-bien-ha-noi>

⁵ In 2008, Ha Tay province is merged to Hanoi.

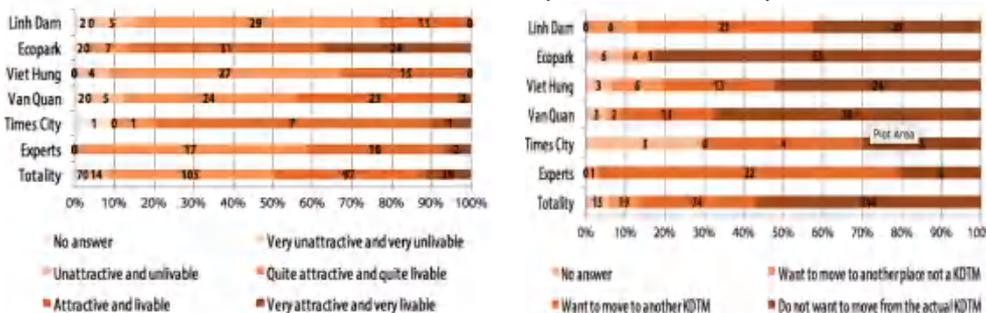
⁶ <http://hanoimoi.com.vn/Tin-tuc/Xa-hoi/856943/lon-xon-va-nhech-nhac-bua-vay-khu-do-thi-van-quan---yen-phuc>

⁷ <http://timescityminhkhai.com>

⁸ Time City is a “pseudo-KDTM” case: this area is not a real KDTM but has similar area scale and population with a KDTM.

tors gain scores approximately 4 (Natural environment, Providing clean water), 2 factors gain higher scores than 4 (Power supply, Information and communication). Three lowest scores belong to the factors: (i) Improving income inside the KDTM, (ii) Initial cost of housing, (iii) Monthly cost for housing, Facilities around the house. The detailed data analysis shows that Ecopark is rated more positively than other three KDTMs. Only the index of the position is rated lower (due to being farthest from the center), the remaining indicators of this KDTM are higher than the average value, between points 4 and 5, i.e., from “satisfied” to “very satisfied.” The assessments of (pseudo) KDTM Times City are only for reference, but also shows that some factors of this KDTM are higher than the average value. Interestingly, both Ecopark and Times City are considered “cities for the rich” because of the housing prices, housing amenities and service utilities are much higher than the rest of the KDTM, which are considered as “cities for all.”

About 10% of people rated KDTMs at the level of “very attractive and very livable.” It is noteworthy that the



majority of those assessments belongs to the people at Ecopark (24/29 reviews). Most people rated KDTMs from the level of “quite attractive and quite livable” (42.9%) to the level of “attractive and livable” (39.6%).

[Figure 4] Evaluation of 5 KDTMs in terms of attractiveness and livable [Figure 5] Residents' desire for future KDTMs environment

Only 5.7% of respondents said “unattractive and unlivable,” and none of the cases rated “very unattractive and very unlivable.” 60.1% of those with answers accepted to stick with the KDTM they are living, 31.2% want to transfer to another KDTM. The interesting point is up to three-quarters of experts (also residents of KDTMs) were asked to transfer to another KDTM compared to more than one-fifth of the respondents who wanted to transfer to a KDTM. Thus, experts may have higher requirements and visualizations of new urban quality because nearly two-thirds of experts assessing KDTMs they are living are “quite attractive and quite livable.”

4. DISCUSSIONS ON THE SURVEY RESULTS AND NEW RESEARCH QUESTIONS GENERATED

Thus, it seems that the natural environment in KDTMs is different from the existing residential areas because of the relatively large ratio of unconstructed areas and integrated natural elements, that become central spaces, controlling construction spaces that people highly appreciate. The most appreciated factors mainly belong to urban technical infrastructures, while the quality of the KDTMs internal spaces has not yet met the expectations of the people, especially the transportation and utility spaces around the building. The KDTMs are designed “for the future,” therefore using cars is becoming more and more popular. Thus, the streets inside the KDTMs always overloaded by the circulation of private vehicles and parking. Linh Dam is a typical example, where the parking lots are not integrated into the buildings leading to the open spaces of KDTMs be used for this function that makes people feel impact of the traffic. The residents of KDTMs must spend a significant amount of money to buy houses and pay monthly service expenses to maintain their lives in KDTMs. These service expenses which are compulsory, and there are no other options, so conflicts often occur between the KDTM owner and the residents. Unlike traditional residential areas with “lucrative housing,” housing in KDTMs is only used for residential purposes. Many people do not have the concept of improving income right in their housing. Finally, if the house price more reasonable, the amenities around the house more diversified, KDTMs will be more attractive.

- We also question the solutions that people think it is necessary for their KDTMs to become more attractive and livable, we have discovered some contradiction points of KDTMs and formulate new research questions as follows:
- Increasing vs. decreasing population density and construction density: this question is noted in Linh Dam.
- KDTM of the first generation built more than 20 years ago: the more attractive and livable KDTMs will attract more people to move in, gradually increasing the density, however, if exceeding a “threshold” of density at some points, the attractiveness and livableness will decrease. So how to determine this “threshold”?
- “Popularization” vs. “high-end”: a “high-quality” KDTM (Ecopark) relatively different from the popular life in the city, meanwhile, a “popular” KDTM (Van Quan) crowded with many street trade activities, is judged to be “without controlling”. “Popularization” to create life activities and vibrant and bustling street activities, while “high-end” to control the natural and social environment and avoid bullying. So how to reconcile these two opposite processes?
- Speeding up vs. slowing down the process of making KDTM: “speeding up” to complete the construction

of KDTMs, without causing adverse effects and ensuring adequate services and life benefits for people. But it is necessary to “slow down” to avoid investment risks for KDTMs owners. So how to control the pace of KDTMs construction?

5. CONCLUSION: CITY OF PROJECTS OR/AND CITY OF PLACES?

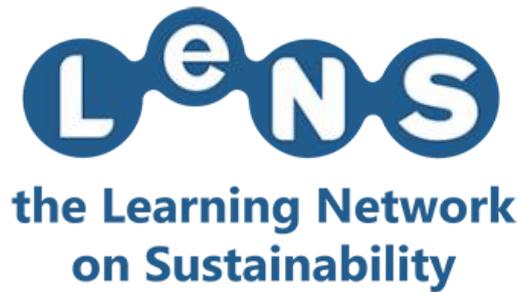
Is that creating a place through KDTMs projects that are being equated with substance construction, which means the project owners try to create the spirit of the place through the infrastructure that hits the psychology of the Vietnamese, after the substance difficulties of the war period and subsidized economy, that expect the improvements in the residence environment? It seems that the philosophy of developing KDTMs is still more inclined to “the place of new technical infrastructure” than the “place of new social communities.” However, Vietnamese people like to buy houses not only to stay as usual but also as a way to keep assets and benefits for the future. Therefore, are KDTMs mostly satisfying the number of houses for the future? The synchronization between 3 factors - technical infrastructure, social infrastructure, and housing - is overlooked in reality: the number of houses is maximized, not adequate with the other two factors. The city is “residentialized” and KDTMs become “sleeping towns” (Trinh 2014) - a way of developing spaces more and more popular in Vietnam. KDTMs projects today are neighborhoods, places of tomorrow. Sustainability in the current Hanoi-(re)making and imaginations of the change of views on KDTMs towards sustainability through their attractivity and livability for improving the sustainable KDTMs.

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MATI- FINDING SELF AND COMMUNITY THROUGH LAND RECLAMATION

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ABSTRACT

A small piece of land outside the N4 campus of Srishti Institute of Art, Design and Technology, was home to wilderness and trash, when the Masters students of Information arts and Information design practices (IAIDP) and Earth Education and Communication (EEC), as a part of School of Law Environment and Planning at Srishti Institute of Art, Design and Technology, decided to build a new ecosystem which could be used by the community next to this piece of land. This project, named Mati, emerged out of this idea of converting the piece of wasteland into a community garden with the vision of bringing the neighbourhood together. The project was initiated by the 2nd year students of the course with a two-week workshop asking how institutions could find ways to look at sustainability and community engagement while engaging hands on with a project like this. It was taken further, as a transdisciplinary unit for the 1st year masters students to continue the questions of sustainability through urban wasteland regeneration and reclamation.

Keywords: Urban wasteland reclamation, Community garden, Community engagement, Student Initiative

1. INTRODUCTION

Through our unit titled Cultivating 'Being' we attempted to transact the knowledge gained through embodied practice. We gained a firsthand understanding of how one can harness creativity through a framework of ethics, social and ecological thinking, and cultural and personal reflection which are key to developing intuition and insight as a art and design thinker. We have discovered that Art and Design is a form of intelligence; It is an inquiry into and of consciousness; It is the action of making and reflecting. It involves abilities in perception, cognition, heightened emotion, embodied and experiential understanding of environment and discernment; all of which then can translate into practice. Training to be an artist/ designer involves training the mind, body and consciousness. Through the embodied practice of gardening, we inquired into our own selves and began to craft ourselves into a state of preparedness in skill, perception and engagement with the outer world.

2. RESEARCH GOALS

The project aimed at:

- a). identifying different issues and finding ways of reclaiming a piece of land.
- b). Building a relationship with nature through the physical involvement of working with the garden, bringing one closer to the self in turn building a deeper relationship with our immediate environment.
- c). To keep everything organic.

3. THEORETICAL BACKGROUND

Managing waste is a particular problem in the city of Bangalore, which has not had any formal landfills since 2013. The city has 10 processing units out of which 8 process segregated trash through recycling and composting and the other two process unsegregated trash. It is estimated that Bangalore produces 3,500 tonnes of waste in a day, and both dry and wet waste is collected on alternate days by the BBMP, just from households. The largest of these processing units in Gudlhalli can process 1,000 tonnes of trash in a day but it faces daily resistance from local residents, and the other processing units handle a much smaller amount of waste in a day. It is easy to see that Bangalore has a waste problem, as one crosses vacant pockets of land mounded with tall piles of trash all over the city (Kumar 2016).

Due to limited space and budget, the dumping of waste in vacant areas is commonly seen throughout Asia, which holds true for Bangalore as well. This leads to the leaching of various chemicals and toxins into the soil and underground water levels, which increases in concentration if this dumping is left unchecked (Saritha, Vuppala, Prashanthi & Anjum, 2014). Over time, this debris accumulates and integrates into the very land underneath it because of the pressure of added waste, seasonal rains and soil runoff.

One of the ways to curb such use of vacant spots is by converting these wastelands into community gardens. Sustainable gardens are effective in various ways to the community around it, as green spaces and infrastructure have been shown to create a sense of well-being in a community. This has been seen in similar projects carried out in other parts of the country and the world, as seen in two such areas of Poznań in China. The activities surrounding two community gardens built over urban barren lands in the Wilda garden and the Koletyw Kapelisko garden, clearly demonstrated how the presence of community gardens increased social activities and the integration of community members in the locality, which ranged from summer outdoor cinemas to growing vegetables in the garden (Gałeczka-Drozda & Raszeja, 2018).

We looked towards other projects which had faced similar circumstances, and came across the Sadhana forest venture carried out in Auroville. The land there was similar to the red laterite soil which is found abundantly in Bangalore (Agriculture Department Bangalore, 2018), where red laterite soil and black cotton soil is found along with the depletion of topsoil and 80% stones and pebbles. The land was severely eroded, and they focused on improving soil quality through the introduction of pioneer plants which consisted of indigenous varieties along with regular supplementation of mulch. They noticed that when they had planted trees with the same soil and no other intervention in the initial stages, the trees all withered and died within a year. In comparison, the secondary experiment with indigenous plants being sown along with care given in improving soil quality allowed the growth of new foliage in many parts of the barren land which helped small fruit trees in surviving in the forthcoming years, and showed the importance of using such plants in recreating the biodiversity that existed in a topographical area, before erosion took place. Their aim is to introduce people to sustainable living, wasteland reclamation and food security through ecological transformation. (Mishra & Rath 2013).

4. RESEARCH METHOD:

4.1 Land reclamation

On the basis of our understanding of reclaiming urban wastelands, we questioned the anthropocentric notions while disregarding the dilation of time in terms of the ecosystem that we live in, and the lasting effects we create while

doing so. Before we could create the garden, we had to assess the current condition of the area. The topsoil mostly consisted of smaller particles of concrete rubble and the subsoil was interspersed with larger blocks of concrete, glass, fabric and plastic. The rubble and waste were mixed with red laterite soil though the rubble vastly out measured the amount of usable soil. Though there was grass growing throughout the land with shallow roots, the land was mostly barren and inhospitable to the sustainability of the existing trees. As a first step, the first layer of this soil and rubble was removed in one area of the garden to create a false topsoil which consisted of fresh red soil. Contour bunds, using repurposed baked clay tiles reinforced by the gravelly soil, were created along the perimeter of the plot of land to stop top soil run off. The earth was loosened and shallow 1 foot deep pits were created to plant indigenous pioneer species which would eventually improve the soil quality. Fresh soil and compost were used to fill these pits in. The plants required constant watering due to the condition of the subsoil. It was apparent that the soil condition needed to be improved drastically before this garden could be sustainable. One was waste segregation and the other was in-house composting to add to the soil quality of this area. We also looked at food waste as a major problem. We started by collecting food waste from our college campuses and paying guest accommodations that students of Srishti occupy. In order to create a compost pit, we looked to our immediate vicinity for effective methods of dealing with waste, by visiting large scale compost pits in nurseries and institutions. Segregating compostable waste is one way of ensuring a lesser volume of waste. Segregation of organic and inorganic materials is already carried out across the city including Srishti campuses, though it needs to be promoted and implemented in a more thorough manner. This segregated food waste could be locally composted, creating accountability for waste disposal and it also gives localities access to enriched compost, which can either be used in home gardens or donated to nearby local farmers who might benefit from it. Small scale compost pits were started, by creating multiple 3 ft X 3 ft pits, which were layered with dead leaves collected from the neighborhood along with 1kg of food waste generated in one day. These compost pits were regularly watered to help in aeration and effectivity of microbes in breaking down the material. The pits started showing signs of decomposition within weeks. The area around it eventually became prime spots for new growth of foliage.

4.2 Keeping everything Organic

We also looked at food waste as a major problem. We started by collecting food waste from our college campuses and paying guest accommodations that students of Srishti occupy. In order to create a compost pit, we looked to our immediate vicinity for effective methods of dealing with waste, by visiting large scale compost pits in nurseries and institutions. Segregating compostable waste is one way of ensuring a lesser volume of waste. Segregation of organic and inorganic materials is already carried out across the city including Srishti campuses, though it needs to be promoted and implemented in a more thorough manner. This segregated food waste could be locally composted, which can either be used in home gardens or donated to nearby local farmers who might benefit from it. Small scale compost pits were started, by creating multiple 3 ft X 3 ft pits, layered with dead leaves collected from the neighbourhood along with 1kg of food waste generated in one day. These compost pits were regularly watered to help in aeration and effectivity of microbes in breaking down the material. The pits started showing signs of decomposition within weeks. The area around it eventually became prime spots for new growth of foliage.

The resources used in order to develop composting methods were materials like dried fallen leaves from nearby areas, coconut shells collected from coconut vendors, waste food from nearby PGs and college campuses. Bamboo sticks and thin wooden sticks found in the area were used as fencing material, the tiles that had been dumped earlier in the garden area were used to block the flow of water outside the garden during rains. Materials used for building the aesthetics of the garden were also eco-friendly in nature.

4.3 Relationship with Nature and Community

Focus was given to planting medicinal plants that could be used by various households, such as Tulsi, Neem and Aloe Vera, edible plants such as Curry leaves, easily recognizable ornamental plants like Champa and butterfly attracting flowering plants such as curassavica, which attracts the monarch butterfly, as well as many other plants. According to sources, almost 90% of the medicinal plants used by pharmaceutical industries today comes from the wild. Almost 70% of these plants are collected as a result of destructive harvesting (Bhattacharyya, 2012).

Plants such as Adhatoda, Bacopa, Plumbago, Neem, Andrographis were some of the options that we had looked at as sources of significant medicinal value. The garden remained an opportunity to build a community of people finding a reason to come together. Medicinal plants could serve as an opportunity for residents of the neighborhood to find functional value in the garden. We also envisioned this process of engagement as a way of life. This was rooted in our collective understanding of past systems, where humans' relationship with plants and herbs was deeply integrated with their daily lives. We were able to plant different varieties of medicinal plants. Something that our later research pointed out and we failed to focus on at the initial stages, was a need to ensure the soil was conducive enough for the growth of these plants.

5 RESULT AND ANALYSIS

5.1 Personal Behavioral Change:

Understanding the land for us was through embodied practices, working physically and mentally on the garden, observing the land in order to understand how it could be converted into a community garden. We reexamined our understanding of nature, our past choices which have directly and indirectly impacted the environment, the idea and importance of community and ways of looking at sustainability. For most of us, the understanding came best with direct physical work on the ground leading to interests in the areas of study like flora and fauna of the region, aesthetics and landscape design, waste and water management, medicinal plants and their values etc.

We articulated the information gathered through working on the land through mediums like visual art, story-telling, poetry, performance art and information design.

5.1.1 Art and Design practices:

Art and design are powerful tools to make people aware, bring about a change in the consciousness, and has a strong potential to bring a behavioral change in the community or a society. One of the students after working on the land reflected on the impact of human intervention on the environment. She came across various types of waste like metal, plastic, fabric etc. This led her to rethink her choices in the past and make a conscious effort to reduce her consumption. She first reflected on commonly used words like 'Time', 'Assumption', 'Responsibility' and 'Connection'. She looked at the implications of these words in the context of sustainability and environment. She created posters that reflected on these words, as her line of inquiry.

As a self-reflective practice, another student represented information in the form of infographics using icons and illustrations which depicts the interdependence between insects, soil and certain plants. It also represents different emotions associated with various actions on the garden.

A comic series was composed by one, depicting social, physical and psychological aspects of working on reclaiming urban wastelands to create a garden. It reflects on the hurdles one has to cross physically and mentally to create a garden space. It further dwells into depicting the positive psychological benefits of creating a garden.

Some of us worked on a performative piece which reflected our understanding of the space with respect to time. Embodied practices into the garden led us to explore our bodies as tools to reflect and understand. The performance was a display of our emotions during our time of working in the garden.

Keeping the benefits of social media in mind, some of the students worked extensively on creating material for the same. Comic series emerged as a practice of communicating the stories from the garden on Instagram and Facebook. A page for Mati named 'Mati-eco-club' on Instagram was created where stories and posts were created every day. Several students from Srishti engaged themselves with the garden by using it as a display space. Another group of students interested in graffiti painted the electricity poles near the garden.

5.2 Social Behavioral Change:

5.2.1 Community Engagement:

Building a community garden for us, would first mean identifying the community in the area and the people who would be most impacted by its presence. An important aspect of our work was engaging with the neighborhood and initiating a dialogue between students and the residents. One thing that worked for us immensely was the support we received from a few children who stayed in the neighborhood. It was their dedication to working on the garden that created a bond between us. There was another aspect of this community that included the students of Srishti. Conversations with faculty members, inviting them and their class to join us for a day of gardening resulted in a few students expressing interest in working in an individual capacity. We organized a community event which would serve as a platform to talk about our work in the garden, but more importantly, also how the members of the neighborhood could contribute meaningfully to making this garden a sustainable space. There were a significant number of people, both students and residents, who showed intent with their presence. Conversations revolved around the need for composting, a demonstration of our experiments with a small amount of waste and how we could find ways to convert this into a larger system.

Seedlings that were given to every person who came for the event. One of the most observable results of starting a community garden was the complete lack of any new waste being generated in this area. The mound of existing waste did not increase in size in the weeks after. None of the flowering or medicinal plants had been tampered with. The addition of certain kinds of plants and trees have led to a development of a new ecosystem where now, butterflies, birds, beetles, frogs and other small beings visit the area every day. Earthworms are also discovered in the garden. One of the most astonishing sights is the view of a swarm of dragonflies often found hovering over the plants.

5.3 Challenges

Being Masters' students of an institution, we are exposed to different contexts, working with different dimensions of practice which serve as an advantage and can also serve as a disadvantage, specifically for this context. We found it to be difficult to keep up with the maintenance of the garden, so much so that we have not been able to allot time for basic garden needs such as watering. Temporary solutions like taking the help of support staff have worked for the purpose of watering, but we haven't managed to fix a system in place for the same.

Weeds can take over the pioneer species in the garden. De-weeding therefore is another important aspect of gardening that we have not been able to be consistent at. Our effort at including the residents and the neighborhood at large has been left incomplete. There is also a challenge of perception that we have had to deal with. In certain conversations, we sensed a clear distinction of our identity as students and were told how, due to the nature of our course, we would not be able to devote more time to a project like this.

Another challenge we faced during this time was this idea of territory that led to altercations with the land owners surrounding the garden. The surrounding land owners found our work to be obstructive. This was first observed when we built a fence around the garden. The fencing was done with the intention of preventing animals from destroying the plants. This led to a dispute between the surrounding land owners and certain residents of the neighborhood supporting the garden project. This was our first exposure to the politics of land and was one of the major reasons for work halting. This was our first encounter with power and territory, putting larger contexts of land and power, into perspective. Working on a small patch of land could become a source of power struggle, in the process, unfortunately questioning the legitimacy of such a project.

6.CONCLUSIONS

Select plant species can have a major role in reversing erosion, restoring soil health and regenerating land and enabling the land to be used as a community garden for growing medicinal plants, herbs and possible food plants such as curry plant, papaya, carrots, tomatoes, beets and greens in the long run. It is possible to enable productivity in even the most degraded soil used as a dumping site within a highly developed urban space and restore it over a few years of careful cultivation of indigenous plants. The general methodology can certainly be followed to design similar experiments near the current plot where urban wasteland including dumping sites can be identified and reclaimed with similar sets of practices and suitable plant species. There are vast expanses in the dry tropics where the species mentioned would thrive. There is a lot of scope for systematic and extensive research and urban wasteland regeneration. The practices are relevant, considering the larger problem of India's expanding wastelands, which concerns both policy-makers and citizens. Given the exponentially exploding challenges of food security, population and the fact that the urban sprawl and industries are replacing the best agricultural lands, a simple sustainable solution is to stop further degradation, and unlock the productive potential of currently unused spaces that the local community can directly engage in. The practices described do not require any special skills for implementation and are effective and inexpensive ways out of the impasse of waste generation, mindless consumerism and the unseen costs of urban growth and development, especially in a city like Bangalore which has gone from being a 'garden city' to a concrete jungle in a very short span, the changes in the climate, rainfall and pollution levels are visibly concerning.

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THE PATTERN AND METHODS CONCERNING THE MICRO-RENEWAL OF THE URBAN ENVIRONMENT

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ABSTRACT

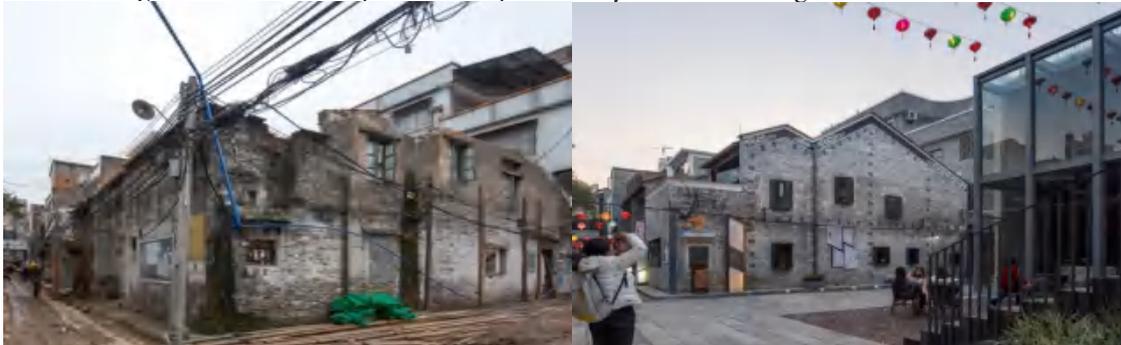
Micro-renewal in historic districts is a small-scale, low-cost and short-cycle urban renewal mechanism which is oriented towards a limited number of people and relatively easy to be carried out. It is an exploratory experiment for cities in China as they are experiencing great transformation. The purpose of Micro-renewal is to make “micro changes” in citizens’ ways of living, promote society-based participatory design and cultivate their awareness to participate in urban design.

Micro-renewal changes a city from the micro perspective just like re-creating a living creature right from its cells. With macroscopic control and intervention by the authorities, higher education institutions and design institutes can find pieces of small renovatable land in historic districts to launch some pilot projects. In these projects, local people can witness that incongruous buildings begin to blend in their life again after reconstruction, and local government can see new possibilities of how to renovate historic districts.

KEYWORDS: Historic Districts, Micro-renewal, Renewal Pattern

1. BACKGROUND

As the origin of a city, historic districts is one of the most important spaces reflecting the city's culture and historical memory. Micro-renewal reinvigorates a city through the smallest changes just like re-creating a living creature right from its cells. In October 2017, during his visit to Yongqing Fang in Guangzhou's Liwan District, Chinese President Xi Jinping commented that urban planning and construction of a city should accentuate its own unique features and improve its living environment in a patient and precise way such as making Micro-renewals.



[Figure 1] Micro-renewal Project of Yongqing Fang
(Left—Before Renovation; Right—After Renovation)

In 2015, the Guangzhou local government issued the “Guideline of Urban Renewal in Guangzhou”, in which the concept of Micro-renewal was put forward for the first time in China. In the Guideline, Micro-renewal was defined as a way to renovate architectures without changing their original architectural layout by maintenance, partial demolition and reconstruction, or change in their function. Micro-renewal is mainly implemented in the built-up area where the current land use and development are conflicting and the living environment is relatively poor. And it also has to be relatively insignificant in the whole layout of the city. This paper attempts to explain the complexity and uncertainty of the city space in China from a new perspective. We have learned that these complicated but all-encompassing historic districts reflect much profound philosophy and vitality. From them we have also found some areas to be explored in the urban aesthetic threshold.

2. LITERATURE REVIEW

While scholars in both China and other countries make different judgements on large-scale city transformation, they emphasize that the basic human needs should be taken into account in urban construction. Besides, they begin to focus on space types which were eliminated or concealed before as they are not practical in terms of spatial practice. Studies on these city spaces that are being demolished, relocated and are thus scattered and hardly visible have made the urban aesthetics more practical.

Chen Zhanxiang was the scholar who first introduced the idea of urban renewal into China. He called it the “metabolism” of a city. Wu Liangyong put forward the concept of “organic renewal” from the perspective of city protection and development at the beginning of 1990s. Since 2010, the number of studies on Micro-renewal has greatly increased and most of them are case-based. For now, Micro-renewal means to make changes in the fragmented built-up area and the existing buildings in the city with the purpose of meeting the new needs of people's daily life and work. These studies have great significance in the exploration of community Micro-renewal path with Chinese characteristics.

Urban living space are stepping into the next stage of crisis of constant unnecessary reconstruction from the stage of reconstruction with crisis constantly happening. Related cases have provided us with experience and much inspiration. There are still some problems in the Micro-renewal in cities in China compared with that in developed countries. For example, we often attach importance to the protection of cultural relics while neglect the protection of historic environment; emphasize the protection of architectures' outer image while ignore the protection of the culture behind them; value the protection of buildings while overlook how to put them to good use. All of the above show that the transformation experienced by cities in China is both complicated and contradictory, and that we should make further studies on how to implement the Chinese theories and methods of Micro-renewal.

3. METHODOLOGY

This paper takes Micro-renewal in historic districts as research object and uses traditional methodologies such as literature review, questionnaire survey, observation and systematic analysis, and innovative methods like digital landscape. In this paper we put forward an ideal method to implement Micro-renewal in historic districts. At the macro level, we have made a comprehensive analysis of studies on the status quo and planning of historic district space through logical reasoning and we have taken successful cases for reference. At the micro level, we have used questionnaire and multi-media information technology and at the same time conducted field research and data analysis

to find out the problems that exist in historic districts and their causes.

4. RESEARCH SIGNIFICANCE

- 1). This paper attempts to explore the new path of urban renewal in historic districts. With new development opportunities of large cities and new challenges brought by the increasingly limited land resources, the urban planners should try to create city spaces where citizens can have greater senses of security, belonging, achievement and happiness. To this end, for the built-up area, they should shift their focus to reconstructing the city space, activating the communities, changing citizens' living style, improving the quality of city space and developing the charisma of the city.
- 2). This paper studies the strategies of urban renewal in fragmented area and their significance. After years of rapid urbanization in China, re-using existing urban and architectural space is as important as creating new space.
- 3). This paper analyzes the aesthetic problems behind the development of historic districts and attempts to find a remedy for urban diseases such as environmental pollution, discontinuity in urban context, and loss of cultural belonging and unique features etc. It provides theoretical and practical guidance of how a city preserves its own aesthetic culture while observes the contemporary aesthetics.

5. CHARACTERISTICS OF MICRO-RENEWAL

- 4). 1). Small-scale: By beautifying the surrounding environment, setting up service facilities and guide signs, and improving traffic facilities etc., the damage of the architectures can be reduced to the minimum. Micro-renewal also integrates the architectures, space, landscape and human activities in the same area into an organic unity.
- 5). 2). Low-investment: By reconstructing public space and revitalizing the community, the cost of renewal can be reduced. All residents in historic district can therefore satisfy most of their own needs. Besides, Micro-renewal also promotes the culture of the historic districts and brings economic returns and social benefits.
- 6). 3). Detail-oriented: Micro-renewal extracts the cultural elements of historic district and reconstructs them into every detail of the new architecture design. By making every renovated architecture a small "city museum", Micro-renewal also extends the functions of historic districts and instills vigor into them by integrating them into the open space of the city.

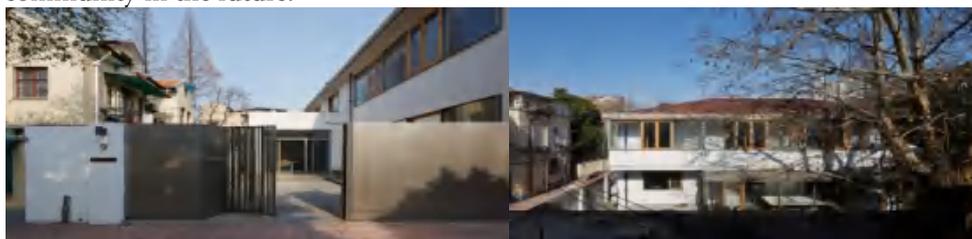
6. PATH AND PATTERN

Micro-renewal in historic districts is an exploratory experiment for Chinese cities against the backdrop of that cities in China are experiencing great transformation. This paper focuses on the common, small things in daily life rather than on the larger perspective.

6.1 "Slow-life" Micro-renewal—Re-design that complements city space's function from a micro perspective and improves the daily facility

This paper puts forward the design idea of "slow life". Historic districts are often passive and closed, and the architectures in them are often in disorder, with unclear spatial structure and insufficient supportive function. To implement this idea, we should make the passive and closed district space open again for the whole city and the citizens. We can realize the goal of enhancing a city's function and quality of city space by improving the daily facilities and extending their functions, inserting small spaces into streets to make them more lively, as well as integrating protected historic buildings into open city space through space replacement. Guided by the concept of "slow life", daily city life can be open to more possibilities through increasing the variety of public space and paying more attention to the openness and diversity of public space.

The figures below show a studio after reconstruction. Its glass door connects the front yard and the outer door, making the studio and the community outside a continuous space. Such design makes it possible that the studio can be open to the community in the future.



[Figure 2] Wuyuan Rd. Studio in Shanghai

6.2 Micro-expansion of “Street layout”—Re-design that expands both sides of street and increases public space in vertical direction

It is common that the street layout in the historic districts is not enough straightforward and simple. These streets are usually humdrum and their public space is inadequate. To carry out micro-expansion for the existing buildings and street space with the purpose of meeting citizens’ need and enhancing street space quality, we should seek the problems that exist in the vertical direction of both sides of the streets, look for those passive space and streets with potential to be renovated, make an investigation of the daily needs of citizens around as well as analyze the existing spatial structure. By doing so, the space of streets will be more lively and better laid out, the passive space will be activated and the land use efficiency will be improved. As a result, more public service will be provided and the public space will be enlarged. Besides, based on the structure of the historic districts, we can some build public courtyards in the city with small-scale buildings that provide leisure and entertainment service to attract more people.

6.3 Micro-intervention that helps “keep the city memory”—Re-design that renovates the existing spaces and makes people’s daily life more complete

Micro-intervention can be implemented in urban renewal projects by preserving the old narrow streets, buildings and the old courtyard or under-the-eaves spaces, then summarizing and blending the characteristics of the existing city spaces to construct new different types of courtyard space (such as garden level, courtyard where old and new buildings co-exist and community-based courtyard). In such way more public and urban green spaces will be created and the residential, office and commercial buildings will become mixed-use facilities after proper integration. Preserving the old spaces helps citizens better adapt to the new elements in their life, and it conforms to the logic of society. Old spaces are irreplaceable in some sense as they can reflect the city memory and city culture.

The below figure (left) shows a Hutong before renovation. In the right figure, the small-scale art museum and library built in the renovation have transformed this Hutong into a new organic and mixed-use complex.



[Figure 3] Micro-renewal Project in Beijing—Micro Yuan'er

6.4 Micro-improvement of “environmental elements”— Re-design that instills vigor into cultural resource in historic districts by making full use of the environmental elements

Environmental elements refer to the basic elements that constitute the whole human environment. These factors are different in their nature, but they all observe the law of evolution. Usually environmental elements are water, air, rocks, creatures, sunlight and soil etc. Environmental elements are interconnected, interactive and inter-constraint. They are fundamental to our understanding, evaluation and modification of the environment. During the Micro-renewal in historic districts, we should put emphasis on the protection, invigoration and renewal of historic and cultural environment.

To this end, we should a) protect the material cultural resources; b) protect the historic architectures and other historic relics; c) protect the elements derived from culture; d) invigorate the non-material cultural resources; d) renovate the facilities in the city space. To make a clear definition of these elements, we should take architectures, people, space and environment into serious account from an inter-discipline perspective. As the fund of renovation in historic districts is usually limited, the above five steps constitute the framework of the Micro-renewal of environmental elements. Under the above framework we should make a combination of traditional symbols and environmental elements, and take a low-cost, easy-to-implement and widely-ranging approach in order to improve the quality of city environment and highlight the historic and cultural environment in the city.

6.5 Micro-integration of aesthetics

Guided by the principle of physical aesthetic comfort and architectural aesthetic coordination, we can set up a physiological sensing model of aesthetic practices in historic districts and carry out aesthetic practices such as “street slimming” (re-designing all the redundant things in the streets of historic districts), “tranquil street design” (reducing noise and increasing privacy of public space), small-scale community design and mixed use of land with the architectural diversity and aesthetic detailed characteristics taken into account. By following the aesthetic logic of historic districts and integrating new elements into their aesthetic space, the aesthetic subjects can establish their own self-identity, gain respect and achieve self-actualization. From this, we can build a social interaction model of aesthetic practices in historic districts. Based on the citizens’ daily life and aesthetic sense, we can renew the experience and value of the aesthetic subjects by the engagement of art in the community Micro-renewal. The existing aesthetic form of historic districts will be thus changed and the residents in them can enjoy new aesthetic designs. From that

we can set up a perception model of aesthetic practices in historic districts.

China has shifted its social goal from carrying large-scale construction into sustainable development. Against the backdrop of transformation in China's social structure, city Micro-renewal has already become feasible. Such humanistic approach of reconstruction can be taken as a reference for the inventory planning and participatory design widely advocated in China.

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RITICAL ZONE: THE EARTH BELOW OUR FEET

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ABSTRACT

This paper reflects on an international collaborative project “Critical Sciencing Zone,” along with works from the Kochi biennale (2018), which responded to the flood and landslides in Karnataka and Kerala. The critical condition of the thin layer of the earth crust is of immense concern in this paper. I am tracing the inclination for vertical movements and aspirations to reach the sky that accelerated technology, to the detriment of the Earth. Postmodern theories that specifically use elements from nature, will be useful to frame radical shifts in perspective, and hence rethink our relation to the earth. This paper will speculate through art works and fundamentally emphasizes learning through cognitive, experiential and affective processes in order to acknowledge and recognize Nature. In short, my aim is to examine and discover perspectives and manufacture discourses.

*“The Earth,” he said, “has a skin, and this skin has diseases. One of these diseases is called ‘Man’.”
Friedrich Nietzsche, Thus Spoke Zarathustra*

INTRODUCTION

The critical condition of the Earth is overwhelming and this is extremely and embarrassingly a very obvious understatement. As much as there is despair, yet it is necessary to find means to make amends to the blunders done to the Earth. My contribution in this paper is to look at perspectives and frameworks, in order to rethink them, so that our attitude, discourses and practices are renegotiated in order to foreground the Other and by that I mean Nature. To begin with, it should not be the Other, however, the othering has deepened so far that a repetitive deploying of poststructural and postmodern questioning of the foundations of discourses and knowledge systems will continue to be pertinent. An archaeology of knowledge unearths the apriori and discourses, or just simply assumptions that precede and preside silently behind logic, questions, frameworks and other normalized principles. (Foucault, 1972)

A projects titled “Critical Sciencing Zone” (March 2018, July 2018) was a major source of inspiration for this paper. The occurrences that followed the projects was an array of related incidents with real and fictional concatenations. The disaster that immediately followed in August 2018 was a rude awakening to two southern States in India, one in Coorg, a district in the State of Karnataka and in several parts of the neighbouring State of Kerala. The unusually severe rainfall, and heavy floods, not witnessed in nearly a century, caused landslides that washed away not only the animals, vegetation and houses, but also the land itself which changed the geography of those regions. These occurrences unfolded the trepidations of the above projects. The calamity was incorporated into the Kochi Biennale Dec 2018- March 2019 (Kerala), at Kochi, a port city in Kerala. The ongoing Biennale titled “Possibilities for a Non-Alienated Life” includes several themes, and highlights ‘ecological disaster on the planet.’ Some of those works will be of importance to this paper and they bear an uncanny connection to the above mentioned projects at IISc. Indeed, I am writing this paper in the midst of raw natural occurrences and reflective aesthetic responses and resonances.

Critical Sciencing Zone—Work Shop and Performance—Frustrating Normal Expectations with Surprise.

Critical Sciencing Zone was comprised of two events: Workshop and Exhibition (March 2018) and Two Earths Lab (July 2018) and they are part of a larger project De/Globalization (India, Egypt, Germany). Link: <http://deglobalize.com> The primary participants are:

Daniel Fetzner, Professor for Design and Artistic Research and head of Media Ecology Lab at Hochschule Offenburg

Dr. Vasanthi Mariadass, Srishti Institute for Art Design and Technology, India, Dr. Martin Dornberg, M.D., PhD Center Psychosomatics/Psychotherapy, Freiburg. Philosopher at Freiburg University, Ephraim Wegner, Electronic musician and artist at Media Ecology Lab, Hochschule Offenburg, Dr. Raghavendra Gadagkar and his Team from Indian Institute of Science (IISc), Indo French Cell for Water Sciences and The Earth Science Department at IISc, India.

This was an interdisciplinary workshop constituted by researchers from Science--Humanities—Design—Art—Social Sciences focusing on environmental question through the fundamental elements necessary for living: Air, Water and Earth. We engaged with Indo French Cell for water science, Wind Tunnel lab, and Earth Science departments at IISc. The participation and performance was by plants and animals (including human beings) along with questions concerning the Anthropocene; the exponential development in Technology and human activity was the primary concern of our project.

Critical and Theoretical concerns by Gilles Deleuze and Felix Guattari, Robert Smithson, Lyn Margulis and Bruno Latour are important here for the brilliant perspectives they recreate to undo the adamant sedimentation of perceptions that delimits other possibilities: To perhaps refresh, cleanse, and expand terminologies and thereby avoid cliché and finally limitations. Primarily, poststructural and postmodern theories will be of importance for my analysis here. They are simultaneously a fundamental and radical source for education, since they constantly engaged with critique and methods for reading, writing, and interpretation. In short, rethinking meaning making dictums and dictates, and hence the valorising games played by the elite through history, politics and religion is systematically unfolded by them. Smithson’s works provide instructions for his audience, but more specifically for Artists, Curators and Art Critics/Historians. His methods include fragmentation and “pulverization” of hardened ideology, similar to poststructural strategies and



hence introduces the process of “leaky minds” that poststructuralism would call sliding signifiers.

[figure 1] Critical Sciencing Zone Performance

Critical Sciencing Zone (March 2018) was a research process for 3 weeks, that culminated in a performance (figure 1). It was inspired by Latour’s (2014) “Some Advantages of the Notion of ‘Critical Zone’ for Geopolitics” which was central to our discussions with scientists. The Critical Zone topic have been of great concern to scientists for a very long time, ever since the forecast of its fragility was speculated. It is the layer of the earth just below the atmosphere and it reaches below to the hard rock layer, also known as the mother rock—the continental crust. Critical Zone Observatories (CZO) exist in different parts of the world, equipped with sophisticated instruments where data is perpetually gathered and shared.

Discussions with scientists, found objects and living beings at the site of the Institute was used for the performance at a small auditorium at Center for Contemporary Studies (CCS) in IISc. It was an unusual staging and surprisingly the audience, predominantly constituted by scientists, performed consequently the whole auditorium became a stage, including the “intruding” bamboo stem that entered through the window out of curiosity, while a wasp hive was placed at the entrance. We the expected performers remained off stage, and the stage was populated by other critical protagonists: a freshly cut wood found around in the wooded areas, live streaming of the Wasp colony, a wasp hive and books used as reference material. The cut wood seemed to be reclining, and appeared like a dead being making the auditorium a funeral space. The puzzled audience must pay tribute to the dead and the living at once, although they were unaware of this predicament. The audience were asked to bring objects representative of their work to discuss, as a result they were forced to become the performers. Of course, we the so called performers were merely facilitators and performed to the extent that we introduced and reflected, along with synthesized background sound found in the surroundings; extracted and shaped to highlight sounds that are forgotten in the Anthropocene.

Here we were in a science institution, introducing a topic that the scientists have already engaged with for more than 30 years. Many have moved on after surveying, analysis and data collection that terminated in publications. And yet the performance impacted them, and included below is a palpable and moving e-mail response by Pascal Jouquet who was then based in IISc at the Indo-French cell for Water Sciences—a scientist who was an audience and performer at once, and reflected on the affects he experienced during and after the performance:

Dear all,

First of all, Sorry(s): Sorry to not have been able to send you a message before; Sorry in advance for all the weird, chaotic and perhaps incomprehensible message you gonna read (perhaps...); and finally Sorry to be so critical of a concept whose utility seems to be so uncontroversial... So... “in a few words”, I take the opportunity of my holidays...to send you a message regarding our discussion and your performance. But first, let me introduce myself (again): I am working in a team called “Ecological Functioning of Tropical and Temperate Soils”... I couldn’t remain insensible to your venue, our discussion and even your performance. You made me think - you made me read - you make me write now in the middle of a night... That’s simply magic and a real pleasure, if not a therapy... ;-) After my many Sorry(S), now please acknowledge my so many ThankS! ...Thanks also for your fantastic and breath taking performance. I don’t know if you remember but I challenged you. I wanted you to make me understand “things”, I wanted to grow, to reach a new state of understanding. I don’t know if I have been where you wanted me to go but yes, it worked. I went far, very far and I was so excited at the end by this incredible experience... I didn’t simply understand it - I felt it!!! Then, SorryS and ThankS! ;-) As your videos of the swimming pool highlighted, an ecosystem (= a watershed) is made of many and incommensurable smaller and entangled ecosystems that are all Critical in the sense that they are crucial for many different organisms...but the “Zone” concept isn’t too ‘linear’ for that? Let’s be honest, we’re destroying our environment and the environment of animals and plants that didn’t ask for nothing - That’s critical, terribly sad and unbearable... Thus, I’ll simply repeat myself: Thanks for this discussion. but I am convinced by the need and richness of the feedback between philosophy, ecology and now even Arts! and by the need to question our approaches, concepts, symbols and why not feelings. A change in perspective (like the one raised by the round table and the final participation of Prof. Raghavendra) is a good example of what can be learnt from any change in perspective... Yours sincerely,

Pascal JOUQUET, IRD / UMR 242 iEES Paris / Equipe “FEST”

32 av. H. Varagnat, 93143 Bondy, France Publications: https://www.researchgate.net/profile/Pascal_Jouquet/

VERTICAL ASPIRATIONS

Before discussing the next project “Two Earth Labs,” a detour to the Kochi Biennale is pertinent here, because it sets the stage for the vertical aspiration of Humans: An egotistical, megalomaniacal assumption to oversee all that exists on the earth and sky. Beginning with Deleuze (1988), who made the remarkable shift from the Tree model, which is man-made and partial, vertical and hierarchical and more particularly a repressive structure constituted by a skeleton of a “tree” that hides the many inconsistencies within, and hence he re-assigns a rhizome structure in his introduction “Rhizome” to *A Thousand Plateaus* (1988). At any rate this tree structure is merely a skeleton, an impoverished version passing of itself as a form that fully and accurately represents the genealogy it sets out to demonstrate. In

the rhizomatic structure the movement is horizontal and they branch out at unpredictable intervals, nonhierarchical and include localized nodes/centers that improvise, add and multiply, but do not produce an absolute, the Center. Often such striking biological and geological forms are used in this paper that forces the theoretical paradigm to emerge out of earth, and not merely from a human mind. More than ever our knowledge systems are derived and appropriated from the environment, but we fail to acknowledge Nature, and the paradigms gleaned from it, since the earth is at our feet literally and must be at our service. Whereas, diligently we acknowledge fellow human beings and their contributions through bibliographies, endnotes, footnotes and credits. Human alienation from nature appropriates all achievements emerging exclusively from and by humans and will interdict acknowledgement of other living beings—a self-authorization that leads to the use and abuse of the Other. In rare occasions, a few like Jean-Luc Godard, the French New Wave Filmmaker, would acknowledge nature as a source of inspiration in his works. Those moments often seem absurd, but they contextually render the unthought acknowledgement of Nature.

Godard's visual essay *King Lear* (1987) includes extracts from two infamous essays "The Death of the Author" by Roland Barthes and "What is an Author?" by Michel Foucault (Lodge, 1988). But Godard stretches them further to include Nature as a tangible source of inspiration and collaboration. *King Lear* a postmodern appropriation of Shakespeare's work, includes a character who plays The Author/Writer figure, called Shakespeare Junior the fifth: a punk who is often found plagiarizing. On several occasions he seeks solitude to write and reflect on a sea shore. He is sitting on the rocks and oblivious to the waves splashing, spraying and washing over him and his book, while he is busy writing. In sum, there is no absolute solitude at all, since the sea, sand, rocks and most of all the waves are engaging with him and those are also the most inspirational moments. It is unthinkable to thank and acknowledge Nature for intellectual activity, from an anthropocentric logic, however, several works by Godard navigate the viewer to think the unthinkable and thank the unthankable. Certainly, a few religions continue to include nature and yet the abuse on the earth continues, overtaken by Techno-Scientific Capitalism.

Postmodern theories suggest that since the enlightenment the vertical drive to look at the sky supersedes the horizontal (Barthes, 1977; Virilio, (1997). Hierarchies, binaries continue with their schemes and advance those vertical concerns. The move towards the sky and space without a horizon or an ever expanding one, becomes the alibi and dissimulation of Modern man to efface the recognition of plunder done upon the earth and justify it—hence, forget and repress. In general, the human race is looking up at the stars, seduced by "heavenly" objects resulting in fabrications that reach and explore space. The prompt for such movement is not merely material, scientific and megalomaniacal but also cultural and theological. Tejal Shah's work at the Kochi Biennale 2019, illustrates a fundamental cultural aspect, such as stories, especially during full moon, that surrounds the mystery and the beauty of this celestial object. Those simple stories and songs generate discourses that incite the fire to find, reach, and possess the moon and stars. Her *You Too Can Reach the Moon* (2013) is an image of a transgender mother/father pointing the moon to a child (lord Krishna), where Shah weaves gender and ecological issues. Parents in general pointed to the moon and told stories to entertain and distract an irritable child, or while feeding a reluctant kid. Along with the food they feed them with limitless desire to reach the unreachable, and yes for sure we have reached the moon. Children are quickly distracted and enamoured by the moon or is it the cultural annotations of it? Later in life the annotations continue as a romantic setting, where the parent is displaced by the lover. Such entangled desire for celestial objects in the sky is sustained by their eternal mystery and distance.

On the adjacent wall is a video by Shah, titled *Moon Burning* (2012), where continuous and intense burning reaches a point to form a crescent, another beautiful and seductive early phase of the moon. The aspirations are incited and they burn through history, until it reaches those destinations where actual intense fire burns the ore, melts, smelts and purifies them to form tools and objects that realise those ambitions. Even if enormous amount of resources and funding is wasted again and again on space research, even by countries that cannot afford to do it – like India for instance—we continue to justify such prodigal waste. For sure they don't need to justify, since such heavenly endeavours are a cause in themselves. More justifiable with instruments of information management--satellites—the one eyed "Cyclop" (Virilio, 1997), for they are contingents to wars and war "deterrence." This latter possibility is a powerful reason to walk away with absolute assurance of doing the "right thing." So where is the need for justification out there in open space without a horizon?

MAN-MADE DISASTERS AND THE SUICIDE OF THE EARTH

Marzia Farhana, an artist from Bangladesh, multimedia installation and video work *Ecocide and the Rise of Free Fall* (2018) at the Kochi Biennale describes the vertical move and the process that converts the material of the earth to reach the sky. Her assemblage is composed of found material obtained abundantly in the aftermath of Kerala Floods Aug 2018: white goods, furniture, books and other valuables washed away in the landslides. Not only the biological habitat and houses with all its possession disappeared in the landslides, but the very land itself on which they stood does not exist anymore changing the geography and mapping of those regions. The installation was distributed in several rooms but not carefully like in a home. They look like they have tumbled down, crowding the space and inverse, since they are dangling from the roof on thin ropes. Movement is difficult in this installation signifying not only the enormous number of objects that got washed away but also the abundance of wealth, old and new, in most of these regions: particularly new wealth, neo bourgeoisie, who perhaps crowded their homes with the

latest appliances and furniture. There was national attention to the Kerala calamity. Indeed, resources poured from several resources. This must have been a sharp contrast to Farhana who hails from Bangladesh, where the river Ganges flows both in India and her country. People are landless or marooned in newly formed islands, created by the erosion and due to the shifting river and this has become a way of life; for ever shifting and moving to the whims and fancy of the river and rain. A film titled *Char-The No Man's Land* (2012) by Sourav Sarangi, was screened in the recent Bangalore International film festival Biffes (2019), Nature's Fury category, is about one such newly formed island called Char. The people cut off from the mainland continue to live with literally nothing to survive on. To make things worse the India-Bangladesh border is drawn through this little insignificant land. The only way to survive is to improvise with the means found around, which happens to be smuggling rice, medicine etc. The border control vultures will not allow that very little they are striving for and relentlessly punish or just make it more difficult to get the very little that is possible. The Indian Government hardly supports them nor does it let them eke out a living for themselves and finally there is no public support for the very vulnerable.

It is pertinent to trace back to "Sedimentation of the Mind" (Smithson, 1968) and particularly to the segment 'From Steel to Rust' in order to connect with the work of Farhana. Her work resonates Smithson's, who first of all critiques artist who include technology in their work, and particularly the euphoric use of it as a medium. By suspending technology, he discovers the sub-stratum of the Earth, since the discourse of the industrial process is framed by the vertical reach away from the earth. His works highlights other processes of oxidation, carbonization, hydration that affect metals and rock weathering and prefers them for art making practice. Such processes are inherent to the Gaia model of the Earth established long ago by Paul Vernadsky a geologist in the early twentieth century (Arenes, Latour, Gaillardet, 2018). A model that remind us of the earth as a breathing and living organism and not an inert substance to be used in the service of Technology. Hence Smithson (1968) states:

By excluding technological processes from the making of art, we began to discover other processes of a more fundamental order. The break up or fragmentation of matter makes one aware of the sub-strata of the Earth before it is overly refined by industry, into sheet metal, extruded I-beams, aluminium channels, tubes, wire, pipes, cold-rolled steel, iron bars, etc. ... Oxidation, hydration, carbonization, and solution (the major process of rock and mineral disintegration) are the four methods that could be turned toward the making of art. (87)

Those torn and crushed household items in Farhana's work, are covered with mud, already rusting and slowly absorbed by the earth—justifiable return of 'man-made' material to the earth. Her anti-capitalist and anti-technology inclination dangles the rusted objects and illustrates its disintegration. She like Smithson recognizes how many artists are also grounded in a powerful ideology of the 'ideal' which incites human imagination and fires technological growth. Those artists therefore need the "refined 'paints' of the studio."

The smelting process that goes into the making of steel and other alloys separates "impurities" from an original ore, and extract metal in order to make a more "ideal" product. Burnt-out ore and slag-like rust is as basic and primary as the material smelted from it. Technological ideology has no sense of time other than its immediate supply and demand, and its laboratories function as blinders to the rest of the world. Like the refined "paints" of the studio, the refined metals of the laboratory exist within an "ideal system." Such enclosed "pure" systems make it impossible to perceive any other kind of processes other than the ones of differentiated technology. (Smithson, 1968, 86)

In one of the small rooms crammed with domestic objects, Farhana inserts a video screening running perpetually on the floor, while leaning against a vertical pipe. The video image is of a red hot fire burning relentlessly and slags of smelting metal sliding precariously. This room by Farhana is not creating a hearth with a fire cooking a warm meal, but a reminder of the industry and manufacture of the ideal material to make white goods and other traditional kitchen objects such as knives and ladles. A small boulder of rock is sitting next to the video as if it were looking at it. Perpendicular to the video and the rock is a mirror reflecting them—a necessary reflection on the smelting process, while the rock is sitting still in silence, unaware/oblivious to any ideology. At the upper end of the vertical pipe is an old rusty television with the image of an airplane silently and consistently swirling and hovering menacingly. The smelting metal on the ground has transcended to become the flying object in the sky. The image on the television is facing the floor and "looking" down at the smelting ore. Hopefully acknowledging the ore from which it was created, since once it floats into the sky it forgets the dirt it came from. Or is it ensuring that the fire continues to burn and smelt? Another adjacent television is also facing down, but it has a fantastical image of a flying horse, a mythical creature that made the planes a reality. The hearth in a home is not merely cooking an innocent warm meal, but various fantasies and thoughts simmer in conversations, and family and friends partake of food and thought. Perhaps the flying horse is the next novelty and technological upgradation, since the planes are not live enough? Fabrications and inventions are extractions of mental fantasy just as the necessary material are extracted from the ore, although based on a very irresponsible subjective-objective notion of the ideal.

Smithson's land art and writings, and Farhana's assemblage, poetically expresses the acceleration of technology as endeavours that move away from the earth. Technology itself is used to achieve this separation through the binary of Earth/Heaven which already implies the hierarchy. Therefore, although the ore found in the dirt below our feet is used for technological advancement, this very ore which is of the earth is forgotten through extreme refinement. Steel is one such "man-made" material that even if made from the earth it appears as man-made and not of the earth. The refinement of the ore exceeds itself to the point where the purified form of the material is not of the earth: refining is an erasure of the sediment that leads to amnesia, amplified by the desire to forget the plunder and

assault on the earth that primarily induces denial and amnesia/Alzheimer. The highly refined materials including steel, aluminium, nickel, chromium including plastic a man-made material par excellence (also made from elements found in the earth) are used for making objects that reach the “heaven.” Rockets, planes and satellites cannot be of the earth, because they must be man-made (not out of nature or God) in an absolute sense—like a god and beyond-The Uber Man. The Eiffel tower is by far the best example that illustrates the euphoria of steel and a symbol of Techno-Scientific aspirations that displaces the steeple of the churches, reaches the sky and visible from most part of Paris—a Techno-Scientific temperament and ideology consistently haunting the imagination (Barthes, 1979).

CRITICAL SCIENCING ZONE—TWO EARTH LABS—VERTICAL TO HORIZONTAL

The second event “Two Earth Labs” of Critical Sciencing Zone at IISc, was based on Land art work by Smithson. While the first event “Workshop and Exhibition” was a performance inside the auditorium, “Two Earth Labs” was outside the auditorium in a small wooded area. One of them was nestled among the trees and a square piece of land of about 3m x 3m was cleared and dug out to a depth of about 6 inches. While the stage inside the audience was about 6 inches high, this dug out was an inverse of it and the performers sat inside the square and performed their respective research (figure 2).

The space itself resembled a Bower bird’s nest to the scale of human and just as they adorn them with colourful found objects we used serial lights that lined the entrance to the nest (Deleuze & Guattari, 1988). The male Bower birds (the stage bird variety) clip the leaves from a tree and drop them on the ground, and they also carefully turn the leaf over to get the right shade of green that they prefer. After setting the stage the male bird sings and performs. Nature continues to perform, come what may, and improvise from what is around, sometimes they even pick bright blue plastic corks to decorate their bower. The project continually improvised to include thoughts emerging from Nature.



[Figure 2] Two Earth Labs

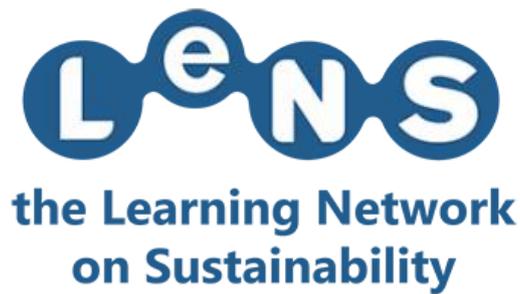
Within the square patch there were several mirrors on the ground facing the sky, but they hardly reflected the sky. Instead they reflected the foliage and soil. One of the mirror that faced the sky was strategically and partially buried in the earth and looked like a pool of water. The mirror in Farhana’s work and in “Two Earths Labs” are the pool of Narcissus. Egotistical, megalomaniacal and Narcissitic tendency gave rise to the overwhelming advancement in technology and ironically this has happened despite the several severe humiliations suffered by the human ego through paradigm shift that emerged since the beginning of 20th century, aggravated by 2 world wars. Radical paradigm shifts by Freud, Marx, Nietzsche et al along with socio-political re-hauling, contributed to a lack, and as a result the bruised ego reinstates itself through endless substitutions (Slavoj Zizek, 1992). Indeed, the exponential acceleration in technology according to Zizek is a result of this humiliation, surpassed by such **extraordinary** achievements. The first event of *Critical Sciencing Zone* introduced death on the stage, and the second by digging out square patches marked burial: the grave became a stage for further research by Scientists, Theorists, and Artists. Perhaps for the death and transformation of the ego. Nietzsche’s citation at the beginning of the paper is a sharp diagnosis of the Critical Zone that proscribes for sure, but also prescribes sustained investigation through denegation and de-alienation of man to find remedy for the disease called “Man.”

“...the great murders [destructions] have become the quiet game of the well behaved.”
Michel Foucault

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STUDY ON THE LANDSCAPE POLICY AND USAGE SITUATION : A CASE OF XIADU PARK IN YANQING COUNTY, BEIJING

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ABSTRACT

From the perspective of landscape environmental policies and usage situation, were the landscape construction actually services for the public? This issue had a strong correlation with the sustainability. Based on the previous research of Yanqing County landscape, this study took the extensive attention of Xiadu Park as example, from the perspective of public feedback and government strategy in park construction, and through the analysis of social media data and on-site investigation, and studied the usage situation of Xiadu Park. Finally, this research put forward that landscape design was not only related to public health and happiness, but also has the important role of serving and guiding public values.

Keywords Usage Situation; Xiadu Park; Micro-blog Data; Field Investigation

1. INTRODUCTION

Since the 1960s, the issue of environmental sustainable development has always been a hot topic. From the perspective of landscape environmental policies, the United States Environmental Act, the European Landscape Convention, and the Construction of Beautiful China, building a healthy, harmonious and sustainable relationship between the public and nature which were the ultimate goal of global landscape environmental construction. But, from the aspects of landscape policies making and usage situation, were the landscape policies actually services for the public? Had the entire process been completed from landscape policies formulation to implementation? How far was the landscape policies formulation to achieve the goal? This study mainly demonstrated the relationship between landscape policy and the usage situation of landscape in practice.

This research taken the Xiadu Park as an example. The Xiadu Park was digged a lake from the Guishui River upstream in Yanqing County. This park was given the title of the propaganda and education base of ecological civilization in 2016. The paper focused landscape activities and usage situation in urban park, collected data of landscape policy and public feedback, combined with research investigation data, conducted comparative analysis, suggested that the landscape policies making and usage situation were an important link to realize the sustainable development and utilization of landscape environment.

2. METHODOLOGY

Based on the previous landscape research result of Yanqing County, this study took the extensive attention of Xiadu Park as example, from the perspective of public feedback and government strategy in park construction, and through the analysis of social media data and on-site investigation, and studied the usage situation of Xiadu Park. Table 1 shows the concrete method of three phases, that were analysis of network data, practical investigation, comprehensive comparison.

The first phase included the network data analysis of the landscape activity in Yanqing County and Xiadu Park. The Yanqing County data collected the micro-blog information from the official website of government propaganda department, and gained micro-blog contents of Yanqing County department official. This paper taken the government micro-blog attention degree as the initial research object, statistical inference that the main landscape policies types of Yanqing County. There had two parts, the one collected the landscape policies information from the government micro-blog, and the others collected the landscape experience comments from the public micro-blog. Then summarized the main activities of the Xiadu Park by the government and public.

The second phase was based on the research results of social network data analysis, further research with field investigation, It included interview investigation of usage situation by the public and government department, focused on the implementation of landscape policies and the landscape experience process of public for detailed investigation and analysis, in order to found out the practical problems of the policy implementation, and further to put forward reliability recommendations for the government to formulate strategic amendments.

The third phase, by comparing the relation between the first and second phase of the research results, such as whether there was a deviation between social network data and practical investigation data, secondly, which commonly concerned problem in areas of social network data and practical investigation data?

[Table2.1] The research method and content of landscape policy and usage situation in Xiadu Park

Object Layer	Criterion Layer	Index Layer	
The park landscape policy and usage situation	Network Data	The landscape activity in Yanqing County and Xiadu Park.	The landscape experience comments from the public micro-blog.
	Practical Investigation	The park management work. The infrastructure and usage situation in the park.	The attitude of the citizens to the park. Types of activities of citizens in the park.
	Comprehensive Comparison	To compare the relation between network data and field investigation information.	

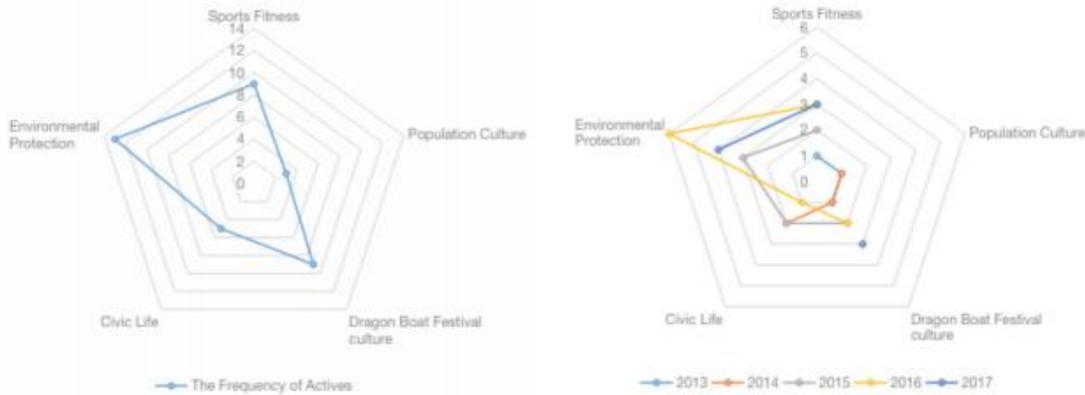
3. CONTENT ANALYSIS

3.1. The first phase

The study gathered 631 original micro-blog data of landscape environmental policies through the Yanqing government propaganda department from June 2018 to March 2019. There included micro-blog themes, key contents, also had the numbers of praise, forwarding and comments. Among those part which taken the numbers of praise, forwarding and comments as the mainly influencing factors of social attention degree, and taken the social attention

degree obtained from the micro-blog as research subject. According to the statistical sorting results can be determined by above 35 people concerned, there had been 27 micro-blog contents identified. After screening, it could be summarized into 6 theme activities of landscape policies in Yanqing County: operation notice(Landscape tourism etc), rural industry, cultural activities(the Dragon Boat Festival etc), propaganda category (scenic scenery etc), the actives of World Horticultural Exposition, transportation technology.

To take Xiadu Park of Yanqing County as an example. The study collected the news about Xiadu Park from Yanqing County government official website during 2013 to 2018. There had 44 activities been screened, mainly covered 5 categories about environmental protection, sports fitness, civic life, Dragon Boat Festival culture and population culture. We could presume that the Yanqing Government has paid more attention to carrying out environmental protection and greening in Xiadu Park, followed by some sports and fitness activities about Marathon,



walking, dragon Boat Race etc, as shown in Figure 1. The relevant government departments paid more attention to leisure and entertainment activities, less arrangements for humanities and arts experience activities.

[Figure 1] The frequency and each year of landscape actives during 2013 to 2018 in Xiadu Park

In view of the rather few samples about Xiadu Park in the public comment network (Meituan network etc), this paper chose to use micro-blog data, and collected the micro-blog text information of public and media in Xiadu Park. There had 578 micro-blog data contents after organized and screened redundant data, and then used the visualization tools to generate the word cloud map. The high-frequency words shown in the word cloud map are parks,



fishing, lotus and umbrellas which are mostly related to the surface of Lotus Lake, and it can be seen that the public always fishing around the Lotus Lake, in addition to some sports activities about marathons, walking and dragon boat races etc, as shown in Figure 2.

[Figure 2] The 100 top high-frequency words of micro-blog text information by pub

3.2. The second phase

In the practical investigation and research, the park not only set the tour map and signs, but also had the identification column about the forest and plant healthy value. There built a horticultural space in the west side of the park, mainly to serve the public for planting experience activities. From the ‘2018 Summary of Xiadu Park’ introduced by Park Service Staff, it emphasized that the park greening as an important measure to enhance the level of civilization in urban development, such as drainage pipes, the river cleaning, the green enhancement actions, pest control, set up additional publicity columns and other projects, as shown in Figure 3. The public cultural events held in 2018 were: Dragon Boat Festival, the countdown activities of Horticultural Exposition, ICE entertainment projects. The Xiadu Park will focus on environmental remediation, landscape transformation and improvement of infrastructure in 2019. Hence, 4 theme activities of landscape management in Xiadu Park: environmental remediation, infrastructure improvement, ICE entertainment projects, culture festival.

The time of field research was weekend in winter, the activities trajectory of Yanqing citizen mainly from the

north entrance, the west entrance, along the lake's eastern in Xiadu Park. In the random interview with the public, as Figure 4 shows mainly on ice entertainment activities, or watching, walking, photography, stopping and meeting friends around the Lake coast. The middle-aged and the elderly came the park were most frequency, and they concentrated on during two to three o'clock in the winter afternoon. The primary and junior high school students chosen the weekend. The university student came to the park in the summer and winter holiday. The pupils were more interested in recreational facilities and games in the park. The older persons had a positive attitude towards the park and look forward to increasing the literary and artistic activities. The middle-aged people were more interested



in the fees issue of the park. The young people look forward to increasing the space for communication in the park.



Hence, the top 6 public activities in Xiadu Park: ICE entertainment projects, walking, watching, photography, stopping, meeting.

[Figure 3] The entrance and publicity column in Xiadu Park

[Figure 4] The usage situation of the citizens in Xiadu Park

In addition, there also has difference between government police and public usage, complementary. For example, Xiadu Park organized an international sculpture art work in 2001, in order to the improvement of urban



culture. But, the citizens did not have a strong enthusiasm for the sculpture works in the interview. By searching the image information of the sculpture works of Xiadu Park, the public did not pay more attention to the sculpture art-

works, but used it as a “fitness facility”, as shown in Figure 5.

[Figure 5] The sculpture works and the citizens in Xiadu Park [photo from web]

3.3. The third phase

From the first phase, we inferred that the landscape development and utilization of Yanqing County had a relatively single type. Above all the humanistic experience had not been paid enough attention. From the practical investigation of the second phase, we found that the ice entertainment projects park were popular for the public. The government did not enough to explore and use the potential value of landscape resource, and they should be further consider the landscape construction with a holistic view.

By comparing the network data and field investigation information, we found that the network data was basically consistent with the field investigation information, and the common concern issues of the two stages were landscape construction, environmental protection and transformation work, tourism operations, to organize the sports activities. Public mainly prefer recreational and sports activities in the park.

4. DISCUSSION AND REFLECTION

This study found Xiadu Park mainly provided leisure activities and sports venues for the citizens. The park landscape was not only an important embodiment of the urban culture but also an important part of public life. Especially, the leisure and entertainment activities were not the whole content, the rich humanities and art activities could provide the public with the self-cultivation value. At the same time, Xiadu Park had ideally location, such as relying on a good ecological environment, increasing the cultural festival activities in the park, and combined the ecological advantages and humanities and artistic activities, and play a role in society could not be ignored.

The park landscape construction had rich functional value, natural and environmental education also was the function undertaken by the park. Based on the existing infrastructure, insert the relationship between people and nature, knowledge of nature and the environment, etc., into the park construction. To organize landscape experience activities In the park. in order to play a more active role for the creation of forest cities.

5. CONCLUSION

From the view of landscape environmental policies and public usage situation in Xiadu Park, we should adhere to the closed-loop of landscape policy making and design, landscape strategy implementation, landscape post-evaluation, and finally return to landscape policy making. We should give full play to scientists, designers, artists, environmental protection organizations, the public and other area in this process. In order to achieve the sustainable usage of the landscape, and actually achieve the ultimate goal of public well-being. In addition, in order to enhance the values of public self-cultivation, Xiadu Park could be based on the advantages of natural ecology, and combined with the thought of harmonious symbiosis between human and nature. Finally, this study put forward that landscape design was not only related to public health and happiness, but also had the important role of serving and guiding public values. The construction of the landscape environment to promote public ‘health, happiness, values’ was also an important part in sustainable landscape construction.

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AN ANALYSIS AND APPLICATION OF AFFORDANCE THEORY IN DESIGN OF URBAN RAIL TRANSIT

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ABSTRACT

This paper explores application of affordance in design of urban rail transit and tries to provide a supplement and expansion for traditional design theories and methods. First, this paper gives an overview of affordance concept in ecological psychology. Second, this paper tries to expound the value of affordance theory in design practice that affordance emphasizes the interaction relationship between environments and occupants. Finally, this paper uses case studies to demonstrate the feasibility on combination of affordance theory with rail transit design. Concerning design practice, affordance could be used to optimize passengers' experiences during the whole journey through effective behavior guidance, so that we will encourage more social groups to participate in this green travel.

Key Words: Affordance, Urban Mass Transit, Interaction Relationship, Behavior Guidance.

1. INTRODUCTION

Urban rail transit has become a more and more important mode of transportation to alleviate urban road pressure, reduce urban pollution and improve urban appearance, which is the preferred transportation for citizens with its advantages of punctuality, convenience, rapidity, safety and large carrying capacity. This kind of transportation also plays a guiding role in the optimization of urban structure and the sustainable development of distributed economy in China.

Nowadays, the spatial structures and forms of rail transit stations have presented a complex diversity in China. The design levels of rail transit stations in different cities and regions are uneven. Due to the deviation between users' understanding and the design intentions of rail transit stations, many negative and disharmonious behaviors have been triggered, which have affected people's experiences in travel, even caused potential safety hazards and management obstacles. Excellent design works made the interaction relationship between environments and occupants naturally. On the one hand, good design can improve the usability and ease of facilities and environments. On the other hand, these design works can also make the environments bring positive guidance and hints, and promote harmonious interactions between people and environments, so as to create an appropriate experience for one in a trip. This leads me to think about affordance theory.

Affordance was first proposed by Gibson, and then introduced into the field of design by Norman. Later, the concept of "Without Thought Design" was put forward to seek unconscious and harmonious relationship between human beings and substances by Naoto Shenzawa, which was also an application and development of affordance theory in the field of design. People are interacting with their surroundings and objects anytime and anywhere include the subway stations, but we are often unaware of our subconscious behaviors. There are many possibilities for the matching of a large number of unconscious behaviors with the affordances of things. This paper will review affordance theory to help readers to understand the ecological relationship between people, rail transit stations and cities better, further explore the application of affordance theory in design of urban rail transit.

2. OVERVIEW OF AFFORDANCE THEORY

Gibson, an American perceptual psychologist, believed that perception was the direct product of human contact with the outside world. It directly reflected the change of external physical energy without experiencing the process of thinking (Gibson JJ, 1950). The concept of affordance was first put forward by Gibson in the 1970s, which was the core of the theory of direct perception. It was initially understood to describe the directly perceptible behavior relationship between environments and animals. Affordances were all the "action possibilities" latent in the environments, which were independent of an individual's ability to recognize them (Gibson JJ, 1979).

Affordance was introduced into the field of design by Donald A. Norman (an American cognitive psychologist). He mentioned affordance in his monograph *The Psychology of Everyday Things*, and believed that in the field of design, people were more concerned about the result of perceived affordance rather than real affordance. Unlike Gibson, Norman closely linked affordance with past knowledge and experience of organisms. The frame of reference was human's psychological and cognitive abilities (Norman DA, 1988). William W. Gaver classified affordance into four types based on perceptual information: perceptible affordance, false affordance, hidden affordance and correct rejection (Gaver WW, 1991).

Japanese modern design master, Naoto Fukuzawa, put forward "Without Thought Design", which is a typical application of affordance in ecological psychology. His design works seek unconscious and harmonious relationship between people and substances. He advocates that design activities should pay more attention to the relationship between people, objects and environments, that is to say, designers need to observe the clues of design from people's unconscious interactions with environments in their social lives. Such as, some railings in public places are all bent because when the height of the railing is equal to the height of a chair. According to the past experience, people will bring out the action of "sitting" on the railing. However, people give the function of "seat" to the railing unconsciously. Naoto Fukuzawa said, designers should discover invisible things in the environments (Takeshi G / Masato S / Naoto F, 2005).

3. THE VALUE OF AFFORDANCE THEORY IN DESIGN PRACTICE

The traditional design pattern, function-centred design mode, take so-called users' demands originate from designers' imaginations as the core often make designers in trouble. For example, the guardrail used for safety isolation at the edge of a pool may become a "rest seat" for people, it not only increases the risk but also contrary to the original design intention. In traditional design methods, the function-oriented design thinking mode leads to a unique solution, which gives users specific restrictions through functional settings. But, traditional design mode is difficult to adapt to the complex multi-interactions between humans and surroundings, and easy to introduce design into idealization (Ma XM, 2018).

We need to rethink whether the so-called "demand" is a real existence that remain to be confirmed. From another perspective, there are some limitations in function-oriented design mode. However, the design practice based

on affordance is a supplement to the traditional design thinking dimension. In a complex interaction, designers could understand the relationship of things objectively and comparatively by affordance theory. On the one hand, design based on affordance concept avoids the experience and personal judgment of designers as far as possible. On the other hand, designers need to evaluate and analyse the environment for project interaction by the perspective of affordance, and avoid any negative impact on people in target environments (Ma XM, 2018). Therefore, a method is provided to find the clues of design from the interactions between people and environments: Observe and find the behavior traces of users through the whole process. Next, try to analyse the material forms related to users' common behaviors. Finally, redesign through the environmental appearance (shape, texture, color, edge, etc.) to realize the behavior guidance, keep the shapes of things and environments are consistent. In addition, we hope this work could provide inspiration and instructions to users through sensory information. Designers develop design activities by understanding the dynamic relationship among people, objects, environments and all the three.

Rail transit station is the core part of urban traffic system, which is a complex combination of functionality, commerciality, sociality and culture. In such an environment, people always interact with their surroundings (Figure 1). There is a great significance to apply the theory of affordance to the field of rail transit station design. Affordance provides a reverse thinking model that encourages designers to create a more open and diverse environment. Put forward design strategies in a more pluralistic, systematic and ecological way, so that users judge correctness of operation will be relatively easy. Establish positive guidance, stimulate users' positive behaviors, let them experience the

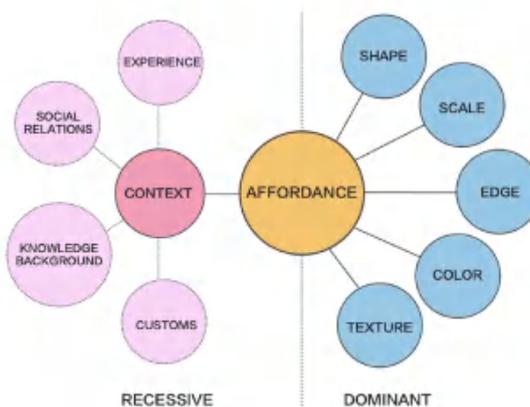


significance and value in the interaction process with environment.

[Figure 1] Interactive Circle on Urban Residents and Rail Transit System

4. DESIGN STRATEGIES BASED ON AFFORDANCE IN DESIGN OF RAIL TRANSIT

The concept of “Design Dissolving in Behavior” could explain the affordance well. For the purpose of dissolving behaviors in travel, designers need to pay more attention to building a system which ensure the whole trip process is inclusive, efficient and continuous. All these interaction activities rely on one’s perception system. People can perceive the shapes, scales, edges, colors and textures of things by processing sensory information, even build contexts by one’s experience, social relations, knowledge background and customs, etc. Therefore, according to these factors, the affordance can be classified as dominant part and recessive part (Figure 2). Take the relationship between residents and urban rail transit system as a starting point, we can look at urban rail transit design from two aspects:



design based on dominant affordances and recessive affordances. Next, we will discuss these two aspects with some

cases, and aim to explore appropriate design strategies for urban rail transit.

[Figure 2] Classification of Affordances in Design Practice

4.1. Design based on dominant affordances

There are constant behavior interactions and information exchanges between passengers and environments (pedestrian passages, information boards, service management stations, ticket machines, gates, elevators, seats and trash cans, etc.). All these constitute the rail transit system. The environments generate affordances are related not only to these entities in these subway stations, but also to passengers. If a passenger's journey from A to destination B is accessible without barriers and smoothly, it will be a more efficient and better experience. Therefore, designers should fully consider the continuity of users' behaviors through the whole trip, when they plan to design spaces and facilities in Metro stations. Many of these consecutive behaviors occur in people's subconscious states. Passengers process sensory information (especially the visual perception) based on people's perception of external things. Designers can connect passengers' behaviors by designing shapes, scales, edges, colors and textures of objects in station to produce positive behavior guidance for passengers.

1) Shape

Shape is an important manifestation of an object, which can make people quickly perceive the characteristics of this object and its value and significance. The following pictures (Figure 3) shows that the automatic ticket checker at a station in Hangzhou often causes passengers' erroneous operations, because information interface of the screen on this machine always shows the pattern and shape of public transport card, and passengers will unconsciously swipe the card on the screen above rather than on the correct card swipe area below. From this point of view, the information screen of the automatic ticket checker provides an incorrect affordance for people. However, the automatic ticket checker in the right picture was taken at a subway station in Nanjing. The designer designed the shapes of one-way ticket collection port and public transport card swipe area coincided with people's cognition. In other



words, the shape features can connect people's behaviors directly. Therefore, passengers can quickly complete the correct action.

[Figure 3] Left: Automatic Ticket Checker 1 Hangzhou, China; Right: Automatic Ticket Checker 2 Nanjing, China

2) Scale

The establishment of scale is based on human. Reasonable scale relationship of spaces or facilities in metro stations can effectively be used to grasp people's perceptual psychology. An example is given in the following left figure (Figure 4). The waiting seats on the wall in Bermondsey Station (London) provide two kinds of scale relationships for passengers: First, there is a metal ball in front of every armrest, which show a scale relationship of action "grip" with people's hands. With the help of the ball, elderly people with inconvenient legs can easily stand up. In addition, the armrests provide an affordance for hanging bags, umbrellas and crutches. Second, the height and inclination of these seats show a scale relationship with people's legs, which effectively control the rest time of passengers and save more space for the platform in the station.

3) Color

According to people's experience, every color usually has its own specific meaning, such as, red makes people feel nervous and yellow provides a striking hint for people. The contrast of different colors in a room can make people perceive the relations among these partitioned spaces. Barcelona Metro station (Spain) provides visual guidance to passengers by using red lines. These red streamlines on the ground contrasts with the clean white wall make passengers feeling intense, so that most of people may be driven unconsciously by these lines without careful observation. Red lines let people perceive where the fast flow area is, where the entrance and exit area is, and where the service area located by changing their density or direction. Similarly, Suzumenomiya Station (Japan), planner keep the whole yellow blind roads as the visual centre running through the subway station space to guide passengers including ordinary human. (Figure 4)

4) Edge and Texture

Just like the description of "edge" in ecological psychology, it has become the visual foothold of space perception. People perceive the depth, level, corner, interface, closure, continuity and interruption of an object though "edge". It can be seen that "edge" plays a very important role in human visual perception. Edge is related to shape, color and texture. Here, I discuss the edge and texture together. Texture is mainly reflected in the surface of an ob-

ject, and different textures can make people quickly distinguish the boundaries of things. Hollywood & Vine Metro Portal and Plaza, the front square of a station provides passengers with rich social functions: rest, socialization, information inquiry, landscape along the street, etc. Highlight the local regional characteristics, it also brings users a



sense of belonging. By distinguishing the textures of the ground, people can perceive the difference and relationship between bicycle lanes, sidewalks, rest areas and entrances of subway stations (Figure 5).



[Figure 4] Left: Bermondsey Station; Middle: Barcelona Metro Station; Right: Suzumenomiya Station

(Image source: <http://www.ianritchearchitects.co.uk>; <http://www.on-a.es>; <http://www.jred.co.jp/>)

[Figure 5] Hollywood & Vine Metro Portal and Plaza (2010) (Image source: <http://www.archdaily.com>)

4.2. Design based on recessive affordances

The above parts mainly discuss how to construct positive affordances by change physical factors of environments. In addition, people's own experience, social relations, knowledge background and customs will help themselves to build some specific contexts when passengers perceive objects in a station. These contexts provide invisible and hidden affordances. For example, things connect people's emotions and memories. Paradise Umbrella Company once designed a bamboo umbrella called "The Words of Bamboo", which is reminiscent of the traditional, classical Jiangnan oil-paper umbrella. This is an internal link between this material form and human beings. In the field of rail transit design, designers should consider not only the basic physical functions of rail transit, but also more internal links between passengers and environments. Through the construction of contexts, passengers or tourists could perceive more urban culture, history and regional characteristics, in order to create better experience for people and practice sustainable significance. For example, the architectural surface of Ningbo Museum (Wang Shu) can arouse people's thinking about urban culture. As shown below (Figure 6), two light rail stations in Japan make good use of urban landscape to enhance passengers' travel experience. Designers design appropriate height of pallets or handrails rely



on building glasses to produce a guiding affordance, which links that people like to watch scenery (sunset) at home

by the windowsill when one is relaxed. Such a scenario design evokes people's emotions, and the simple architectural style also makes passengers feel permeable and comfortable.

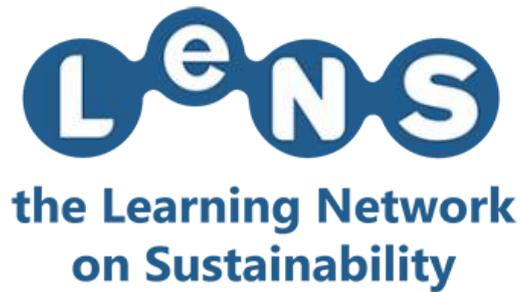
[Figure 6] Left: Isawa-Onsen Station; Right: Iiyama Station (Image source: <http://www.jred.co.jp/>)

5. SUMMARY

Compared with traditional design methods, affordance-based design process focused on the relationship between environments and behaviors. Many people misunderstand the affordance, which is not a new design method or tool, but provides us with a perspective from ecological psychology. Design convey value through human intuitive behavior process. This communication reflects the designer's concern on environment in which people live. We have to emphasize that core of affordance theory is a discussion about "relationship". As Naoto Fukuzawa said, great designer not only designs the appearance, shape, structure of a product, but also needs to design a relationship. It is more meaningful for designers to deal with this relationship by reasonably utilizing physical attributes and constructing contexts of environments. Now, China is investing more in the construction field of rail transit. Besides meeting the basic functions for rail transit system, we should pay more attention to the harmonious relationship between the whole city's ecology, people and environment, and then promote sustainable development. Affordance of ecological psychology gives us a different perspective in design application. The interpretations between Affordances and complex environments should be pluralistic and horizontal without unique solution (Ma XM, 2018). Of course, there still are more possibilities to be excavated about this theory. This paper is also a tentative discussion.

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DISCUSSION ON THE SUSTAINABLE MODE OF NEW RURAL CONSTRUCTION IN CHINA FROM THE PERSPECTIVE OF ENVIRONMENTAL CONSTRUCTION AND COOPERATIVE RELATIONSHIP

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ABSTRACT

Nowadays in China, because of the acceleration of urbanization and the influx of large numbers of agricultural population into cities, the rural areas show a serious aging and hollowing trend. In order to attract rural residents to return home for development, the government has carried out extensive new rural construction from the political, economic, cultural and social aspects. In large number of rural construction practices, there are many cases of copying urban living patterns, separating rural residents from land, and not respect for the actual conditions of villages. How to improve the living environment of rural residents, how to protect and inherit the context, how to respect the local residents' architectural culture, folk customs and traditional way of life, enable the residents can get sustainable benefit from the cooperative relationship, is a new challenge for designers. Taking the construction of Wuxi Oriental Pastoral Mitao Village and Hangzhou Xiajiang Village as examples, this paper attempts to explore the impact of different modes on local residents, the relationship between residents and the main subject of construction, what conditions are needed for sustainable mode, and what positive role design can play in the construction.

Key words: new rural construction, sustainable mode, environmental construction, cooperative relationship

1. INTRODUCTION

In the past 40 years of reform and opening up, China's urbanization construction has made remarkable achievements. The promotion of urbanization has formed a siphon effect on the vast villages and towns around the city. A large number of agricultural populations poured into the city, making the rural areas show a serious aging and hollowing trend. When industrial production and urban development have a certain basis, it is imperative to properly feed agriculture and support rural construction and upgrading. Since the Fifth Plenary Session of the Sixteenth Central Committee of the Communist Party of China put forward the policy of speeding up the improvement of human settlement environment, improving the Peasant quality, and promoting the construction of "new rural areas of objects" and "new rural areas of human beings" to go hand in hand since 2005, it has gone through nearly fifteen years. During the exploration of more than decades, many new rural models have been experimented and thought, with failures, successes, breakthroughs and generalizations.

Looking back on the past, there are not only the pilot activities of minority artists in Bishan Project in Anhui Province, but also the successful cases of the combination of ancient towns and commercial development such as "Wuzhen Model" exhibited at the Shanghai World Expo. Through repeated exploration, the new rural construction has gradually formed a complete transformation model of government regulation, factor extraction, moderate commercialization and villagers. participation. In the process of construction, more attention is paid to human factors and sustainability, so as to actually realize double upgrading of industry and environment. Jiangsu and Zhejiang are the forerunners of new rural construction, and a large number of successful cases of new rural construction have appeared in Jiangsu and Zhejiang, such as the well-known "Wuzhen Model" and the "Songyang Story" exhibited at the Venice Biennial Exhibition in 2018. This paper chooses two cases of new rural construction, namely, Mitao Village, Yangshan Town, Wuxi, Jiangsu Province, known as "Oriental Pastoral", and Xiajiang Village, Fengshuling Town, Chun'an County, Zhejiang Province, and discusses the sustainable model of new rural construction from two aspects of rural environment building and cooperative model.

2. CASE 1: MITAO VILLAGE

As a case of propaganda that has been taken as a successful model by the local government, it is very easy to arouse criticism by putting forward different opinions. However, the construction idea of Mitao Village, has a lot to ponder over. Mitao Village is located in Shifang Village, Yangshan Town, Wuxi. The total planning area of the project is about 6246 Chinese acres. The project is invested by Orient Landscape Industry Group for 5 billion Yuan. It started construction in April 2013. It has been put into operation in less than five years and has been used as a model in other cities. In the course of exploring the new rural construction, the model of agricultural complex proposed by Mitao Village has indeed put forward a new direction and thinking, that is, the idea of combining agricultural mod-

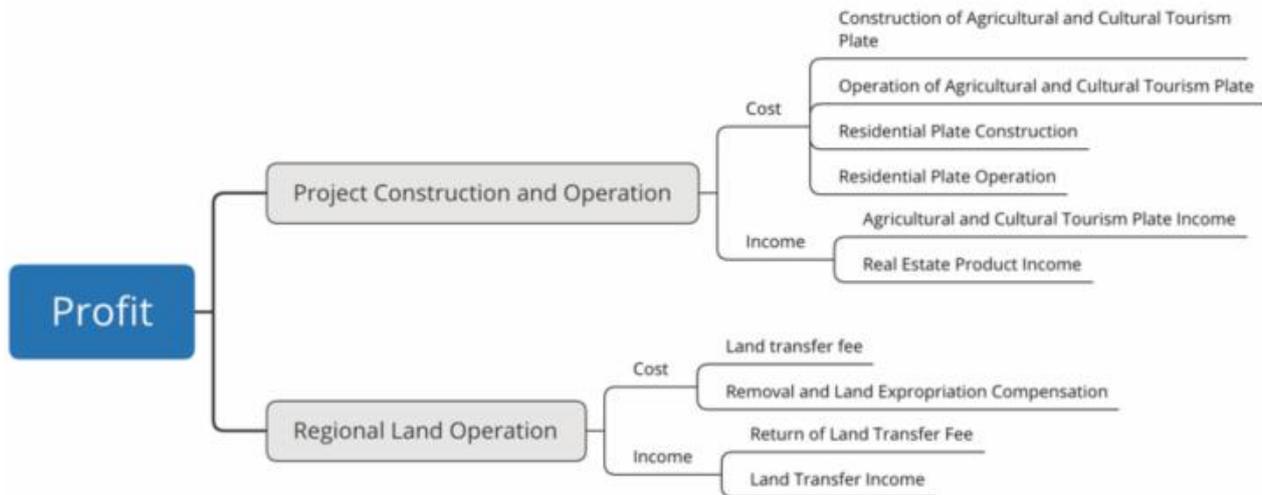


ernization with leisure tourism.

[Figure 1] Panoramic view of Mitao Village

Mitao Village has a superior geographical position, abundant tourism resources and mature agricultural and sideline product production, but the transformed area is large, and the amount of funds invested in the early stage is also large. The capacity matched with the area of modern agricultural area designed may not be profitable or be difficult to form long-term large-scale profits in the short term. Looking at the transformation of Mitao Village, from the perspective of overall construction, it is difficult to say that it is a case of sustainable new rural construction. Fei Xiaotong expounds the relationship between farmers and land in his book "Rural China": Chinese farmers are naturally and closely linked with land, and the agricultural society is a model of differential cooperation based on land. Although the construction model of Mitao Village is presented in the form of agricultural complex in design, it is not the local villagers who participate in agricultural production, project operation and site management.

At the early stage of reconstruction, Mitao Village introduced capital for development, purchased the ownership of land by onetime economic compensation, let the villagers move to another resettlement site for unified resettlement and no longer carry out agricultural production, and the villagers cannot benefit from the long-term operation of the project after transformation. The original villagers of Shifang Village are composed of villagers with three major surnames, and there is no close clan as a link. Once all the villagers are given a one-time economic compensation to let them leave their homes, it is tantamount to splitting the connection between farmers and land. In the affluent areas in the suburbs of cities where non-agricultural industries are developed, and villagers can earn income through other industries, this method may be feasible in the short term. But in the vast rural areas, if the connection between farmers and land is split and the villagers are not brought into the new production model, can the rebuilt rural areas still be called real rural areas? If the villages have no villagers and there is no continuation of sustainable agricultural production and lifestyle, the context cannot be truly inherited. Even if the reconstructed model is profitable, it can-



not be considered as a real rural construction model that can be promoted and replicated.

[Figure 2] Profit structure of Mitao Village

3.CASE 2 XIAJIANG VILLAGE

Another case is Xiajiang Village, located in Fengshuling Town, Chun'an County, Zhejiang Province. Although it is not a “web celebrity” case in the new rural construction, the construction idea is simple and friendly to the people. Xiajiang Village is located in the northeast corner of Fengshuling Town, Chun'an County. The existing Fengling-gang river way and county road Chunyang Line pass through the village. It consists of three natural villages: Zhaier (Houlongkeng) Natural Village, Yijia Natural Village and Xiajiang Natural Village. There are 237 peasant households in the village, with a total population of 745. It was a contact point when Chairman Xi Jinping and Vice Premier Zhang Dejiang were appointed the Secretary of the Zhejiang Provincial Party Committee. The construction idea of Xiajiang Village is firmly established on the basis of improving the living environment and living standard of villagers. The budget of early investment is controllable, the feasibility is strong, and it has a significance of reference in environment construction and cooperative model. At the beginning of overall construction plan procedure of Xiajiang Village, the planning unit made a thorough investigation of all residential buildings and permanent populations, took photos and filed each building, established the “Building Status List” and put forward optimization suggestions one by one; delimiting of residential areas, unified control and regulation, coordinated coloring, reproduction of styles and features, and effective integration of public spaces were implemented.

In the aspect of guidance of industrial transformation, Xiajiang Village creatively puts forward the rural broker model. According to the current situation and reality of Xiajiang Village, a development and implementation plan of incoming material processing projects is formulated. Through the introduction and cultivation of resource processing and incoming material processing eco-industries by the rural brokers, it helps more villagers to achieve employment and income increase at home. The establishment of incoming material processing township enterprises with precise orientation has created a new income increasing mechanism and new jobs while helping industries upgrade and increase productivity.

The mechanism of attracting talented people back to the countryside attracts migrant workers to return home for development and entrepreneurship. After several years of environmental upgrading and industrial upgrading brought by cooperative model, the construction of Xiajiang Village Tourism Service Center has become an important place for Xiajiang Village to carry out cultural tourism; and resource-processing eco-industry such as bamboo and wood product processing has also brought new possibilities to this traditional village. In Xiajiang Village, the promotion and planting of organic vegetables in the past five years has played an important role in promoting economic development. The sales volume and price of ecological agricultural products have risen at the same time.



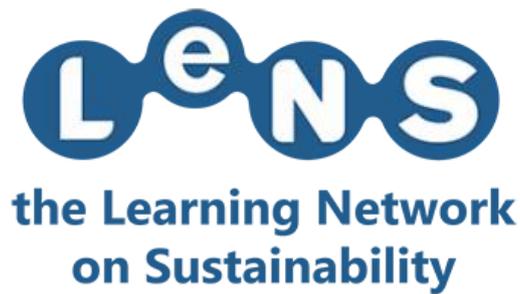
Villagers have gained remarkable profits from it. Such changes have also laid the villagers' confidence and provided greater impetus for long-term self-renewal.

[Figure 3] Schematic map of Xiajiang Village Reconstruction

4. CONCLUSION

From the case of Xiajiang Village, it can be seen that the various strategies for new rural construction are aimed at not only solving various local problems, but also promoting the positive interaction between rural and urban areas. The new rural construction is to mainly construct the image of countryside in the new era and excavate the traditional culture in depth, rather than operate farm stay all in the same key. Local folklore is fully excavated, cultural activities are carried out by using it as a carrier, and local specialties, special snacks, exquisite commercialization are maximized. On this basis, cultural and creative products and projects are further derived, rural cultural experience projects that attract urban tourists are designed, and by using the opportunities offered by e-commerce platform to bridge the gap between urban and rural areas, new chances for external sales of rural products are brought about. Thereby, local problems are solved, and new choices are offered to the residents of surrounding cities. Naturally, tourism economy can be promoted, and talents can be attracted back. Although the new rural construction is based on the principle of protecting the original rural environment, the current rural lifestyle, productivity and production relations have undergone fundamental changes. Young people go out to work and bring back new concepts and new life needs. Therefore, it is the root for rural areas to protect the tradition, but the renewal of concepts and models is irreversible. Industrial upgrading and cooperative models are to meet the needs of modern life. The government's key investment lies in infrastructure. On the basis of upgrading infrastructure, upgrading of supporting industry and cultivation of differentiated culture are the real soft core which is valuable. Manufacturing differentiation is an in-depth and systematic project, which requires a long-term management team who has strong operation and execution ability, adheres to unified standards, and not only focuses on the immediate economic interests, but also focuses on the future of the village. The best participants are the villagers themselves. There are three core demands for a good sustainable model, i.e., improving the quality of life of local residents, creating a sustainable profit model, and creating a residential environment with local cultural characteristics. The new rural construction cannot be attributed to simple commercial development, nor can it copy the business model of the city. How to locate the countryside should be rooted in the local cultural soil and select the characteristics that express differences. Any transformation should be based on improving economic efficiency, improving utilization rate, and keeping in line with modern lifestyle. Different from the largescale demolition and construction of urban renewal, the rural renewal is not a simple commercial development of the village by attracting investment. Instead, it takes the villagers as the main body and the public space as the carrier, promotes the local traditional cultural elements, optimizes and packages traditional industries, and combs the space in order to increase the public space and cultural functions. Through in-depth investigation and analysis of the history and culture of each village, traditional process formats and local villagers' living needs, the most representative cultural or industrial elements are selected, and unified control planning standards are used to promote the orderly self-renewal of the surrounding environment. Only the sustainable content and model can promote sustainable self-renewal of villages.

11. EDUCATION AND DIFFUSION OF DESIGN FOR SUSTAINABILITY



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DSXC: TOOLKIT TO SUPPORT DESIGN EDUCATION PROCESSES FOR SUSTAINABILITY

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ABSTRACT

The education for sustainability in design should be approached from the knowledge of global methods but taking into account the contextualization of the tools and not the simple translation and use of methods developed outside Colombia, using tools that connect with students and new ways of learning and facilitating the teacher the dissemination of knowledge in a structured and concrete way. The (DSxC) aims to develop this support, always focusing on the context and facilitate the student to understand and apply sustainable strategies to the development of their projects in classroom.

Key Words: Sustainable design, design methodology, academic tool

INTRODUCTION

The current academic paradigm as a mediator of the relationship between sustainability, design -theory and praxis- and designer presents great difficulties. Approaches between sustainability and design date from the 70s (Andrade Vicente, Frazão, & Moreira da Silva, 2012, Madge, 1997) has been transformed from the hand of the social conjunctures; The Rio Summit of 1992 and its proposal for the reorientation of education towards sustainable development marks the entrance of the academy as a mediator in this relationship. To date, Education for Sustainable Industrial Design presents multiple difficulties excelling the distancing between the generation of academic knowledge and its application in professional praxis. In the case of Educational Sustainable Industrial Design (in Latin America, this distancing is the product of: 1. There is little specialized training of professionals in Sustainable Design which translates into an inappropriate transfer of knowledge, 2. The theory surrounding Sustainable Design has been imported, which to generated barriers of the context for its implementation, 3. The Education for Sustainable Industrial Design thought only as isolated courses in the curriculum-does not allow to know and use by students the broad spectrum of principles, methodologies and methods offered by the Sustainable Design (Geli de Ciurana & Leal Filho , 2006; Sterling & Thomas, 2006). According to the previous assessments, the research question is formulated: What characteristics should have a pedagogical tool that supports the processes of education in sustainability contemplated under the academic context of industrial design?; This problem question is the starting point for the design of the research project whose main objective is then: Design an academic tool that supports pedagogical processes in sustainable design. Consequently, the hypothesis is presented: Through the use of a pedagogical tool -linking the general concepts of Sustainable Design, tools, methods and principles of different existing methodologies- as support for an academic design exercise it is possible to improve the teaching process in classroom for Educational Sustainable Industrial Design.

METHODOLOGICAL FRAMEWORK

The process to reach the DSxC has been systematically developed in the following steps: research, structure approach -architecture of the tool-, design of the information and interface and finally the presentation of the results for validation and feedback.

RESEARCH: This process has been carried out to understand the content and the form. On the content, the pedagogical models applicable to the Education for Sustainable Industrial Design (Aguayo, Estela, Lama, & Soltero, 2011, Bovea & Pérez-Belis , 2012, Ceschin & Gaziulusoy , 2016, Navarro, Rizo, Ceca, & Ruiz, are tracked and analyzed. 2005, Pigosso , McAlloone , & Rozenfeld , 2015) prior , prioritizing those that allow a flexibility approach, construction and dialogue between the teacher (Marlene & Rodríguez, 2007) , the student and the case study.

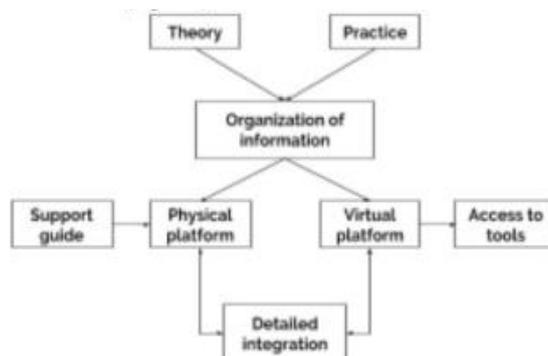
DESIGN: Based on the research, it begins with the conceptual and criteria approach of the DSxC, then the information architecture is designed and finalized with the materialization of the tool taking advantage of design principles. The results of the research are based on the creation of the structure of -DSxC- managing to integrate theory and practice as a guide.

PRESENTATION: The tool is exposed to be used in different academic contexts in Educational Sustainable Industrial Design processes looking for a feedback as part of a process of continuous improvement.

RESULTS THE DSX COLOMBIA: ANATOMY OF AN ACADEMIC TOOL.

STRUCTURE AND FUNCTION OF THE TOOL

The general structure of -DSxC- is divided in two parts, that is, the theoretical vision and practice of the Sustainable Design is integrated through two platforms -Enterprise and Virtual - which provides support to the teacher as a guide and accompaniment to the process of design, in order to generate knowledge and improve Educational Sustainable Industrial Design training. Under this order of ideas, the guide is composed of: key questions for the formulation of the challenge and/or problem, step-by-step guide for the theoretical analysis that facilitates the es-



establishment of the requirements of a service product system, checklists for the evaluation of results of objectives and

tips to reduce complexity in the application.

[Figure 1] General structure of -DSxS-

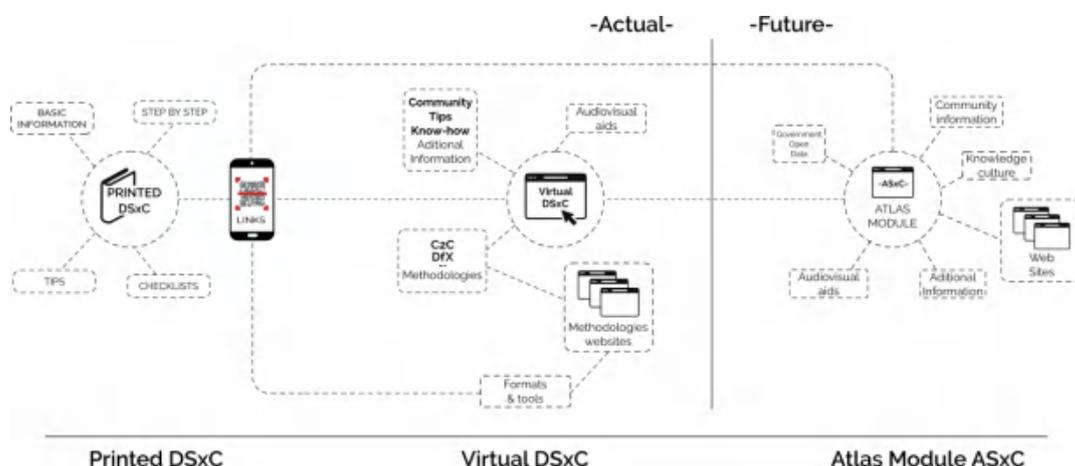
ANATOMY OF THE FUNCTION. DSxS acts as a tool composed of four phases: investigate, conceptualize, detail and deliver; that within each one opens a range of possibilities so that the student or professor according to a series of recommendations established by the booklet can generate his own methodological algorithm. These possibilities are the decomposition and characterization of 10 methodological approaches and principles around Design for sustainability considering those that address systemically the problems (Design of Product Service Systems for Sustainability and Distributed Economy -SPSSDE-, Systemic Design, Biomimicry, Cradle to Cradle -C2C-, Circular Design, The Natural Step - Backcasting , Human Centered Design -HCD-, Life Cycle Assessment -LCA-, Design for X -DFX- and Permaculture). The printed DSxS, shows the theoretical structure of the tool under a pedagogical approach that allows to understand the generation of methodological algorithms and acts as a step-by-step application guide for the application process, making recommendations through the research project , proposing general visions and checklists.



[Figure 2] Printed DSxS and Virtual DSxS design .

The Virtual DSxS -www.dsxs.ga- that it deepens the information of the booklet and the previously categorized methodologies to take to the generation of the methodological algorithm according to the suggestions made by the physical guide; complemented by Colombian Atlas for Sustainability, which presents information in open data mant Colombian territory making a gate understanding the context depending on the tool and algorithm generated.

The Colombian Atlas for Sustainability - ASxS - It is a future phase of the research whose aim is to incorporate a database of the Colombian context as a tool that complements the DSxS and exercises as a fundamental module of the methodological algorithm through the use of data from real contexts that enables the optimal development of the project. The atlas collects the information from the open data generated by the Colombian government, provides timely information to the designer and practical integration in the academy with solid foundations, as Leal (2016)



says: “that has shown a preference in developing programs that are culturally sensitive to the contexts in which they operate, instead of being satisfied with the importation of ‘prepared solutions’ from other countries/regions.”

[Figure 3]. Status and structure of the project

The DSxS proposes to connect through three platforms (printed, virtual and the atlas) to maintain a broad and detailed perspective of the project that provides and makes efficient the SPSS development process, as well as facilitating the understanding and education in the Sustainable Design to students and teachers. That is why DSxS seeks to generate feedback that allows improving the application of this toolkit, due to its cyclical, systemic approach and the U-Process that according to Hassan, Z. (2006) is based on the belief that there are multiple ways of dealing with highly complex problems, some of them more successful.

CONCLUSIONS

I. The activity has been carried out in 2 groups (57 students) of the University of Research and Development of Bucaramanga and 6 groups (180 students) of the Pontificia Universidad Javeriana of Bogotá (Figure 4), which at the

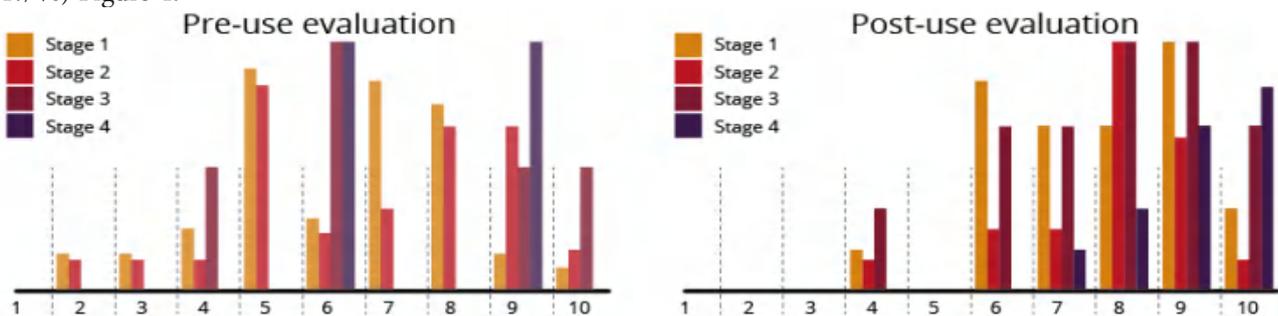
beginning and end of each of the stages have been able to evaluate the state of knowledge and usefulness of the tools around three thematic axes: usability, usefulness, and content.



[Figure 4]. Development of classroom activities

To date, there are numerous proposals for the Sustainable Design that have been developed, among them you can identify clear differences in approach that respond to the very nature of the intention with which they have been conceived. If we cross this premise with the current situation of the Educational Sustainable Industrial Design seen as a chair within the curricula of the industrial design program in addition to the lack of teacher training, it is essential to consider a tool that contemplates: 1. The accompaniment to teacher and not only the training of students, 2. Guide in the selection of the Sustainable Design approach according to the characteristics of the project, 3. Support the process of recognition of the contextual features of the project and 4. An important contribution from the design of the information that would allow a better acceptance by the interested parties of the process.

Regarding usefulness, between the first and last stages of the exercise the students expressed improvement in their learning and knowledge of the concepts related to sustainability applied to design (mostly valued in 5 out of 10 (25.4%) before starting stage 1 and in 9 out of 10 (27.3%) after finishing this stage. In the last stage the students evaluated their knowledge previously divided into 6 and 9 out of 10 (50% each value) and later into 10 out of 10 (41.7%) Figure 4.



[Figure 5]. Comparison charts BEFORE AND AFTER

In the first and last stage, the total number of students affirmed that the tools have been useful to facilitate the planning activity, but these values have not been maintained in all stages, indicating some type of difficulty in the usefulness (usefulness of the tool in stage 2: 95%, stage 3: 90%). Finally, in terms of content, the importance of the components of the document has been ranked as follows: in stage 1, Description 10: 27%, tools 8: 27%, tips 5: 31%, how 8: 22%, examples 8: 36%. In the final stage, Description 10: 33%, tools 10: 33%, tips 9: 33%, as 10: 42%, examples 9: 41%

DEBATES

USABILITY: Regarding the usefulness and according to the results, there is a favourable perception on the part of the students in all the phases; however, the students in the interviews carried out have expressed some difficulties in the way in which the contents are exposed both in the platform and in the shared pdf document, but we consider that this is due to several aspects: the first one, they do not read the contents but they seek to go directly to select the tools that guide them step by step, not to make an adequate selection according to their difficulties. Second: the platform and the book are not very clear which is the most appropriate tool to develop each theme (social, product, service). Third: the time for the exercise often does not allow us to delve into a topic, so many students do not seek more information outside the classroom or provided by the teacher. Fourth: the designer is not used to reading during the development process of the project, but more to executing it. With respect to the printed guide, when it is designed in polychrome, it presents disadvantages when printed in black ink; some graphics are incomprehensible and some elements lose the intentionality given by the color and the backgrounds of photographs lose contrast with the letters in the coverage pages; on the other hand, the digital platform has proved to be very useful as a support

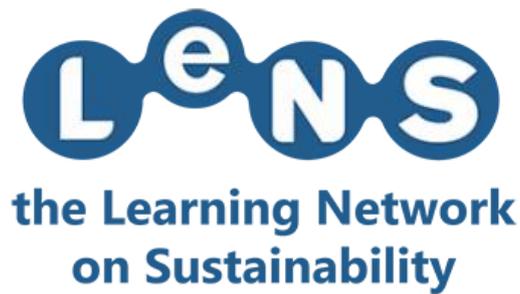
for the process but not without presenting usability disadvantages in terms of navigability, particularly to find additional information to that presented in the printed content; this situation is presented given that the additional information is not directly linked to the phases of the process; this situation is presented given that the additional information is not directly linked to the phases of the process. Similarly, the students state that the process is orderly, but when they arrive at the tools they consider that there is no clarity as to their contribution to the project. The difference between the tools is very noticeable and it is not clear which is better or more adequate than another. Not even by themes, a small description of each of their functions can be made.

UTILITY: In some moments of experimentation, attention has been overloaded on operational processes such as the use of tools and their formats, a situation that has led to the neglect of the reflective processes inherent to sustainability for design; this process of excessive “formatization” the SD process is typical of the scientification of design inherited from German schools in the second half of the twentieth century (Krippendorff, 2008); although it brings to the design project procedural rigour and standardization in deliverables, if it is not well worked on by the teacher, fundamental aspects of educational processes in SD can be neglected. Phase 2 called MACRO is the one that has presented the greatest complexity for students, given that in the cases studied there were few precedents of academic processes in which these issues had been addressed. This is why it is essential to improve the support material in this phase by including audiovisual help in the web platform. In this way to maximize the usefulness.

CONTENTS: There is evidence of a contribution of the tool in terms of process information, evidenced in the results (see figure 4) there is an increase in understanding of the exercise and its contribution to sustainability, as well as the fact that sustainable analyses must be done from the outset but their relevance can be better explained by themes, the most problematic are economic and social. On the other hand, a very important point is that it allows the teacher to help in organizing the process and does not seek to replace it but to strengthen and argue their work at each stage. The tool, having a strong theoretical component that in many cases is completely new for students, requires a learning quota that is difficult to achieve in the academic time of the case studies, causing the practical part to assume a leading role during phases 3 and 4 of the process, and the theory is left in a second plane and left to the disposition of each student to expand their knowledge individually; a situation that in most cases does not succeed. The tool must be adjusted according to the results and be used again in new academic contexts with a view to being officially presented for use.

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UPSCALING LOCAL AND NATIONAL EXPERIENCES ON EDUCATION FOR SOCIAL DESIGN AND SUSTAINABILITY FOR ALL TO A WIDER INTERNATIONAL ARENA: CONSIDERATIONS AND CHALLENGES

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ABSTRACT

While there are a few Europe-wide Higher Education courses and/or programmes of study in social design and innovation at national levels, efforts to upscale them to a wider cross-national audience are lagging behind. If we are to develop a disciplinary benchmark that transcends national boundaries and achieve a wider consensus on the disciplinary boundaries thus providing for a level of comparability across national boundaries, the considerations and challenges confronting this upscaling, need to be addressed. This paper will elaborate on this issue drawing from a combination of European policy documents and the research of the authors in the area of social design and innovation. The identification of some challenges confronting upscaling will provide a stepping stone for future investigations towards cross-national collaborations in the areas of social design, social innovation, and sustainability for all.

Key Words: Higher Education, Social Design, Social Innovation, Sustainability.

1. SUSTAINABLE DEVELOPMENT EDUCATION

Today we face environmental and social challenges, at regional and global levels, that we can ignore no more (Santos, 2017). The United Nations Sustainable Development Goals (UN, 2015) presented a set of 17 measures to foster sustainable development across many Human endeavours and domains. Along with sustainable development (SD) research, education plays a critical and catalytic role in the formation of future leaders and in the creation of a social change mindset for a sustainable future. To address global sustainability problems, often complex, ill-defined and intermingled, it is critical to integrate knowledge from different academic disciplines, from natural and exact sciences to social sciences and humanities (Mochizuki & Yarime 2015). It also helps to a better perspective about the enablers and barriers for societal actions for sustainable behaviour and transformation (Korulanin & Ferreira, 2018). Moreover, diverse expertise and experience are important to design and implement serious engagement and fruitful collaboration between academia and stakeholders - industry, government and civil society – to address sustainability challenges, in most cases involving a significant degree of diversity and uncertainty.

The research and educational programmes to integrate sustainability in policy making, in both developed and in developing countries, have started establishing (Mochizuki & Yarime, 2015) and reflects the changing attitude and understanding about the role of education in the context of the environment and sustainability. As shown by Michelsen (2015), it is possible to identify three different phases on the topic until 2014. After that, further impulses for the implementation of education for sustainable development were expected, focused on five priority action areas: 1) processes for the political integration of education for sustainable development at national and international levels must be strengthened, and the success factors for its establishment identified; 2) support is needed for holistic approaches for schools and higher education (whole-institution approaches) to sustainability, not viewing it merely as a topic for lessons and teaching but as a comprehensive mission that will impact the shape of educational institutions. 3) the should aim at strengthening activities integrating education for sustainability development in the areas of pre-service and in-service teacher education and training; 4) young people should not only be seen as target groups of education but should instead be more closely involved in educational processes and provided opportunities to serve as change agents, especially in the informal and non-formal educational sectors and finally; 5) efforts should be increased to promote education for sustainable development on a local level and to support network local actors.

2. DESIGN EDUCATION FOR SUSTAINABLE DEVELOPMENT IN PORTUGAL AND CYPRUS

The five priority action areas previously presented as key aspects to the implementation of education for sustainable development are still to fully explore in Portugal and in Cyprus. In fact, as presented by Sambade & Ferreira (2017), sustainable development is not yet in the top of design curricula. It exists in most cases as an isolated component, something optional, that could be chosen – or not – to integrate into the design idealization and creation phase. Although this view is changing and many Universities are already reviewing their educational programs, in order to change or improve their curriculum to address sustainable development goals, there are still a lot to run as noticed by Rocha et al. (2017b) in the paper entitled ‘Benchmarking Higher Education in Design for Social Innovation and



Sustainability’. A similar situation can be found in Cyprus, Limassol.

[Figure 1] Fostering Social interactions, New forms of Mutual Learning and Creative Solutions in Lisbon, Portugal (Sambade & Ferreira, 2017) and Limassol, Cyprus (authors)

Some advantages of education for sustainable development called, in some contexts, as design for social change and innovation or design for social innovation and sustainability are multiple and linked to the cultivation of participatory and co-design mindsets (Souleles et al. (2017). This stems from the need to assess in collaboration with others the needs of varied groups of people, and to address with others a variety of social challenges. Subsequently, there is value in promoting the practice of collaborative design, of engaging in local social contexts, and of practising collaborative and participatory problem-solving. Through appropriate instructional strategies, learners can explore the connection between design and problem-solving through a process of collaborative learning (Bernarda et al, 2017). Although critical, those punctual practices are exercises approaching the fourth-generation design epoch, as presented by Souleles (2017) when reflecting on the different stages of design transformation. In fact, in most recorded

cases, they assumed a transdisciplinary nature, materialized service design solutions, transform and are transformed by the social system in which act and have a profound and positive impact in students and the communities. Yet, a systemic and scale transformation is necessary for a true transformation of the quality of the HE system and an embedded practice and understanding of social design and education for SD (Souleles et al, 2017).

3. UPSCALING LOCAL AND NATIONAL EXPERIENCES ON EDUCATION FOR SOCIAL DESIGN AND SUSTAINABILITY

Innovation is a context-dependent phenomenon with a cycling behaviour. (Ferreira, 2008, 2009). This fact makes evident the need to go beyond the spiral model having in mind that representation is not good enough to express the complexity, the interconnectedness and systemic nature of the global challenges that social challenges and innovation impose. Furthermore, it does not consider the fact that innovation is not a linear process. (Nesta, 2010) (European Commission, 2017) (Ferreira, 2019). These perceptions are of the most importance when reflecting on scaling-up processes of social innovations.

In ‘The Open Book of Social Innovation’, from Nesta (2010, p. 83), we can read the words of former US President Bill Clinton, in relation to scaling and diffusion [of social Innovations]: “nearly every problem has been solved by someone, somewhere. The challenge of the 21st century is to find out what works and scale it up”. When looking to systemic change, it possible to observe that it concerns the interaction of many elements, from social movements to laws and regulations untill entirely new ways of thinking and doing. It generally involves new frameworks or architectures made up of many smaller innovations (Ferreira, 2008). Individual innovators may bypass barriers of the old system, but the extent to which they can grow will often depend on the creation of new conditions, much based on synergic actions, and to make the innovations economically viable and socially important (Ferreira, 2009).

As reinforced by Dale & Newman (2005), sustainable development must be seen as a process, not a goal, considering that it is a constantly moving target whose boundary domains evolve as the dynamics between the three imperatives shift. This perspective is in line with the three stages noticed by Mochizuki & Yarime (2015) in respect to the different but evolving levels of learning about education for SD and the corresponding degree of integration of knowledge - multidisciplinary, interdisciplinarity, or transdisciplinarity. The first stage is an essential first step which aims at deepening awareness, knowledge and understanding of the concerns of sustainability. The second stage is vital to individual and social change, as it involves questioning of the usual frame of reference to respond to the challenges of sustainability. The third stage involves epistemic change and leads to cultivating a culture of sustainability. Under the same perspective, Barth and Michelsen (2013) have identified three types of ESD and sustainability 1) looking educational contribution to fostering competencies of individuals, advance discussions on sustainability literacy and improve teaching and learning get there; 2) the ones that address organisational change and social learning through interdisciplinary approaches tackling, for instance, the root causes of the fundamental ‘unsustainability’ of the current model of progress; and 3) lastly but not least, the ones situated learning and ‘communities of practice’ in the context of inter and transdisciplinary collaboration bringing about epistemic change by systematically involving knowledge users in the research process and active collaborations with various stakeholders throughout society.

4. CONSIDERATIONS AND CHALLENGES

As pointed out by Deshmukh (2017), education and culture are intimately and integrally connected. Just as culture influences education, much in the same way education also exerts a powerful influence upon the culture. Nevertheless, there is a lack of widespread and shared understanding of design for social change and innovation as an integral part of Higher Education curricula in Europe. Be aware of the five strategic action areas identified in the Global Action Program to the practice and research in the area of sustainable development (Michelsen, 2015) could make a difference. This note is also true for Nesta’s report In and Out of Sync (EC, 2017), identifying the characteristics that scalable social innovations tend to have. In line with the conceptual constructs presented by Velazquez et al. (2006) and Santos (2017), higher education institutions are challenged to turn sustainability principles into practice through management, research, the transfer of knowledge and teaching - curricula and the teaching of new competencies to address sustainable development dimensions - and to fully integrate sustainability in their thinking. The challenges to fully embrace education for sustainable development and social design are clear. We work every day - with everyone - to promote and achieve this system change and sustainability to all.

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INTERDISCIPLINARY HIGH EDUCATION IN PLACE BASED SOCIAL-TECH: THE EXPERIENCE OF THE TAMBALI FII PROJECT IN DAKAR

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ABSTRACT

The place-based approach to innovation is a strategy that provides to communities the opportunity to innovate by triggering a systemic change. While researchers and policymakers are experimenting place-based strategies around the world, there is a need to develop appropriate educational tools to foster a place-based approach to technological and social entrepreneurial solutions. The Tambali Fii project is a step toward this direction.

This paper depicts the high-education interdisciplinary workshops “Social-Tech4Sustainability” – held at the IPP-Dakar in the first year of the Tambali Fii Project – by sketching their objectives, theoretical model, structure, tools and results, in order to present a model to transfer and/or to scale up in larger experimental and applied social-tech education program.

A validation test through qualitative content analysis of data collected in the field is carried out in order to investigate the actual potential of teaching concerning new design tools in the bottom up process of creation of place-based social-tech entrepreneurial businesses.

Keywords: social entrepreneurship, entrepreneurship education, place-based innovation, social-tech, design 4 social sustainability

1. INTRODUCTION AND LITERATURE REVIEW

Innovation ecosystems group together different actors, embedded in a series of dynamic and generative processes pursuing innovation and technology development objectives. (Jackson, 2011; Oksanen and Hautamaki, 2014). More specifically, the members of the ecosystem provide innovative solutions to a series of shared challenges from different perspectives.

Place-based innovation ecosystems constitute a subset of innovation ecosystems. The “place-based approach” stresses a key characteristic of innovation namely that it “takes place in precise locations” and that it can offer responses to local needs (Rissola et al., 2017). The creation of place-based innovation ecosystems is gaining prominence in the innovation and development strategies of governments and international organizations both in developed and in BOP countries (Rissola et al., 2017) as in the case of the European Union.

In the context of innovation ecosystems, social entrepreneurship can play a fundamental role in mobilizing resources and addressing societal needs through innovative solutions.

In this paper, we follow the definition of social entrepreneurship as a concept collecting different organisational forms which merge the generation of social value to a paradigm of economic and financial sustainability, “demonstrating entrepreneurialism and self-sufficiency” (Swanson and Zhang, 2011). In this perspective, Pinch and Sunley (2016), Mazzei (2017) highlight the linkage of social entrepreneurship with the local “place context” and local resources, suggesting the potential of these organisations in place based innovation strategies. Actually, according to Surie (2017), social entrepreneurship can play a unique role in innovation systems by providing innovative services and products to “targeted” local population “neglected by the established firm”. Consequently, the role of social entrepreneurship can be particularly relevant in the BOP countries (Surie, 2017) where uncovered societal needs are diffused. Surie (2017) also outlines a series of key characteristics at microlevel enabling social entrepreneurship to become an engine for innovation ecosystem: the “availability of social entrepreneurs” ready to tackle societal needs, the presence of fecund inter-organisational relations and the existence of “enabling technologies”.

The increasing reliance of social entrepreneurial forms over new technology is leading to the definition of a new social entrepreneurial genre: that of social-tech ventures characterised by the usage of innovative technology “to solve societal issues” (Ismail et al., 2012, Arena et al., 2017) and creating scalable innovations.

In the context of BOP countries, Schonwetter and Van Der Viele (2018) recognise the potential of a new wave of digital technologies as 3D Printing as factors enabling the development of the new forms of social-tech entrepreneurship and innovation. Rognoli et al. (2015) on their side attribute this potential also to DIY materials, due to their low degree of standardisation which allows a high rate flexibility in production and adaptability to different local contexts, coherently with an innovative place-based approach.

Also due to the rise of social-tech organisations, the interest towards social entrepreneurship is fostering the growth of tailored educational programs addressed to develop specific skills required by social enterprises (Al Taji and Bengo, 2018). Some theoretical models about teaching and training for SE have been published (among others Smith et al. 2012; Pache and Chowdhury 2012), also adopting a place-based approach to the theme (Elmes et al., 2012). Nonetheless, educational models designed at developing social-tech entrepreneurial forms are still scarce in the literature: only Dzombak et al. (2016) effort in discussing the capacity of an educational program mixing engineering and social entrepreneurship in US context. Consequently, this paper presents an educational theoretical model for social-tech entrepreneurship education, capable of making social-tech entrepreneurs key actors in place-based innovation ecosystems also in BOP countries by taking advantage of new technological tools and design instruments for societal goals.

We apply and test the model in the workshops “Social-Tech 4 sustainability” (ST4S) held at the Institut Polytechnique Panafrican of Dakar, Senegal, as part of the international research project Tambali Fii led by the Politecnico of Milan. In the following sections, the ST4S workshop is depicted through its objectives and activities, in-field test and result. In order to validate the results, a series of semi-structured interviews was conducted to understand the potential of the educational model in social-tech entrepreneurship in order to foster the development of place-based innovation ecosystems.

2. THE SOCIAL – TECH 4 SUSTAINABILITY WORKSHOP @ TAMBALI FII I DAKAR

The Tambali Fii project is a step toward the design of theoretical educational models for social-tech entrepreneurship education, by proposing an high-educational workshop to develop both technical and social entrepreneurial skills. A specific set of activities is framed in a tentative theoretical educational framework with a series of supporting tools. The framework has the goal to train designers and entrepreneurs in the field of sustainable design for social entrepreneurship, maintaining two key elements: the usage of advanced technologies and a place-based approach with a continuous reference to the local context. We apply and test the model in the workshops “Social-Tech 4 sustainability” (ST4S), organized and run by the authors at IPP Institute Politechnique Panafricain Dakar, Senegal. The educational workshop involved 15 students with the goal of foresee, ideate and develop PSS (Product Service System) social solution addressed to the Senegalese fishing sector.

2.1. TAMBALI FII PROJECT

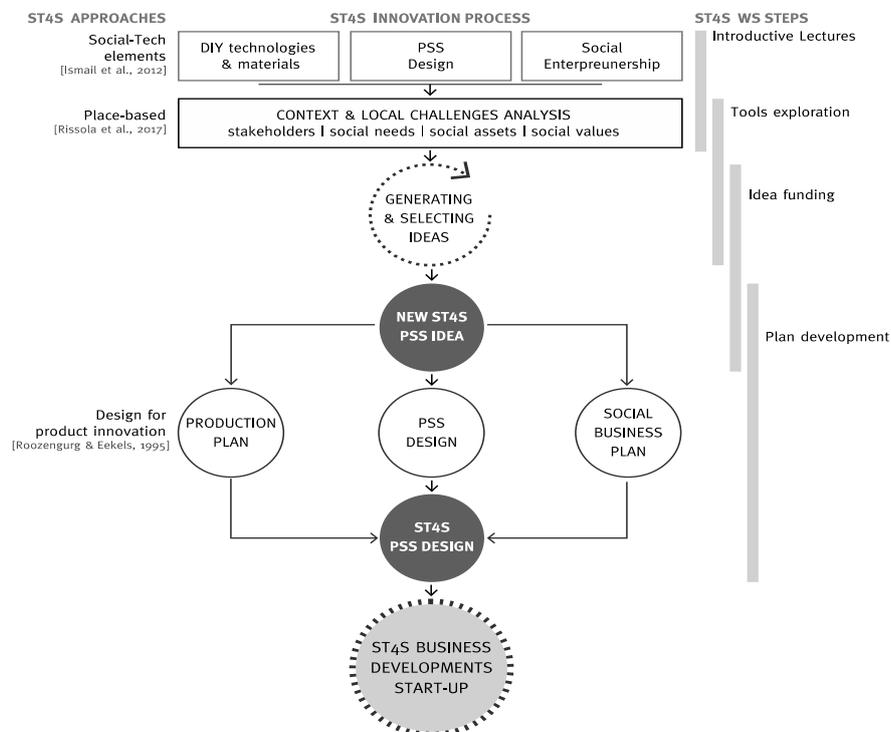
Tambali Fii is an international research project supported by PoliSocial –the social engagement and responsibility programme at Politecnico di Milano (<http://www.polisocial.polimi.it/>)– aiming at creating a social and technological innovation Pole in Dakar, Senegal. The primary objective of the project is eliciting place-based innovation processes able to respond to social and economic challenges in the local context by training and fostering entrepreneurial activity in the field. Furthermore, the project in 2018 led to the foundation of a technological incubator in the IPP Dakar headquarter. The incubator has the objective to provide an effective technological transfer, to design and apply training programs, to foster research and synergies between academia and local entrepreneurship.

In this context, the first research activity developed in synergy with local stakeholder was field research on social and technological innovation in the fishing sector including the whole boat, boatyard and fishing equipment production chain. During the research activity, innovative PSSs were foreseen as well as the social business plan to further develop it.

2.2. THE WORKSHOP METHODOLOGY

The ST4S workshop methodology was designed by the authors to reach the intended workshop objective of (i) exploiting the potential of innovative design models in stimulating place-based innovation projects able to respond to social and economic challenges in local contexts; (ii) training social entrepreneurship and design for social and technological sustainability with a place-based approach; and (iii) developing PSS project to strengthen bottom-up entrepreneurship with a place-based approach. The methodology of the educational workshop could be adopted as a training program in Academia as well as in startup, as is addressed to professionals with different backgrounds and no previous knowledge on social-tech 4 sustainability. To achieve its objectives, the workshop covers three main topics: PSS Design (and project related design sub-topics), DIY materials and technologies; social entrepreneurship. The ST4S workshop is organised in the following four steps according to the ST4S innovation process below described:

- **INTRODUCTIVE LECTURES:** lecture on the three main topic and subtopic including case studies and context analysis.
- **TOOLS EXPLORATION:** first exercises approaching the use of the tools including design tools, DIY techniques, and tools for DIY materials, and social business model canvas
- **IDEA FUNDING:** generating loops and selecting of the technological and social innovation strategy and goal according to the context and local challenges analysis.
- **PLAN DEVELOPMENT:** development of the promising ideas into a PSS plan including PSS design, DIY production plan, and social business plan. This last step drives the project to the social entrepreneurship start-up.



[Figure 1] ST4S Innovation process and workshop steps

Based on the Product innovation process model created by Roozengurg and Eekels (1995), the ST4S innovation process [Figure 1] shows how product and PSS design is embedded in a more extensive process based on social and technological place-based innovation. The process distinguishes two main phases: the idea funding that leads up to the PSS strategy, and the development plan strict connected with entrepreneurship start-up. The ST4S process

objective is to plan and manage a place-based project and to keep an overview while designing on technology, PSS and social business plan in synch. To achieve these objectives, a set of tools is given to the participant: Braindrawing and How-tos enquiring (Tassoul,2006), design drawing, storytelling and Tecdoc (Bertone & Wiebe, 2002), DIY material receipt (Ayala Garcia, 2019) and DIY digital technology tools and instruction, local context social need analysis, stakeholder mapping and analysis and social business model canvas (Joyce and Paquin, 2016).

2.3. THE TAMBALI FII ST4S WORKSHOP AND RESULTS

The ST4S workshop methodology and innovation process were tested during the experimental phase of Tambali Fii project to design new PSS strategies for the whole local fishery and supply chain strengthening. The fishing market is one of the main economic drivers of the Senegalese economy. However, this sector fails to create attractive opportunities for its young population suffering from a traditional and risky fishing approach, and a foreign companies competition operating with modern and well-equipped deep-sea fishing vessels. This competition at sea is also accentuated by the lack of appropriate storage and refrigeration equipment, making promptly consistent the waste of products.

The workshop was addressed to these challenges aiming at creating innovative long-term strategies for technological and social entrepreneurial solutions and at training students on social entrepreneurship and design for social and technological sustainability. The activity was developed involving 15 students of the 1st and 2nd year of the architecture and civil engineering master degree at IPP-Dakar for three weeks. The work period and tasks were split into sections, and the students were divided into five different mixed groups. These give a rhythm to the design activity, allowing the organisation to verify time and tasks, and meeting efficiency according to the ST4S workshop methodology and innovation process. The workshop sections are following described.

INTRODUCTIVE LECTURES & TOOLS EXPLORATION [collective - 7 days]: Introduction, individuation of the main workshop drivers; division of the participant into groups [3 hours]; case studies [3 hours]; place-based approach for design and tools [3 hours], yacht design principles and methods [3 hours]; DIY digital techniques and tools [9 hours]; DIY Materials approach [3 hours]; DIY Material case studies and tools [6 hours]; Social business entrepreneurship and tools [9 hours]; social business entrepreneurship case studies [3 hours].

IDEA FUNDING [in groups – 4 days]: context and local challenges analysis, and social needs [6 hours]; PSS generation loops through Braindrawing and How-tos enquiring answering the local challenges identified [6 hours], PSS strategy selection [3 hours] and description with storytelling tools [3hours]; analysis of the resources and technological requirements [6hours].

PLAN DEVELOPMENT [in groups – 7 days]: overlap activities of product and service design planning development [12 hours], production planning development [12 hours] and social business pan development [12 hours]. The final phase is the presentation of the PSS plan to the involved community of students, professor, and stakeholders, through visual representation and speaking presentation [6 hours].

During the Tambali Fii ST4S workshop, the students developed 5 PSS projects and related social business plan facing at local fishing sector challenges. Between them, the transportable maintenance platform for pirogues envisages a new product-service system addressed to the local fishermen's associations that easy the hauling and launching of a traditional fishing boat. The platform can be adapted to the different vessel bodies and used from different vessel owner. Furthermore, it could also be employed as a station for the ordinary maintenance on the seaside. Another project, the "Pirogue Balancier modulable", uses the plastic waste as raw material to build new 3D printed balancing equipment for pirogues. This project faces two of the main societal problem of the fishing sector in Senegal: onboard safety and plastic pollution in the marine ecosystem. The project proposes the use of the DIY "Plastic Fantastic" tools for plastic material recycling and 3d printing filament production in order to additive manufacture custom and modular balancing arms. These arms contribute to stabilizing the traditional fishing boats during the nets handover avoiding vessel capsize. A third project is addressed to the fisheries conservation and transportation chain. Due to the scarce availability of onboard refrigerate containers, the waste of fishing products is consistent. The "Hi Tadjji" project designs a new double layer fish container that can be filled by ice in slot box. This box is at the centre of all the conservation and transportation operational chain. Thanks to the modular feature of the container and to the 3d printed handle and hermetic latch, fishers can place more than twenty boxes on a single pirogue, balancing the weight and stabilizing them while filling. Once landed, the boxes can be used to transport fishes to the local market avoiding the contact of the fishery with soil and sand. The business model defined the propriety of the boxes to the local fishery market association renting them to fishers in the form of service and providing maintenance and substitution. This PSS model ensures a better quality of market hygiene and food conservation. Furthermore, it reduces the transportation time from vessel to market and the cost of product waste.

3. RESULTS, DISCUSSION AND FURTHER DEVELOPMENTS

In order to validate the results of the ST4S workshops, a series of semi-structured interviews was conducted to a sample of four students, two local professors from IPP-Dakar and two professors from the Politecnico of Milan also interviewed a local entrepreneur involved in the Tambali Fii Project for technological support. The interviews covered four main themes: (i) the perceived relationship between new technologies and the societal challenges in

Senegal, (ii) the perceived satisfaction and (iii) efficacy of the ST4S workshop and (iv) the perceptions about the development of social entrepreneurial forms in Senegal. Students' interviews revealed a strong appreciation for the ST4S workshop and its interdisciplinary approach. Students appeared to have particularly enjoyed the emphasis on the interlink between new technologies as 3D printing or DIY materials and social entrepreneurial opportunities. This particular appreciation, coupled to the development of the social business model, may be read as a validation of the educational model, coherent with Rognoli et al. (2015) and Schonwetter and Van De Viele (2018). The social entrepreneurial opportunities are perceived as being capable of tackling local societal challenges as the heavy coastal plastic pollution present in Dakar and low productivity of the fishing sector.

Students appear to have strongly improved knowledge about entrepreneurial skills, and they started perceiving entrepreneurial careers as a potential outcome for their studies. Nonetheless, students' interviews also highlighted a well-founded awareness about the difficulties in introducing new social entrepreneurial forms in the local economic system, which does not appear ready to a deep change in its entrepreneurial models. This perception is also confirmed by the other local interviewees who, despite stressing the potential of social entrepreneurial forms, underline many systemic and cultural obstacles to the development of social business in the Dakar context, mainly because of the difficulties in recognizing the economic opportunities in responding to socio-environmental challenges.

However, also due to this strong understanding, both the local and the foreign interviewees underline the value of education in social entrepreneurship and sustainability. Respondents suggest that the design of entrepreneurial educational programs founded on social and environmental challenges should be improved and also diffused at lower educational levels and with greater continuity. Interviewees suggest the necessity to apply the theoretical model about social-tech entrepreneurship also in a different context from that of traditional fishing which displays highly settled business models. Actually, in sectors displaying a higher propensity to innovation social entrepreneurial education appear to display a greater potential. Moreover, interviews also stressed the importance of maintaining a place-based approach in this typology of education, creating educational models able to be tailored to local contexts and local societal needs, involving local communities.

Overall, both students projects and validation interviews highlight the potential of education in social-tech entrepreneurship, founded on a place-based approach, in order to foster social-tech entrepreneurship as a key player in innovation ecosystems, also in BOP countries. The results also stress the necessity to deepen research about educational programs merging technology and social entrepreneurship, to collect best practices in this field and to elicit the construction of more systematic models which could also be extended also to students at different educational level and applied in different sectors and contexts.

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EDUCATION STRATEGIES AND BEHAVIORAL ACTIONS TO MITIGATE ENERGY POVERTY

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ABSTRACT

In the recent years, Energy Poverty (EP) has become a big challenge in the European Union (EU), affecting 50 to 125 million of EU citizens. The EU is working to implement effective actions to tackle it. Home retrofitting is the most impacting solution, but it requires a large amount of money; on the other hand, energy-related behaviour change represents a first step for vulnerable consumers to reduce energy consumption and energy bills. With this aim, ASSIST 2gether project (H2020, Grant Agreement 754051) has created the “Home Energy Advisor” (HEA), trained with an innovative course, about energy, social system and communication skills. The goal of the HEAs is to implement pilot actions to mitigate EP by educating vulnerable consumers and increasing their consumption awareness, through behaviour change. In this paper, the planning and first results of HEAs training are described and analysed, together with the possible impacts on energy poor consumers.

Key Words: Energy Poverty, Energy Efficiency, Training Course

1. INTRODUCTION

Energy poverty is becoming increasingly important in the EU Commission agenda, mostly due to the high number of EU citizens affected by it (BPIE, 2014). While each Member State (MS) is free to adapt its local regulation to the country specific situation, the EC is putting a great effort in setting standardized guidelines through different directives and regulations, especially in the recent update of the Directives regarding Energy Efficiency and Electricity (Clean Energy Package, 2016).

However, large differences remain in the way in which Energy Poverty is defined and measured at EU and national level and in the actions to tackle it.

ASSIST project tries to answer these questions by going deep into energy poverty in different ways:

- by performing an analysis of the current definitions and indicators to measure energy poverty and how to intertwine them in order to reach a standardized definition and a common action target;
- by designing a dedicated training course that allows a new figure of advisor, called Home Energy Advisor (HEA), to acquire the required competences to successfully providing support at vulnerable consumers;
- in parallel to the above mentioned activities, by identifying which are the most effective soft (behavioural and low-cost) actions that can be put in place by the HEAs at national and EU level.

Thus, after a literature review on EP regulation and definition in all EU MS and an investigation on the most effective actions that have been put in place in the 6 project partners countries (Belgium, Finland, Italy, Poland, Spain and the UK), ASSIST project partners have designed a general training course for HEAs, that has been then adapted to the local context of each involved MS. The trained HEAs will then implement on-purpose defined pilot actions to support vulnerable consumers. This paper will go in deep in the analysis of HEAs training and in the action planning, presenting their first outcomes.

2. HOME ENERGY ADVISORS TRAINING COURSE DESIGN AND FIRST RESULTS

Energy poor consumers usually face several issues in accessing information on how to improve their conditions and/or to have access to subsidies and financial measures: this leads them to the need to relate to several different operators, each working in a specific field, but often with no competence to tackle this particular type of poverty. To improve such a situation, ASSIST project has planned to create a new figure, called the Home Energy Advisor (HEA), which should act as a “energy poverty single contact point” in order to provide assistance in different fields to energy poor consumers.

2.1. Training course structure

The primary task of the HEAs is to analyse energy needs and energy consumption behaviours of the involved consumers and to advise them on how to improve their consumption and/or reduce their costs, by increasing their energy consumption awareness. This can be done in different ways: first of all, by modifying their behaviour, then by changing their energy provision contract and/or by requesting financial support, and finally by using low-cost energy saving devices and measures. The final goal is, anyway, to increase vulnerable consumers awareness on how they can improve their economic condition, without reducing their comfort.

HEAs are not “autonomous” professional profiles but they have a supporting role within consumers care, social services and other working contexts; their role can be played by some already existing professional profiles (social assistants, civil servants, consumer association advisors, utilities employees, charity volunteers, etc...). HEAs are not technicians or energy professional figures (they do not need technical competencies to suggest deep and costly renovation), but are expected to have soft and integrated competencies. In order to build such competencies, it has been necessary to define a specific training course, whose basic structure, common to all involved MS, is:

- Analysis of energy consumption behaviour;
- Consumption check-up and energy support;
- Communication and consumers advice.

These macro-areas are then declined in different ways in the partners countries, in order to customize them to the available types of HEAs and the specific context in which they will operate. The Italian training course for national HEAs (called “TED – Tutor per l’Energia Domestica”) is structured as shown in Table 2.1. The course foresees a blended teaching mode, in which some modules are provided online, while some of them can be attended either online or in-person. The online course has been completely built by partners, in all the needed EU languages, on Moodle platform.

[Table 2.1] Italian training course for Home Energy Advisors

Area	Modules	Time [hours]	
M1	ASSIST2gether HEAs Introductory Module	2-4	Blended

Energy behaviour	M2	Basic Knowledge on Energy Sector	6-12	Online
	M3	Basic Knowledge on Social System and Vulnerability	6-12	Online
M4		Security and privacy elements	2-4	Online
Energy check-up and support	M5	Energy Behaviour check-up	2-4	Online
	M6	Energy Consumption Support	1-3	Online
	M7	ASSIST2gether Actions	1-3	Blended
Energy check-up & support	M8	Communicating Energy	4-6	Online
	M9	Relational Competences	6-8	Online
	M10	Planning and realizing communication initiatives and resources	2-4	Online

2.2. First results in Italy

The timing of courses and the methodology in each partner country has been defined based on the local needs; thus, the results cannot easily be compared among them. In this paragraph, only the results for Italy are reported. In Italy, the first edition of the course, fully online, has been completed by the candidate HEAs between September and December 2018. A second online edition started in January and, at the moment of writing (end of February 2019), some participants have already finished the course. Most of the involved HEAs were stakeholders involved during different dissemination events, while some of them have enrolled after reading about the project on different magazines or on the website and social media. In parallel, for some organizations that enrolled groups of volunteers or workers in the same geographic area, dedicated training (both online and in-person) has started at the beginning of 2019. Moreover, the involvement of students from high schools (“School-work alternance projects”) has foreseen the creation of dedicated short courses that fit in their working and studying duties. The main results are reported in Table 2.2.

[Table 2.2] Italian training course first results

Edition/time		Sectors
First ASL (School-work Alternance) edition - June 2018	6	High school students
First edition (full training) – September/ December 2018	57	Unemployed, third sectors operators, civil servants, social assistants, consumers associations, university students, researchers, energy & home companies
Second edition (full training) – January/ March 2019	15	Unemployed, third sectors operators, civil servants, social assistants, consumers associations, university students, researchers, energy & home companies
Second ASL edition – January/ June 2019	1230	High school students
Consumers associations dedicated course – February/March 2019	13	Consumers associations volunteers
North West Italian charities dedicated course	110	Charities volunteers (providing shelter, food and clothes to poor people)

The HEAs trained in the first course have already started implementing the pilot actions, that are described in the next paragraphs.

3. PILOT ACTION PLANNING AND MONITORING OF THE RESULTS

In order to support vulnerable consumers, three types of activities have been planned:

- engagement activities, that have the aim to involve vulnerable consumers and get them close to the HEAs, for a further support; these activities are called, in the project, “Energy Cafés” and are foreseen as large events, open to all consumers, where generic information on energy saving is provided and vulnerable consumers are addressed in a general way;
- pilot actions, that have the aim to provide vulnerable consumers with one-to-one dedicated advice on how to optimize energy consumption and reduce energy bills; they are called, in the project, “dedicated advice”;
- mixed activities, called “synergies” (with other projects), that can be either energy cafés or dedicated advice, and are put in place in parallel with other projects (e.g. energy education for vulnerable consumers in recently renovated social housing stocks).

A deep analysis of the pros and cons of the foreseen activities has been performed by the partners, through literature reviews; moreover, they have been presented to many stakeholders, either during dissemination events or private events, in order to assess their feasibility. What is reported here is the final selection of activities.

3.1. Activities planning in Italy

In all the involved countries, the above mentioned activities are declined in different ways. For example, in Spain no “Energy cafés” are foreseen, but home visits will be performed by homecare personnel and social assistants and energy companies will organize in-person helpdesks for vulnerable consumers.

In Italy, however, there are more categories of HEAs than in Spain, so several activities have been planned, with the support of the already trained HEAs:

- a). Energy cafés:
 - a. Energy cafés at high school premises: the students that have already completed the short course are organizing an event at their high school (in a rural area), in order to increase families awareness on energy;
 - b. Energy cafés at charities premises;
 - c. Retail shops customers advice on home appliances, performed by students in the “Alternanza Scuola Lavoro” program.
- b). Dedicated consultancy (pilot action) will be mostly organized either as home visit or physical/telephone help-desk. The advice that HEAs can possibly give during the consultancy are:
 - a. Customized advice on energy consumption behaviour: it will be performed by all HEAs, examining consumers habits and energy bills (through questionnaires or direct measurements) and providing customized advice on how to reduce their energy consumption through behavioural actions.
 - b. Customized advice on available financial measures: it can be performed by different types of HEAs, such as consumers associations and energy companies help-desk personnel, public bodies personnel, etc....
 - c. Customized advice on how to read energy bills and choose a suitable tariff: it can be performed by different types of HEAs, such as consumers associations and energy companies helpdesk personnel, public bodies personnel, etc....
 - d. Customized advice on energy efficiency measures to implement in the house: it will be given only by those HEAs that will perform home visits (e.g. social workers, homecare professionals).
- c). Synergies – some examples:
 - a. Combination of energy cafés and dedicated consultancy with energy bills payment support in social housing;
 - b. Combination of dedicated consultancy, home retrofitting and energy consumption detailed monitoring in social housing.

3.2. Monitoring of the results

Monitoring of the results is done through the collection of data from the HEAs in the Moodle platform: HEAs will periodically report on the type of activities they have performed, the number of involved consumers and the obtained results. Only for the activities categorized under “dedicated consultancy”, the HEAs will collect a baseline questionnaire, in which socio-demographic, building, consumption and comfort data are requested to each involved household. After providing the household with advice, the HEAs will verify their progresses with a second questionnaire (performed at least 6 months after the first), requesting the same data. At the end, this will be used to verify the project results, in terms of:

- Increase in energy efficiency (toe/y);
- Reduction in energy expenditures (€) related to behaviour or change in energy contract/request for subsidies;

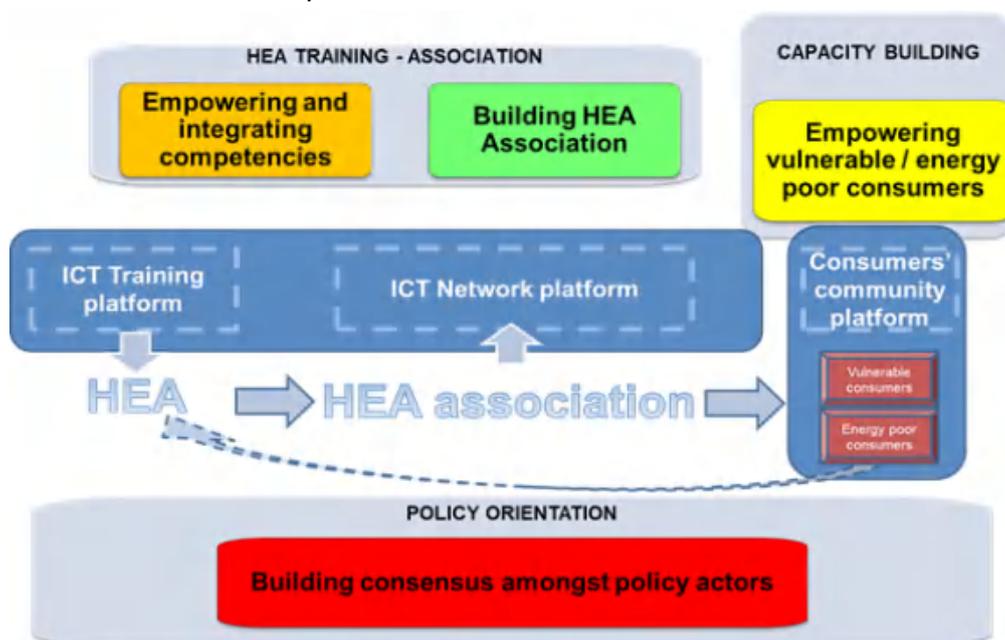
- Increase in comfort perception (either subjective or measured through temperature control from consumers);
- Increase in social status perception, related to the first two (more economic availability and higher comfort help to open-up the house to external visitors, for example).

At the moment (February 2019) the first actions are starting, so there are still no numerical results. However, for the people reached by energy cafés, a reduction in energy consumption of 2% with regards to their previous situation is expected. For those involved in dedicated consultancy, it is expected an equivalent reduction (that takes into account all the above mentioned parameters) of 7.5% with respect to the baseline.

4. HEA NETWORK

HEAs are supported by project partners and, moreover, by HEAs national and EU networks: through a dedicated space on Moodle platform, they can connect with all the other trained HEAs, with different skills and backgrounds, and enrich their experiences, by comparing them. On the platform, they can:

- Find tools to support the advice actions (e.g. short factsheets on different topics, including how to get a subsidy or how to read an electricity bill);



- Find support material to disseminate their events, and short guides on how to organize them (e.g. templates for energy café organization);
- Connect with all the HEAs in their own country or connect with all the HEAs in the EU network, to exchange information and ideas and support each other, with different competencies.

[Figure 1] HEAs training and network structures

The HEA network is very important because it will guarantee the survival of the activity started during this years also beyond the 3-years duration of ASSIST projects established by the EU Commission, thus allowing a real impact to be obtained.

5. CONCLUSIONS

The issue of EP still represents a big challenge for all Member States in the EU and, despite the current effort, no definitive solution has been found to the problem. Many actions have shown that some solutions can be found to, at least, effectively address the phenomenon on a local scale: however, to obtain their replicability and scalability at the EU level there is still a long way to go.

In order to try to address the EP issue and provide some concrete and effective tools, the ASSIST 2gether project is building a model based on the role of a new figure (called HEAs, Home Energy Advisors); they are usually professionals already operating in the fields of energy, social sciences, consumers associations, charities or similar organizations, who are trained in order to be able to communicate with energy poor consumers and guide them to optimize their consumption. The training of the HEAs is performed in a blended mode, mostly through an online platform and partially with in-person lectures or webinars. In order to support energy poor consumers, HEAs will implement engagement activities and pilot actions, sometimes in synergy with other projects. HEAs will then monitor the results of their actions and report to the project partners, through the online platform. The same tool can be used by HEAs to keep in touch, to support each other and to compare their activities both at national and EU level.

The goal of the project is to understand which strategies are more effective in tackling energy poverty and to support policy makers in pursuing them, through the preparation of policy recommendations.

The first results obtained so far have proven that the ASSIST 2gether approach is successful, therefore all the ASSIST 2gether partners will work in the next months to strengthen the ASSIST 2gether approach and both consolidate the already obtained results and explore new actions to be implemented.

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DESIGNING FOR CLIMATE CHANGE FOR ALL—A MEDIA AND COMMUNICATION DESIGN COURSE TO INCREASE PUBLIC AWARENESS

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ABSTRACT

In order to proactively respond to the 13th category of Climate Change in UNESCO SDGs, the course of Media and Communication Design for Climate Change is designed to deliver comprehensive future-oriented design methodology to inspire and increase public sensibility and awareness about the vigorous environmental and human health situation caused by global warming and pollution.

The course introduced the tools and methods of design upfront, to assist the students in addressing the issues, analysing the logic and, more importantly, building up capability to imagine the future and inspire potential short, mid- and long-term solutions. After 2-week practice, the students had chance to create design works in various medias and circumstances by different design approaches. Through intensive collaborations with students, the course aims to empower the practitioners to confront the fundamental changes at every level of society, and embrace the social innovation in more effective and dynamic ways of design.

Key Words: climate change, media and communication, design public awareness, pedagogy

1. INTRODUCTION

The threat to human civilization posed by man-made climate change has become an indisputable fact embraced by a near-unanimous consensus of scientists around the world. Limiting global warming to 1.5°C would require rapid, far-reaching and unprecedented changes in all aspects of society (IPCC Climate Report, 2018). The problem of how to solve global warming is complicated by the urgency of the matter. Scientists agree that curbing greenhouse gasses must begin immediately if we as a civilization are to avert its dire consequences. This change is predicated upon the widescale cooperation on the part of citizens, governments, NGOs and private entities in order to drastically reverse long-held practices that contribute to greenhouse gas emission. This task poses an enormous and daunting challenge to media designers and communications experts, who must educate, convince, engage and change organizational and individual behaviours within a short time frame. Our teams' contribution to this endeavour, Design for Climate Change, emerged from a collaborative media design class recently taught at Tongji University in Shanghai, China, by Tongji professor Bo Gao, and professors Glenda Drew and Jesse Drew, from the University of California. Using the lessons learned from this experimental design course, we have chosen to extract our pedagogical approach and formulate it into a reproducible course that could be taught at other universities.

In response to the 13.3 category of Climate Change in UNESCO SDGs (Sustainable Development Goals)—including improving education, raising public awareness, mitigating human and institutional capacity, encouraging public adaptation of new behaviours, and reducing impact and creating early warning systems (UNESCO, 2018)—thirty-eight, second-year undergraduate students from Media Communication Design at Tongji University participated in this experimental course from November 2017 to January 2018.

Media and Communication Design for Climate Change is an approach to problem solving that places climate change in its social, economic, political and ecological context, but also considers the myriad of stakeholders and other factors that could channel outcomes into a broad array of possibilities. The course introduces the tools and methods of design upfront, to assist the students in addressing the issues, analysing the logic and, more importantly, building up capability to imagine the future and inspire potential short, mid- and long-term solutions. After 2-weeks of theoretical introduction, research and skills building, the students move into practical design teams to create design works using various media, target audiences and delivery platforms. Throughout this short but intensive collaborative class, students are empowered to confront fundamental challenges brought about by climate change, and develop innovative methods to fuse the design discipline with changes in behaviour.

2. THE APPROACHES

The problem of changing individual and organizational behavior to fight climate change is posed as a problem that must be understood and acted upon by large sectors of society. This is the central problem posed to designers fighting climate change. Students are introduced to basic theories of communicative theory, including the public sphere and the practice of social investigation (McQuail, 2010). Then, students collectively identify key topics and roadblocks in the public view of climate change.

2.1. The Public Sphere

An understanding of how “publics” are formed and informed by communication methods is a primary consideration—whether traditional newspapers, radio, television, or newer forms of social media such as We Chat, Facebook, Instagram or Twitter. Understanding these media spheres of the public illustrates the division of the public sphere today, mostly along lines of age, gender, nationality and cultural behaviors. (Habermas, 1991) Understanding exactly who the public is and how to reach them is critical to designing for social change. Other critical understandings include: what is meant by “civil society,” how public opinion influences the levers of power in a society and how an agenda gets set in the social realm. “Public Opinion” is broken down into its own constituent parts; all issue publics, apathetic publics, single-issue publics, and hot-issue publics. Tantamount to this relationship is the role of “gate-keepers” or key influencers within the public who are key to passing on ideas to larger groups of people. Oftentimes, an effective design strategy targets gatekeepers first and foremost among the public.

2.2. Social Investigation

Students are directed to engage with the public around them, isolating several different target groups; family members, the university community of staff, faculty and students, and random people on the street. Using an agreed-upon questionnaire and personal media recording devices such as smart phones, this exercise gets students out of a passive position and puts them face-to-face with the public they wish to engage with. (It was surprising how difficult this was for many young people, who are “social” on media, but shy in public.) Here is a sampling of questions students came up with during the experimental course:

- Where do you get your news?
- What are the five most important issues to you?
- What would you like more information about?
- Rank five problems in order of importance.

Questions about global warming and climate change were then seeded into these questions, as a means of understanding what people knew and how they ranked the issues that were important to them. If students are to utilize design skills to influence social, cultural and economic behaviour, the understanding the way ideas flow through society and how behaviour change is adopted is important. Many of these concerns involve understanding diffusion theory, recognizing different types of adaptors in any social structure and considering different levels of adaptation to new ideas. (Rogers, 2003). Traditionally, members of the public can be broken down into these categories:

- Early adopters
- Early majority
- Majority
- Non-adopters (laggards)

Understanding the order of events whereby new information is grasped by people can be generalized by the following levels:

- Awareness—Individual is aware of “it.”
- Interest—Wants to learn more.
- Evaluation—Asks others for feedback.
- Trial—Uses a sample, etc.
- Adoption—Now a user/believer.



[Figure 1] The agreed-upon questionnaire has been adapted in the course

2.3. Different concepts of media formations

Finally, different approaches to what “media” is can be helpful for students devising a means to reach a public with information in the hopes of changing behavior. Some of these different concepts of media formations can be identified as the following (Drew, 2014):

- 1). Marginal communication, or communication unrelated to organized movements, such as social networking sites that share personal information.
- 2). Horizontal communication, an equal exchange between organized sectors of oppositional organizations for purposes such as joint strategy and action.
- 3). Anticommunication, or the willful subversion of mainstream media messages (sometimes referred to as “culturejamming”), including activities such as billboard altering or jamming of radio/television signals.
- 4). Alternative communication, or the communicative activities of oppressed groups both within the group and towards a mass audience.
- 5). Internal communication, or communication among the membership of organizations or between the leadership and membership of organizations.

2.4. Praxis and a Hack-a-thon

Following the theoretical work of designing for social change, the class of students are led in a focused “brainstorming” session with the goal to generate the four most important areas of media to focus on depending on the public they are trying to reach. Based upon the work of their targeted interview groups for questioning; family, students, worker/staff and people on the street, students generate several important communication arenas on which to concentrate. Outcomes from the experimental course included a video campaign of short videos to distribute via youtube and other online channels, a mobile device app using gamification, an app to code and launch for mobile phones, an animated display that would be projected underground in the metro stations, and a print poster campaign for dissemination on public kiosks and walls. Faced with the challenge of changing public perceptions and understandings of global warming, students strategized creative and provocative prototypes to inform, educate and evoke behavior change. The wide-ranging strategies included using data visualization, fostering empathy with threatened animal life, generating humor or fear in the target audience, and a myriad of other possibilities.

Once key areas are decided, students work in their teams within a short time-frame to link their ideas about climate change to a practical or speculative, realizable, prototypable media products that can be introduced into the public realm. Students work collaboratively around shared tables, energizing each other to complete their tasks, while sharing skills, ideas, iterations, concepts, sketches, drawings, models, codes, iterations, etc. It was our experi-

ence in the experimental course that students greatly enjoyed this collaborative and creative work.

Outcomes of this experimental course were shown at Tongji University as well as within the Design building at the University of California, Davis campus, to great public enjoyment.



[Figure 2] The brainstorming and the presentation of the draft ideas about climate change to a practical

3. THE OUTCOMES

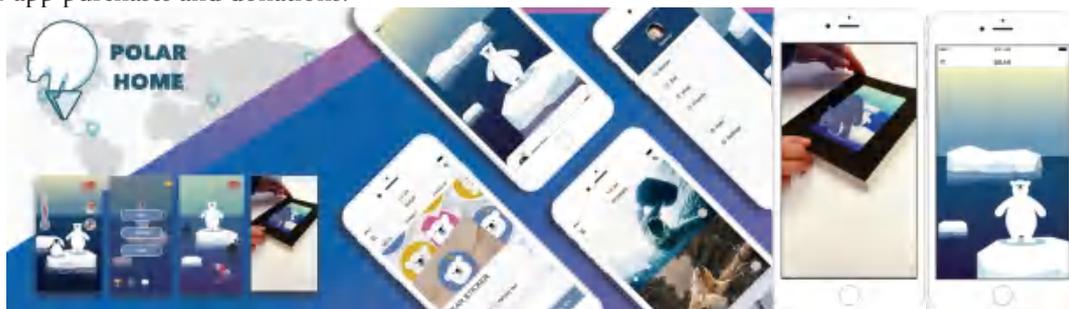
Five design projects were prototyped and developed in the Tongji course. The “New Life in 2048” team developed a series of creative interventionist posters (using digital design tools and hand-painting) for speculative fashions as a way to cope with extreme weather. The “Polar Home” team created an animated app to educate and warn users about the severity of the melting of polar glaciers. “The Ancient China Myths” team created an evocative silent video based on two well-known ancient Chinese myths, “Kua Fu Running After the Sun” and “Nu Wa Patching up the Sky,” to highlight the damage of smog and ozone depletion. The “What Makes You Die” team created animations for delivery in the underground metro stations of Shanghai that revolved around the death of a protagonist in different harsh environments due to climate change. The “Tap the World” team created an interactive game encouraging players to save the earth. Case studies for “Polar home”, “The Ancient China myths” and “What makes you die” follow.

3.1. Polar Home

Target Audience: The Unconcerned

Output Format: Mobile App

Global warming has caused the melting of polar glaciers, and thereby has deeply threatened the survival of polar animals. While some people are unaware of the situation, others turn a blind eye to it. The purpose of this app is to educate users about the severity of the issue (through news stories, documentary photography, AR features and built-in, ironic games) and motivate users to make simple behavior changes on a daily basis. In addition the app harnesses robust social media features: Users can play games with their friends, or invite new friends to contribute actions in support of environmental protection. When the users attain certain achievements, collaborating environmental organizations will do something practical to save the planet. Users may in turn support such organizations through in-app purchases and donations.



[Figure 3] The App design of Polar home

3.2. The Ancient China Myths

Target Audience: Family

Output Format: Silent Video

The design team fused environmental pollution and climate problems with two ancient Chinese myths. The stories of “Kua Fu Running After the Sun” and “Nu Wa Patching up the Sky” were creatively adapted to highlight the damage of smog and danger of ozone depletion. In the adapted stories, Kua Fu chases the sun and dies of poisoning caused by inhaling excessive, harmful smog, rather than dying of exhaustion. Because of the increasing size of the ozone hole, the azure sky breaks faster than Nu Wa can patch it, which ultimately results in her failure. As a public service runner in video screens of shopping complexes, the adapted stories engage a wide range of viewers. The videos influence viewers of the importance of the climate problems and protection of environment.

3.3. What Makes You Die

Target Audience: Youth and Adolescents

Output Format: Metro Animation

Due to the limitations of the subway screens, the animation is made up of four short clips, each corresponding to a word of “What Makes You Die”. The theme of the animations is the environmental issues of water caused by climate change. The four segments individually address acid rain, water pollution, desertification and sea level rise. A design strategy of a single white line is used to create a pastel effect, highlighting the “culprit” of human life represented by fluorescent colors. The whole animation revolves around the death of the protagonist in different harsh environments. This metro animation communicates using subtle black humor and attracts young people visually in the subway.

4. CONCLUSION



[Figure 4] The exhibition of student's work in UC Davis

Each project was featured in a poster for exhibition in the lobby of Cruess Hall, the well-trafficked Design Building at the University of California, Davis. Because all posters shared a common design strategy of layout and typography, the group looked cohesive and attractive as a whole. Just around the corner from the poster exhibition was a large, flat-screen display that looped through videos showcasing the trajectory of each project, from target audience interviews to design concepts and iterations to the final work. The exhibition and video display were so popular that they were extended from a two-week show to a five-week show. Students (both undergraduate and graduate) and faculty alike were impressed by the conceptual depth, creative ideation and excellent final outcomes.

As professors who work in both the theoretical and practical areas of design and media, this course led to enhanced understanding of design principles and practice addressing the critically important problems of global warming and climate change. We found this collaboration between Tongji University of Shanghai and the University of California, Davis, as one important step that contributed significant outcomes of contribution to individual and organizational change, as China and the United States are the two leading industrial powers in the world, and are well-placed to make an impact on climate change. In addition, it was an exciting and impactful international, educational exchange for the professors, student participants and greater university populations who experienced the final works.

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DESIGN PEDAGOGY FOR SUSTAINABILITY: DEVELOPING QUALITIES OF TRANSFORMATIVE AGENTIVE LEARNING.

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ABSTRACT:

For design educators who are developing students readiness as sustainably aware design practitioners, it remains a challenge to create meaningfully transformative learning experiences. We contend that, in tackling this challenge, it is key for design educators to develop compelling pedagogy where students experience their evolving agentive selves in relation to wider systemic relationships. To explore this we examine a project case where Biomimicry was introduced to complement a pilot course promoting a Sustainable Product Service System (S.PSS) view and tools. The question framing this research paper is: What are the qualities of an ecologically immersive pedagogy that is productive of sustainable design dispositions in students? By connecting social learning theory and design for sustainability, we draw together concepts of learning ecologies, and agentive learning. Conducted as participatory action research, the qualitative inquiry process reveals how pivotal learning moments were found to have cultivated attributes of resilience, performative adaptability, and relational awareness.

Key Words: Sustainable design pedagogy, learning ecologies, agentive learning, Biomimicry, S.PSS.

1. INTRODUCTION AND BACKGROUND

This paper reflects the efforts of five design educators in the Cape Peninsula University of Technology (CPUT) in developing pedagogy and curriculum over a five-year period that prepares design students for a world urgently in need of sustainable design practitioners. Against this backdrop we argue for compelling design pedagogy that seeks to enable authentic ontological shifts in a student's sense of self and emergent designing agency in relation to wider human and non-human ecologies (e.g. Snaddon et al., 2017). Bringing about transformative learning experiences for students is the challenge for all educators, but in empowering young designers to move beyond dominant unsustainable anthropocentric habits in designing, this challenge is one of paradigm shift. This requires inventive thinking, practice and methods not commonly found in many design programmes. In our experience such approaches need to expand beyond didactic skills-based agendas to emphasise pedagogy that enables agentive, experiential learning that is transformative for a learning subject. An important aspect of this is situating students' experiential learning within new sites for pedagogy where they are exposed to 'community realities' (Taylor & Fransman, 2004) as a means of locating "individual action within the broader context of its consequences" (Sachdev, 2014, p. 438). In this paper we explore how students negotiate learning as agentive subjects moving across disciplinary, social, environmental and personal learning thresholds.

To do this we present the conceptual framings informing these perspectives, followed by the methodology we have used in provoking the above learning and resultant dispositions. Next we report on learning within a project case as prompt for our analysis and close with a discussion and a set of propositions for what constitutes the qualities of an ecologically immersive pedagogy for sustainable design.

2. THEORY AND CONCEPTUAL FRAMINGS

In adopting a sociocultural perspective on situated and experiential learning (Lave & Wenger, 1991; Leander et al., 2010; Freire, 2015; Shreeve, 2016) we acknowledge processes of learning as not only contained in individual minds but distributed across and mediated by people, tools, language, and learning environments (Leander et al., 2010). The question of the relationship "between an individual with both a mind and a body and an environment in which the individual thinks, feels, acts, and interacts" (Gee, 2008, p.81) is a prompt for design educators to explore potential learning spaces and places that are relationally agentive. Agency so understood extends beyond localisation within individuals and is considerate of agentive entanglements (Haraway, 2016) that widen a nascent designers relational awareness of self in a wider systems view. To this point, Mathews argues that we as humans are "enmeshed unavoidably in ecological relations with other species and with the biosphere at large" (2011, p. 5). In a previous LeNSes conference, Narayanan (2010) has questioned the conventional starting points in design education for sustainability, and argued for initiating with an "integrated and holistic development of consciousness as core to a new form of design thinking – one that grounds autonomy, experience and agency" (p. 19). Sachdev (2014), also based at the Shrishti School of Art Design and Technology further develops Narayanans pedagogical approach of combining "being with doing and creating capacities for ways of knowing, sensing and seeing our world" (p. 423). He argues for pedagogy that carefully considers "how we interact within the larger dynamic of participation and consequence of actions" (p. 439).

In terms of design pedagogy, these are important concepts for framing critical inquiry into transformative learning spaces that "forge participation in the times and spaces of relationality between inside and outside" (Ellsworth, 2005, p. 46) as students negotiate self in relation to others. Furthermore, Jackson (2013) develops the concept of an individuals 'learning ecology' comprising "their process and set of contexts and interactions that provides them with opportunities and resources for learning, development and achievement." Importantly for the concept of learning ecologies, Jackson cites Lemke's (2000) argument that for learning processes "each step along a developmental trajectory changes the way the system interacts with its environment at the next step" (p. 284). These are supportive views for design pedagogy that is reflexive and responsive to how meaning is made within an 'eco-social systems view' where a "developing person engages in socially meaningful interactions with others and with the non-human surround" (Lemke, 2000, p. 283).

2.1. Methodology and research methods

The paradigm of inquiry is primarily constructivist while leaning towards advocacy and participatory approaches. We adopt the roles of participatory action researchers within a practice-based action agenda for transitioning curricular and pedagogical reform (Creswell, 2003; Denzin, 2017). That is, we planned and enacted our pedagogy and then through qualitative inquiry methods of participant observation during the coursework, and semistructured post-project interviews we have been able examine and lift up nuanced understanding of emergent learning dispositions. In addition, we draw on survey data contained in the independent observers report which is a mandatory element of a pilot LeNSes course. These methods all contribute to a multivocal and dialoguing approach (Tracy, 2010) and generate a rich contextualisation and recounting of learning experience.

3. CASE STUDY: LEARNING TO DESIGN LIKE AN ECOSYSTEM

The pilot project ran over a period of eight weeks alongside regular coursework as part of CPUT's Industrial Design departments fulfillment of its mission as a member of the LeNSes partnership to integrate S.PSS tools into a curriculumated trans-disciplinary course, the first of which dealt with renewable energy alternatives. The challenge was to develop alternative strategies for enabling access to energy for under-developed areas in Cape Town. The student and staff group comprised five educators and 30 undergraduate level students in the Industrial Design and Mechanical Engineering Departments at CPUT. Consent has been given by students for interviews and material generated by the project to be used in this study.

In addressing local challenges of socio-material change in relation to a wider context of complex ecosystems, the methodology and tools of S.PSS¹ and Biomimicry² were used. In this way, the pedagogical approach and ethos of Biomimicry was introduced to draw students' social ecologies into closer proximity with local natural ecology. By immersing the group in a natural setting, students were exposed to alternative solutions for energy production based on their observations. After this exploratory phase, a process of abstracting design principles from observed natural strategies followed. The Life's Principles³ checklist, in conjunction with other biomimetic design tools were used in a series of exercises. This enabled students to explore possibilities for innovative product design by first understanding existing energy systems currently used in rural, peri-urban and urban social contexts, and then to assess the potential for adaptation according to efficient energy systems prevalent in nature. Students then established a relationship with a local community partner to map the existing socioeconomic and environmental context using S.PSS methods. The final outcome was a conceptual product prototype designed using an S.PSS view and tools, achieved through a process of engagement with deep social and environmental sustainability as a benchmark.

A comprehensive analysis of the project outcomes are beyond the scope and topic of this short paper and so we focus now on learning brought about through the inclusion of biomimetic pedagogy, and how students navigated their experience of this approach as a meaningful starting point for sustainability education.

3.1. Suspension and inspiration

Our project work commenced with a detailed overview of Biomimicry, its methodology and methods along with inspirational examples of the use of this approach in various disciplinary domains ranging from healthcare to architecture and product design. We then shifted our studio to the biodiverse Kirstenbosch Botanical Gardens to initiate the first phase of scoping and discovering, which would prove to be a key step in expanding ecological awareness that would enable students to sense and see the world differently. As students learned, with assistance from a biologist, about the strategies evolved by local fauna and flora to sustain life over billions of years, they entered "unfamiliar territory, in a process of discovery" (Fendler, 2013, p. 787). One student commented on how this phase levelled hierarchies often prevalent in the studio: "When you are taken out of the class environment and into nature you let all of that drop... everything is new to you, everyone is on the same level". In being introduced to a new language of how natural systems work and 'quieting' their designing cleverness, an egalitarian trans-disciplinary space was opened up. In one student's words, "It was like first year all over again, you felt uncomfortable because everything was new". Students learnt how to suspend their usual competitive rush for task completion, listen to each other and also widen their view of where inspiration might come from. This would be a significant move towards seeing nature as mentor, as an immense resource for modelling, and as an existing measure for sustainable solutions.

3.2 Application and evaluation

A second phase challenged students to apply their new learning in a designerly way involving two exercises known as 'Design to Biology' and 'Biology to Design'. In the latter exercise, drawing on deeply observed biology and selected natural 'champions' would later move students to consider how evolved symbiotic processes can inspire design solutions⁴. For example, observing a *Strelitzia* flowers 'valve' petal which acts as a perch for a bird pollinator by releasing pollen due to its weight, inspired one group of students to later emulate this valve release action in a design concept for a biogas stove. Gas only flows with the weight of a pot, thereby preventing fire if knocked over.

Student reflections on their experience go beyond the strictly procedural and highlight interesting threshold crossing moments where socially meaningful learning ecologies were forming. Some commented on the confidence gained as their groups community of practice started functioning like an ecosystem, where unexpected resources were shared and the groups interdependence ensured that no member would be left behind as progress was made.

One student reflected that Biomimicry was a catalyst for her creative process and that along with "dreaming and motivation helped her come up with wild ideas for real world problems". Another confided that, being such

¹ Sustainable Product-Service Systems (S.PSS) is a promising model to couple environmental protection with social equity, cohesion and economic prosperity in different contexts around the world (LeNSin Project, n.d.).

² Biomimicry is the conscious emulation of tried and tested strategies found in nature to develop sustainable solutions to human challenges (Benyus, 2002).

³ Life's Principles are drawn from overarching patterns and strategies evident among species thriving on earth. By learning from these deep design lessons that have evolved over 3.8 billion years, students can model innovative strategies, measure their designs against these sustainable benchmarks and be "mentored by nature's genius using Life's Principles as... aspirational ideals" (DesignLens: Life's Principles, 2016).

⁴ Students used the AskNature website to explore a library of biological strategies that have been mapped to design challenges (AskNature, 2018).

a turning point in her young design career, she would find it difficult to go back to previous ways of thinking and working. Others commented that even though they were bewildered and scared by the complexity of working beyond their disciplines, they found motivation and confidence in how the evaluative Life's Principles tools could support their creative imaginings and the viable sustainability of their designs. "It was a dramatic performance as we



shared ideas" said one student as she described a sense of euphoria in her group as they explored an expanded space for design possibilities. In summing up her experience one student said, "It made you think critically about things you wouldn't normally consider, it gave me the chance to think like a different type of designer". These reflections give some indication of transitioning steps towards trans-disciplinary thinking where students were able to move beyond habitual and siloed practices.

[Figure 1] Close observation of a biological 'champion' coupled with the S.PSS mapping tool enabled this student group to address the socio-economic and environmental challenges within a particular peri-urban community context. Images: Andrea Grant Broom.

4. DISCUSSION AND CONCLUSION

We have briefly shown in descriptions of the case above and through reflective comments how the intensive and sometimes uncertain process yielded valuable experience in becoming self-regulated learners capable of handling risk and ambiguity (Edwards, 2014, p. 25). Educators involved in planning, coordinating and running this pilot course reflected that the Biomimicry methodology/tools and the S.PSS method/tools shared similarity in both having a systems thinking approach, while each brought different strengths i.e. a Biomimicry focus on the ecological and S.PSS focus on tools for economic and socio-political aspects of design for sustainability. Even though logistics prevented an extended immersive phase commonly used in biomimetic pedagogical approaches, the survey and interview data showed that students responded more positively to the experiential pedagogy than the S.PSS taught method which was handled in a lecture format in studio on campus. The early beta version of the LeNSes website also contributed as a barrier for students trying to engage with the material. The biomimetic approach was inspirational for them enabling them to 'own' their learning in a socially and ecologically mediated process. They learnt that 'sustainability' means deep consideration of designing agency within planetary limits and boundaries, and that Life's Principles may be relied upon as a set of principles that can complement the S.PSS approach and add a deeper ecologically sensitive dimension to the analytical toolkit.

We now present an overall framing of what we call the qualities that are core to ecologically immersive pedagogy. These qualities are interdependent and individually significant as they collectively describe learning experience that is transformative of design dispositions relevant to complex contexts. Moreover, these qualities are seen as unfolding and about doing pedagogy with students that activates the present and empowers "a situation with capacity to provoke new relations", co-creating a space where students can be in the presence of emergent values and their consequences (Tironi, 2018, Chapter 5, Section 3, para. 2). These qualities comprise:

Opening – spaces for suspending and deterritorialising in a spatio-temporal move away from anthropocentric environments. Thinking–feeling in a non-threatening trans-disciplinary mode encourages local attunement and noticing of what is already thriving in a real-world project context, socially and ecologically.

Becoming – affording design students opportunity to build their own learning ecologies through critically expanding their current knowledge (episteme) of sustainability through immersive being (ontology) in close proximity with living ecologies.

(Re)connecting – remembering that we are part of nature and not as disentangled from other species as we have come to believe (Mbembe, 2016). This is an ethical move that enables design students to operate with conviction and shared agency "within a wider realm of care" (Sachdev, 2014, p. 437). In this way students perform a move away from ego towards becoming ecosocially aware of their designing agency.

Integrating – by integrating the unexpected and being open to more than one narrative, cooperative relation-

ships may be recognised and cultivated that enrich the design process. This includes a pedagogy of integration that draws together knowing, being and doing in ways that have the “ideals of social and ecological justice as its basis” (Sachdev, 2014, p. 423).

Emulating – enactive emulation (rather than appropriation or extraction) of natural strategies (rather than resources) through a process of learning with nature as model, mentor and measure, effects respectful design that is better suited to thriving futures for all.

Measuring – by evaluating creatively innovative design possibilities against a set of living principles, motivation and confidence to challenge the unsustainable status quo may be cultivated in young designers.

In conclusion, by reading this case through the literature; our position is that immersive, situated design pedagogy that is enacted with our students produces pivotal moments during the learning process which have been found to have been effective in transforming students’ dispositions, cultivating attributes of thoughtfulness, self-awareness, resilience, adaptability, and shared agency. These are moments that effectively enable design students to understand and more confidently create their social learning ecologies through collaborative interactions with their design peers, other disciplines, local communities and natural ecologies. These pivotal learning moments are consistent with the skills and agency desired for knowing how to be sustainable designers in a rapidly transitioning world.

Cape Town’s particular socio-economic and political complexity, together with its biodiverse natural environment provides a rich landscape within which we as educators are able to draw on and dynamically situate our pedagogy. In this paper we hope that in sharing this experimental pedagogical approach in the spirit and ethos of the LeNSes network, that we are contributing to and learning from a diversity of place-based methodological approaches that are unique to different parts of the world. In this way we can continue to develop the concept of ecologies for learning where the network learns as an ecosystem does.

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ENVIRONMENTAL ASPECTS IN THE UEL DESIGN COURSE: LEGAL CONCEPTIONS AND REALITY

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ABSTRACT

The current environmental problems have brought forth a demand for professionals who can conceive their products and services in a manner which is less harmful to the environment. Therefore, university courses must set up a curricular structure focused on this approach, both in terms of specific disciplines and of interdisciplinarity. Thus, this paper aims to analyze the emphasis currently placed on environmental issues in the curriculum of UEL (State University of Londrina) Graphic Design course. For that purpose, documentary research was carried out in state and federal laws and bibliographical research in scientific articles, books and theses. In addition, a specific diagnosis was made via a questionnaire applied to the course students, as well as an interview with one student, based on several different themes. The results have shown that we are in a transition phase, i.e. some educational laws and policies have already incorporated the need to address environmental issues effectively in the curriculum, while others have not. Our analysis of the course curriculum has shown that it still fails in this respect, since although it includes the Design for Sustainability discipline, the main emphasis of the course is still placed on marketing aspects.

1. INTRODUCTION

Given the current environmental issues, design students need to be prepared to conceive products and services that go beyond the traditional concept of design – i.e., their responsibility now goes beyond the adequate functioning of that good or service and must also address its socio-environmental impact throughout its life cycle. For this change to take place it is necessary that current undergraduate courses have an adequate curriculum structure and an adequately prepared faculty. Within the Design field, the Graphic Design discipline is the one that faces more challenges in this respect, since in comparison to Product Design it has fewer bibliographical references and its environmental studies are more recent.

The main objective of this paper was to reach an overall view of the environmental approaches in the UEL Graphic Design course and to find out whether the students' training is actually focused on the current environmental issues. This objective was achieved through the analysis of the current educational legislation and of the curriculum of the UEL Graphic Design course, as well as through questionnaires applied to the students asking about their degree of interest and knowledge of the subject.

2. DESIGN TEACHING IN FACE OF CURRENT ENVIRONMENTAL ISSUES AND ITS LEGAL ASPECTS

According to Pazmino and Santos (2017), design is generally taught – just as we see in other areas – totally ignoring the current immense environmental imbalances, already described and proven by science; rather, its didactic guidelines are still driven by marketing considerations. “Theories and approaches to innovation, marketing and consumption are emphasized, while issues related to the environment and sustainability are scarce in educational institutions” (Pazmino & Santos, 2017, p.12).

Since the beginning of Design teaching in Brazil, with the launching of the School of Industrial Design in Rio de Janeiro in 1963, the curriculum of Design courses has focused on marketing concerns, although environmental problems were already included in similar courses in developed countries. Today many Design courses include sustainability issues as a separate discipline. As a consequence, students do not apply those concepts to the projects proposed in other disciplines. In several universities, sustainability is taught only at the end of the course, when students will have already done several projects without including sustainability precepts and therefore never reflected upon the environmental aspects involved in their projects. (Pazmino & Santos, 2017).

Still according to Pazmino and Santos (2017), sustainability must be taught transversally, in a cross-disciplinary approach, thus changing the whole teaching paradigm and bringing about[...] a holistic view of current issues affecting society, making students more aware of relevant issues regarding their ethical, social, and environmental responsibility in their professional activities. It will also enable them to shape their codes of conduct so as to become critical, active and reflective citizens in regard to the multiple dimensions of sustainability (Pazmino & Santos, 2017, p. 15).

The sustainability paradigm demands a novel adaptation of educational guidelines. Therefore, State of Paraná Law nr. 17,505/2013 established the State Environmental Education Policy and the Environmental Education System (Lei 17505, 2013). As to higher education, its Paragraph 2 determines the fostering of “[...] environmental education at all school levels and of society’s commitment to preserving, conserving, restoring and improving the environment [...] in an integrated, interdisciplinary and transversal manner in the school curricula, as well as integrating it as both applied practice and as a continuous and permanent educational principle at all levels and modalities of formal education.” (Lei 17505, 2013, p.3, Emphasis is ours.)

The Paraná State Environmental Education Program promotes research, studies and production of teaching materials, and recommends that Environmental Education should be “an integrated, interdisciplinary, transdisciplinary and transversal educational practice in the school curricula.” (Lei 17505, 2013, p.6). In the specific case of higher education, Environmental Education must be included in the Paraná state political-pedagogical project.

However, analyzing the national curricular guidelines for Design undergraduates, through CES/CNE ruling 0195/2003, approved on August 5, 2003 and published on *Diário Oficial* on February 12, 2004, as well as CNE/CES5/2004 Resolution of March 8, 2004, the neglect of environmental issues is evident. Of the thirteen articles of the ruling only the 5th Article, Item I mentions the subject:

The Design undergraduate course should include, in its pedagogical projects and in its curricular organization contents and activities that address the following interconnected axes: I - basic contents: the study of Design history and theories in their sociological, anthropological, psychological and artistic contexts, covering project methods and techniques; means of representation, communication and information; the study of relations between user/object /environment; the study of materials, processes, management and other relations with production and market. (Resolução nº 5, 2004, p. 2).

Thus, each course must take the initiative to insert a discipline with those specific themes in its grid, as well as how to apply them in projects etc.

In view of this mismatch between the curricular guidelines and the Parana state environmental education policies, we will proceed to analyze how the UEL Graphic Design course has positioned itself in this regard.

3. GRAPHIC DESIGN TEACHING AT UEL AND SUSTAINABILITY ISSUES

The UEL Graphic Design course, which was established in 1996, seeks to:

Offer instruction in Graphic Design, aiming to develop the students' analytical, critical and expressive skills, integrated into contemporary reality; to give a sound basis and apply theoretical principles and practical activities to work in the methodological phases of graphic product designs; to find out major human needs and their relationships with production systems; to provide students with their integration into the socioeconomic and cultural system of their regions; to develop the students' analytical, critical, technical, creative and expressive skills; to apply ergonomic, cultural, economic, social, technological and aesthetic aspects to graphic projects; to propose visual solutions to communication and information issues; to develop their analysis, reflection and synthesis skills stemming from research activities and to coordinate, synthesize and apply design methodologies, with their functional, plastic, aesthetic and symbolic features, to the creation of graphic products (Universidade, 2017a, p. 1).

Although the above mentioned objectives indicate important aims for a graphic designer's training, there is no mention of aspects related to professional designers' interaction with their environment. However, it is important that a student can see himself or herself as someone who interacts with nature and impacts it in some way, as a professional who knows how his or her projects will affect their environment and also their social milieu. It is essential that students align their graphic design projects with Graphic Ecodesign principles and that they find and apply solutions for any potentially unsustainable design projects.

The course includes the Design and Sustainability discipline, taught in the third year, whose syllabus is, briefly, "Environmental sustainability and sustainable development. Environmental economic thinking. Design geared to sustainability, taking into account product life cycle: steps and strategies. Methodologies and tools. Design and environmental management" (Universidade, 2017b, p. 1).

A new Pedagogical Project has recently been implemented in the course (2017), thus giving it an interdisciplinary profile, with a stronger coordination among its various disciplines.

4. GRAPHIC ECODSIGN

In order to understand Graphic Ecodesign, it is necessary to grasp the concept of environmental sustainability, which [...] refers to the systemic conditions according to which, at the regional and global levels, human activities should not interfere with the natural cycles on which the resilience of our planet is based; at the same time, they should not impoverish its natural capital, which should be passed on to future generations (WCED, 1987 apud Manzini & Vezzoli, 2008, p. 27).

Thus, Ecodesign can be defined as "a design model guided by ecological criteria." This term, although self-explanatory, unfolds in different ways in its various applications. When applied to graphic design, it refers to performing this activity seeking to minimize its negative impact on the environment. Manzini and Vezzoli (2008, p. 28) present the general requirements for sustainable design:

- Relying your design primarily on renewable resources (while ensuring their renewal);
- Optimizing the use of non-renewable resources (such as air, water and land);
- Avoiding accumulating waste material that the ecosystem would not be able to "renature" (i.e., return to their original mineral substances and, importantly, in their original concentrations);
- Acting so that each individual and each community of the "rich" societies remains within the limits of their environmental space and that each individual and community of the "poor" societies can effectively enjoy the environmental space to which they are potentially entitled.

The first ideological guideline of Ecodesign is "green" design. This term was taken from political movements favored in the 1980's, when an increase in the general population's awareness of the multiple impacts on the environment, several Green parties emerged in Europe proposing this ideology.

In 1988 *The Green Consumer*, by John Elkington and Julia Hailes, was published. This guide was widely read by those who wanted to find out how to consume goods with minimal environmental impact. Afterwards, the Friends of the Earth group raised the issue of Eco-consumerism or "Green Con" (Madge, 1997). In view of this market demand, many designers began to work on environmentally friendly products, often utopian. Thus, green design lost a quite a bit of its reputation due to a large volume of non-ecological products and unreliable certificates and stamps.

After World War II (1939-1945) Europe experienced a severe economic crisis, which prompted a culture of "less is more", driven by the restriction of materials and energy. Thus, many products that consumed fewer raw materials started to be highly appreciated.

Later, in the 1970s, Victor Papanek's book *Design for the Real World* laid the groundwork for Ecodesign. In this book, Papanek innovated by presenting a designer's moral responsibility in the face of environmental problems. He argued that a designer should raise people's awareness to those problems rather than further promote consumerism. In his view, when socioeconomic and political crises affect access to materials, designers are motivated to plan and design products with greater creativity to improve product performance.

Another influential book by Victor Papanek was *The Green Imperative*, 1995, where he championed the spiritual aspect of ecological consciousness. He believed that there are spiritual issues inherent in the relationship between man and nature. Furthermore, he considers that in the 21st century design would be transformed by environmental issues, taking quality into consideration when it comes to consumption. He proposes that designers must question the very concepts of products and services, taking into account their environmental performance rather than their profit potential exclusively (Lopes, 2016).

Papanek also inspired the 1960s counterculture movement, when several projects were launched that prioritized social and environmental responsibilities, set against industrialized mass production. Designers then came up with the concept of “conscious consumption” and with products for educational purposes, among other proposals; however, these and other Ecodesign initiatives remained dispersed (Lopes, 2016).

Regarding Graphic Design, Papanek questioned the importance and purpose of packaging design. He objected to the amount of ink used in graphic design and to the difficulty of recycling it. He exemplifies his point with powdered soap packages, stating that generic packages are more elegant and communicative than brand packages that invest in design aiming at higher sales to the end consumer (Lopes, 2016).

In 1971, with oil prices on the rise, there was an improvement in technologies for alternative sources of energy. Thus the Product Life Cycle concept emerged, quantifying the impact of a product or service in each phase of its life, through the analysis of its inputs (raw material and energy) and outputs (carbon emissions and waste in general). Later, in the 1980s, with the beginning of a wave of eco-consumerism, many products considered “green” began to be consumed in large quantities in Europe and the United States. In order to assure more security to ecological products the ISO 14000 ecological certificate was launched (Lopes, 2016).

5. RESEARCH METHODOLOGY

The methodological procedures applied in the stage of theoretical grounding were exploratory, through bibliographic and documentary research, based on sources like books, scientific articles and legislation (GIL, 1999). The main authors referred to were MANZINI AND VEZZOLI (2008) and LOPES (2016).

In order to gauge the student’s interest and knowledge about environmental issues and Ecodesign, a questionnaire was conceived through an online form with 8 multiple choice closed questions, of which 3 contained spaces for discursive responses. The target group were the undergrads of the UEL Graphic Design course; from approximately 80 students overall, 30 answered the questionnaire. The questions were: (i) Do you believe the news stating that the environment is threatened by anthropic actions (those carried out by men)? (ii) Do you carry out environmentally conscious practices in your daily life, such as separating waste and saving water?; (iii) How do you assess your knowledge about graphic materials and processes in regard to their environmental impact?; (iv) Where did you acquire this knowledge?; (v) Do you consider that graphic products impact the environment?; (vi) Are you aware of any Ecodesign tools (such as checklists, for example) that can be applied to your projects in order to make your printed products less impactful?; (vii) Do you think that an ecological approach in the making of a graphic product raises its final cost?; (viii) Would you be interested in a potential Graphic Ecodesign module in the Graphic Design course?

Additionally, a senior student (randomly chosen) was interviewed so we could listen to the views of someone with a holistic view of the course, having already gone through all disciplines and projects. The interview was based on themes; according to GIL (1999), this type of structured interview is based on points of interest, that drive the interviewee to speak freely about each theme. The themes were: (i) Do you think the course has place any emphasis on environmental issues? If so, in what discipline? Was it at the beginning or at the end of the course? Were the issues discussed in isolation or applied to other disciplines as well? (ii) Do you consider that your professors stimulated you to search for new information on those issues?; (iii) Do you think the course has stirred up your critical sense?

5.1 DIAGNOSTIC RESULTS

According to the resolutions of UEL CEP (Ethics Committee on Research Involving Human Beings), the student must initially agree or disagree with the Term of Free and Informed Consent.

The first question asked if the student believed the news claiming that environmental problems are man-made. Only one respondent stated he had no knowledge of the subject; the others responded positively, thus showing that students are well informed on the issues.

The second question asked if the student has environmentally conscious practices in his daily life, such as separating waste and using water rationally. Seventeen students (56.7%) answered that they adhere to these practices “sometimes”; the remaining ones said that they perform these acts daily. This result is encouraging, since someone who has already incorporated those habits in his or her daily routine will transfer them easily to his or her professional activities.

The third question evaluated the respondent’s knowledge about graphic materials and processes and their environmental impacts. It is interesting to note the high percentage (13.3%) of students who did not have any knowledge at all about graphic Ecodesign – almost twice as many as those who claimed to have advanced knowledge of the subject (6.7%). We think this results from the lack of literature on the subject (LOPES, 2016). No less than 80% of the students stated that they have a medium degree of knowledge of the subject – an encouraging finding, showing they are

interested in the subject and have already sought information about it. The next question asks about the source of this knowledge: 65.4% say they have acquired it at the university, while 34.6% pointed to the internet or other media.

The fifth question, an open one, asked students to write about the pollution potential of graphic products and their polluting source. The respondent had 3 options: a) those products do not impact the environment; b) they impact moderately; or c) they cause a strong impact. Those who responded that the environment is impacted were invited to write about what exactly makes them polluting. The responses were very diversified, covering topics such as deforestation for timber production; the release of pollutants during the production chain; the finishing and enhancement of graphic products (lamination, varnishes); paint binders; wasteful paper use; waste generated in the processes (even if this waste is recyclable); adequate disposal of packaging; lack of environmental awareness in the consumption of graphical products, as well as in primary school and high school teaching and also in home education; and input toxicity. One student wrote about the relationship between the layout design phase and the final impact of the product, producing an especially interesting analysis, according to Lopes (2016). The sixth question asked about the students' awareness of Ecodesign tools. Only one respondent answered yes, but did not specify which tool he was aware of. The seventh question asked the students' opinion as to whether or not a product becomes more expensive when it has a lower environmental impact. Only 16.7% of the students said no. According to the results achieved in Lopes' thesis (2016), greener products do eventually become more expensive, but in most cases their final cost is reduced.

The last question asked if the student would be interested in a potential future module on Graphic Ecodesign in the course. Of the respondents, 90% said yes. Only 3 students answered "maybe", showing students are quite receptive to subjects related to the environment.

As for the individual interview, initially the student firmly stated that the course placed only a minimal emphasis on environmental issues, and in those rare occasions the subject was addressed in an isolated approach, without continuity. The student said Graphic Ecodesign was discussed only in the Graphic Production discipline, addressing the impacts of pre-printing and post-printing phases, as well as proposing arguments the designer could present so that the client would agree to produce a less impactful graphic product. However, none of these points was applied or addressed in other disciplines. Anyway, the respondent believes there should be a specific discipline to address this content in the first year (this discipline is part of the course but only taught in the third year). That respondent stated that it is necessary to educate students to become not only professionals, but also conscious citizens.

6. FINAL CONSIDERATIONS

Our analysis of state and federal legal documents, as well as UEL's Graphic Design course, shows that we are in a period of paradigmatic change, since the 2004 Curriculum Directive did not make any mention of environmental issues at all, while the 2013 Paraná Law asks for a more ecological approach in the curriculum. However, the curriculum analysis of UEL Graphic Design course and the applied diagnosis shows that although it has a Sustainable Design discipline, it is taught late (only in the third year); it focuses on general aspects of Ecodesign, rather than on Graphic Ecodesign; and does not have an interdisciplinary approach, such as practical applications in design projects. It can be said that the course approach is still mainly focused on market issues, rather than on socio-environmental demands, although it has had significant changes in the implementation of the most recent Pedagogical Project, in 2017. Most students are aware of environmental issues and expect the course to place its focus on issues related to environmental protection.

We can thus conclude that although the state legislation follows updated guidelines regarding the needs of a professional designer whose projects will be aligned with environmental demands, UEL Graphic Design course still needs to improve this alignment, in order to correspond to the expectations of the students.

We can also state that the course reflects the lack of specific educational materials for adequate teacher training in the specific area of Graphic Ecodesign.

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EDUCATION FOR SUSTAINABLE DEVELOPMENT. CASE OF AN INDUSTRIAL ENGINEERING PROGRAM IN COLOMBIA.

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ABSTRACT

The environmental problems are a reality in the Colombian context and its effects are associated with high costs invested to solve health problems and the damage of ecosystems. Higher education promotes a change of values, behaviors, skills, knowledge that could help humanity to be closer to sustainable development. This is the case of the Eco-design class, part of the environmental management emphasis of the Industrial Engineering program of El Bosque University in Colombia. In this class, pedagogical projects are developed in which students apply and present the gained knowledge during semester in an institutional event every semester. In this paper, is analysed the scope of the projects in accordance with levels of ecodesign application and levels of the evolution of design for sustainability, finding that the class has advanced in the last years generating innovative projects focus on the development of sustainable product-service systems. Moreover, is reviewed how from the class are promoted key sustainable development competences.

Key words: Ecodesign, Design for sustainability, Education for sustainable development, Industrial Engineering Program.

1. INTRODUCTION

In Colombia, the effects caused by incorrect practices from both industry and consumption of goods and services are evident on one hand, in high cost for the country, associated with diseases in the Colombian population. According with a Colombian study the environmental impacts on health due to solid and dangerous waste, water pollution, air pollution, and generation of toxics, involves high costs associated with deaths produced by heart, cerebrovascular and respiratory diseases; which represent almost a third part of the total diseases in Colombia (Ministerio de Medio Ambiente y Desarrollo Sostenible, 2012, p 323).

On the other hand, according with a biodiversity inform in Colombia, “Environmental changes are unleashed mainly due to dynamics linked to mining, agriculture, livestock and urbanization. These dynamics break the natural mechanisms regulation of ecosystems, affecting (in many cases even destroying) its integrity and functionality” (Ministerio de Medio Ambiente y Desarrollo Sostenible & PNUD, 2014, p 40). Moreover approximately the 3,8 % of the Colombian PIB is covering annual costs of environmental damages (Ibid).

According with this Colombian situation is urgent to do education for sustainability because not only the costs invested in water sanitation and hygiene, natural disasters, air pollution and land degradation would decrease but also ecosystems damage and human diseases.

In that sense, Education for Sustainable Development (ESD) is an urgent need for Colombians in order to allow them “to acquire the knowledge, skills, values and attitudes that empower them to contribute to sustainable development and take informed decisions and responsible actions for environmental integrity, economic viability, and a just society for present and future generations. [...]” (UNESCO, 2018, p 41). Consequently, from the program of Industrial Engineering, Education for sustainability is promoted with its emphasis on Environmental management.

1.1 Background of the study

Eighteen years ago the program of Industrial Engineering of El Bosque University has been developing an emphasis on environmental management for this career. The program achieve this emphasis through 3 classes: The first one ecology, the second one Eco-design and the third one Environmental management. This paper will focus on how is promoted education for sustainable development from the Eco-design class in students, analysing their final projects of the semester from 2011 to 2018 and also the evolution of the program during this period of time.

The Eco-design class is addressing the development of products and services with an ecological approach taking into account the methodology of eco-design and its strategies, as well as the life cycle assessment of the products, to reduce environmental impacts during their life cycle and contribute to the sustainable production and consumption from the industry.

The general contents of the class during the period 2018 – 1 were:

- Product life cycle. Life cycle analysis tools (qualitative and quantitative). Environmental problems.
- Eco design and sustainability. Methodology. Strategies. Closed cycle (technical and biological). Sustainable Product Service System. Circular economy.
- Eco product design for environmental and business improvement (project). Ecolabelling Eco-innovation.

The theoretical background during the Eco-design class is:

- Eco-design (Life Cycle design), “is considered a practical mechanism for integrating environmental considerations throughout the life cycle of the product” (Luiz, Jugend, Jabbour, et al., 2016).
- Life Cycle Assessment: Methodology that evaluates the environmental impacts associated to processes and materials of the life cycle of a product or service in relation to its functional unit (Vezzoli & Manzini, 2015).
- “Circular Economy (CE) aims to overcome the take-make-dispose linear pattern of production and consumption, proposing a circular system in which the value of products, materials and resources is maintained in the economy as long as possible” (Merli, Preziosi, & Acampora, 2017). The model of circular economy also called “economy from cradle to cradle” or “closed-loop economy” (Ellen Macarthur, 2013).

Product service system design for sustainability is:

“the design of the system of products and services that are together able to fulfil a particular customer demand (deliver a ‘unit of satisfaction’) based on the design of innovative interactions of the stakeholders (directly and indirectly linked to that ‘satisfaction’ system) where the economic and competitive interest of the providers continuously seeks both environmentally and socio-ethically beneficial new solutions” (Vezzoli, C., Kohtala, C., Srinivasan, et al., 2014, p 50).

From Eco-design class is promoted Education for sustainable development through applied projects during the semester very close to reality and the best projects are presented in a semiannual event organized by the Industrial Engineering program, called Responsible Production and Consumption. Through the development of the projects, students are encouraged to innovate and get new solutions to products and services found in the market. From this perspective, the students are stimulated to change their values and attitudes towards what means sustainability and how they can contribute to sustainable development from their professions working for industries and as daily consumers too.

2. METHODS OF ANALYSIS OF THE STUDY CASE

As part of the pedagogical focus on Eco-design class, students ought to present a project where they should apply the theoretical knowledge acquired during class. In the present document are analysed the projects presented by students from semester 2011 to 2018 (7 years).

The students projects will be analysed taking into account four levels of the evolution of design for sustainability and the four levels of eco-design application as the following table shows:

[Table 1] Evolution of design for sustainability and Ecodesign application levels (Font: Ceschin & Gaziulusoy, 2016, Balboa & Domínguez, 2014)

Evolution of design for sustainability Levels	Ecodesign application Levels
Level 1. Product design innovation: “design approaches focussing on improving existing or developing completely new products”.	Level 1. Product improvement: progressive and incremental improvement.
Level 2. Product-Service System innovation: “here the focus is beyond individual products towards integrated combinations of products and services (e.g. development of new business models)”.	Level 2. Redesign of the product: new product based on another existing one.
Level 3. Spatio-Social Innovation: “here the context of innovation is on human settlements and the spatio-social conditions of their communities. This can be addressed on different scales, from neighbourhoods to cities”.	Level 3. New product in concept and definition: radical innovation of the product.
Level 4. Socio-Technical System Innovation: “here design approaches are focussing on promoting radical changes on how societal needs, such as nutrition and transport/mobility, are fulfilled, and thus on supporting transitions to new socio-technical systems”.	Level 4. Definition of a new system: radical innovation of the system.

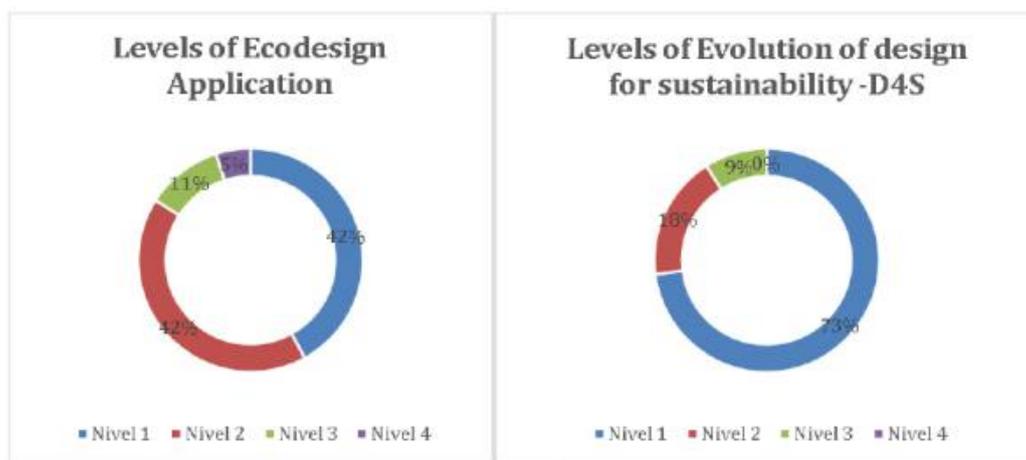
Moreover there is an analysis about how from the Ecodesign class are promoted the 8 key sustainable competences defined by UNESCO (2018).

3. RESULTS AND DISCUSSION

3.1 Analysis about the projects developed by students of Ecodesign class

The analysis of information of the students Eco-design projects during the last 7 years make evident that the proposals designed by students in their projects at the end of the semester from 2011 to 2016 are mainly focused on product improvement (level 1 – 42 %), and redesign of the product (level 2 – 42 %), according with levels of eco-design application. In relation with the evolution of design for sustainability levels the projects has been focus mainly on product design innovation with a 73% (level 1).

From 2017 has been evolving the innovation of the projects and its scope creating solutions, which apply Ecodesign in levels 3 and 4. New product in concept and definition with an 11% of projects (Level 3) and Definition of a new system with a 5% of projects (Level 4). In the case of the levels of evolution of D4S the projects have



evolved providing solutions focus on level 2 and 3. Product-Service System innovation with an 18 % of projects (Level 2) and Spatio-Social Innovation with a 9 % of projects (Level 3). (See figure 1).

[Figure 1] Analysis of levels of Ecodesign Application and evolution of D4S in students' projects (Font: Archives of Ecodesign class 2011 to 2018)

The reasons for the evolution of the application of eco-design and the evolution of D4S the last years could be the following: In 2016, the University organized the 2nd Ecodesign Latinamerican Congress, one of the results of this event was to make part of the Learning Network on Sustainability (LeNS) with the launching of the Colombian LeNS Network. The participation of both the professor and students in this network has open new knowledge windows, which have widen the scope of the class, teaching to the students new systemic paradigms that are not only

related with the improvement of a product from the environmental perspective. On the contrary in these new perspectives, solutions are more complex and must be designed new business models where are different stakeholders involved in order to achieve the satisfaction of economic, social and environmental needs expressed in Sustainable development goals.

Below are some examples of how the results of the projects proposed by students from the Ecodesign class have evolved:

Proposal of a bubble gum packaging (2012)

A bubble gum packaging is redesigned with the aim of reducing the environmental impact caused by the use of the materials in the current chewing gum packaging. The mono-materiality ecodesign strategy is applied, going from 3 materials in the current product to 1 in the proposal proposed by the students (Galan et al., 2012).

Proposal of a tooth paste packaging (2014)

Redesign of monomaterial packaging reducing the use of 3 of the materials of the product: aluminum, polyethylene and cardboard. In addition, the primary packaging is redesigned so that it can be refilled when the toothpaste is finished (Montoya et al., 2014).

Proposal Alumilk (2018)

Students propose Alumilk a company dedicated to the production of aluminum can packaging as an alternative to Tetra Pak packaging focused on the sale of milk. Despite the impact caused by aluminum in its extraction, a system is proposed that uses aluminum so that milk can be recharged in this type of packaging and consumers pay for milk recharge. At the end of the useful life of the packaging, the company is in charge of recycling the packaging so that it can be part of the technical cycle again (Bedoya, Medina & Olmos, 2018).

Proposal to reduce the consumption of water in a rural area in Colombia (2018)

Within the framework of the 3rd meeting of the LeNS Colombia Network, an inter-institutional workshop was held on the 25-liter water challenge promoted at the international level by the Open Source and Circular Economy days network. From the ecodesign class of the Industrial Engineering program were proposed alternatives to close the water cycle using living organisms to purify water, and other purification technologies to reuse water in showers, sinks, and dishwashers. Moreover, a dry bath proposal was developed in order to avoid the use of water in the bathroom and take advantage of human waste in other processes.

As the examples above show, students have evolved in their learning on sustainability, going over the improvement of a product from its environmental life cycle perspective, towards new models of business or the solution of complex systems. This new perspective implies to take into account the interconnectedness of the improvement of products, services and systems in order to bring more sustainable solutions. It means, the solutions should have economic, social and environmental benefits. For example, the project focus on the access to freshwater for a rural community during all the year. The solution generated by students promote the rational use of water through its purification and reuse. It is beneficial for the environment because the community will not generate polluted water, and at the same time, they optimize their use having access to potable water during the entire year, which will be socially and economically beneficial.

3.2 Key sustainability competencies promoted from Ecodesign class

According with UNESCO (2018), there are eight key sustainability competencies to have in mind for education, in the following table are analysed how through the Ecodesign class are developed some of this competences in order to promote in the students to think and act in aid of sustainable development.

[Table 2] Key sustainable competences promoted in Ecodesign class (Font: Adapted from UNESCO, 2018 pag. 44)

Key Sustainability competences	How are promoted in Ecodesign class
Systems thinking competency: the ability to recognize and understand relationships, to analyse complex systems, to perceive the ways in which systems are embedded within different domains and different scales, and to deal with uncertainty;	Students analyse the life cycle of a product and they create solutions focus on Sustainable Product-service systems or solutions from the perspective of Cradle to cradle, which promote new model business.
Anticipatory competency: the ability to understand and evaluate multiple futures – possible, probable and desirable – and to create one’s own visions for the future, to apply the precautionary principle, to assess the consequences of actions, and to deal with risks and changes;	Students compare the solution proposed with the initial diagnosis of the project that they develop during class through quantitative and qualitative tools.
Normative competency: the ability to understand and reflect on the norms and values that underlie one’s actions and to negotiate sustainability values, principles, goals and targets, in a context of conflicts of interests and trade-offs, uncertain knowledge and contradictions;	Students reflect about how their solutions are responding with the Sustainable development Goals.
Strategic competency: the ability to collectively develop and implement innovative actions that further sustainability at the local level and further afield;	The development of the projects during semester, look for the achievement of sustainable production and consumption patterns; however, any of the projects has been implemented in reality.

Collaboration competency: the ability to learn from others; understand and respect the needs, perspectives and actions of others (empathy); understand, relate to and be sensitive to others (empathic leadership), deal with conflicts in a group; and facilitate collaborative and participatory problem-solving;	Students should develop a project working in groups' maximum of 4 students, and they should solve the situation.
Critical thinking competency: the ability to question norms, practices and opinions; reflect on own one's values, perceptions and actions; and take a position in the sustainability discourse;	They argument why from the sustainable perspective it is better the solution they design.
Self-awareness competency: the ability to reflect on one's own role in the local community and (global) society, continually evaluate and further motivate one's actions, and deal with one's feelings and desires;	Students individually perform a reflective essay about their role as consumers to reduce environmental impacts and the importance of ecodesign in the industry to promote consumption and sustainable production in the business context from Industrial Engineering.
Integrated problem-solving competency: the overarching ability to apply different problem-solving frameworks to complex sustainability problems and develop viable, inclusive and equitable solution that promote sustainable development – integrating the above-mentioned competencies.	As Industrial Engineerings students are trained to solve problems, in Ecodesign class they must solve different situations detected through tools learned during the semester and apply solutions from different design for sustainable approaches.

In conclusion, the Ecodesign class belonging to the program of Industrial Engineering as an emphasis of environmental management help students to develop the key competences to achieve sustainable development: Systems thinking, anticipatory, normative, strategic, collaboration, critical thinking, self-awareness, and integrated problem –solving competences. However, the weaker competences could be anticipatory and normative since the class has not the normative emphasis and it is not focus on future scenarios. The other 6 competences are strongly developed through the semester project which they develop in groups in a collaborative way.

“Sustainability performance depends on the interplay of knowledge and skills, values and motivational drivers, and opportunities. The interrelation of these dimensions influences personal behaviour” (UNESCO, 2018), according with this statement, the Ecodesign class is an opportunity for students to acquire knowledge and skills about sustainable consumption and production and apply this knowledge through semestral projects, nevertheless to change values and generate motivational drivers is a challenge for the Ecodesign class in four months of study. In that sense, should be mandatory to apply what the students learn in this class in projects the students develop for other classes and in other semesters.

4. CONCLUSIONS

As well as the design of sustainable product – service systems need the association of several actors to satisfy a need. In the same way, in education for sustainability, it is necessary to have the association of several actors, either from other university institutions at a national or international level or other actors in society, government or companies, so that the ideas generated by the academy can be nurtured and implemented in reality. An example of that is how Ecodesign class has evolved thanks to the interaction with local and international professors belonging to the Learning Network on Sustainability. Consequently, the development for sustainability won't be a distant goal, but an activity that we do every day from different professions. The case of the Ecodesign class immersed in the career of Industrial Engineering is an example of how these strategies should be applied transversely in the curricula of all professions, as is the case of transversal environmental projects in pre-school, basic and media education in Colombia.

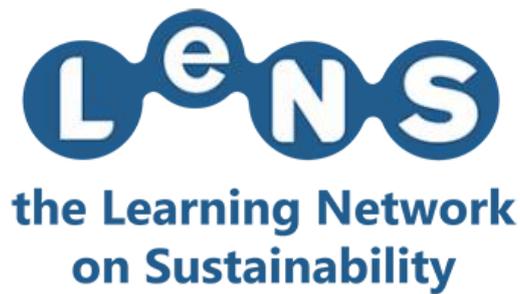
Educate for sustainability is a key point to achieve sustainable development goals, from the class are promoted key sustainable development competences such us: systems thinking, strategic, collaboration, critical thinking, self-awareness, and integrated problem –solving competences. These competences could be reinforced with the application of knowledge and skills of the class in other classes and other projects of other semesters in the career. It will be useful to strengthen values and motivational drivers in students and professors to behave in a sustainable way as consumers and to influence producers for sustainable practices.

The Eco-design class has had impact on more than 1000 students from 2011. This impact is evident in student's participation on academic activities such as: presenting their Eco-design class projects in national and international events through presentations, posters, and papers, the development of degree works on topics related with the class that benefit real Colombian companies. All this interaction with academic and business context helps to appropriate what it means sustainable development and to put in practice this knowledge learned to the service of others.

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USING DESIGN THINKING AND FACEBOOK TO HELP MOROCCAN WOMEN ADAPT TO CLIMATE CHANGE IMPACTS

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ABSTRACT

In Morocco, floods carry wastes that pollute the water of the wadi. Design thinking and Facebook were chosen to accompany Moroccan women in the resolution of the water problems. Design thinking promotes user needs analysis and rapid prototyping. Facebook facilitates the collaborative definition of problems and solutions. The purpose of the research was to evaluate the potential of design thinking and Facebook as approaches to climate change education. At workshops and in Facebook exchanges, 12 women shared their experience of floods and studied the water and waste problems. They prototyped and experimented with hand-held filters for water cleaning and with waste reuse techniques. They improved their «awareness» of climate change impacts. Their technological and geographic «knowledge» grew as well as their problem-solving «skills» and «self-efficacy». Women »participated» by operating an electronic flood warning system, making hand-held water filters, making compost and recycled jewellery, and starting a waste reuse cooperative.

Key Words: adaptation to climate change, design thinking, Facebook, environmental education

1. INTRODUCTION

UNESCO-UNEP (1977) identified five learning objectives for environmental education (EE). Environmental educators have to develop learners' awareness and knowledge (of the environment and problems), attitudes (conducive to their commitment to improve their milieu), skills (that facilitate their engagement) and participation (direct involvement in the field). In climate change education, these objectives prevail, in particular the one of «participation», since citizens affected by climate change must implement adaptations to reduce risks that threaten them directly. How to provide educational support to citizens as they analyze local climate problems, propose, test and implement adaptations? How to educate citizens to climate change while developing their awareness and knowledge of the problems of their environment, their willingness and ability to act and their tangible involvement in adaptation actions?

In this perspective of climate change education, 12 women from Ourika, a region of Morocco, victims of floods, were accompanied for three years during the four stages of the adaptation process (Risbey et al., 1999): detection (realizing the need to adapt); evaluation (determine the consequences of the situation); decision (choose accommodations) and monitoring (observe the effects of selected adaptations). The accompaniment of women had pedagogical intentions: to progressively develop their awareness and knowledge of floods and subproblems, their skills (problem solving, communication, etc.), attitudes (self-efficacy) and their tangible participation in adaptation. To achieve these educational goals, two interventions were chosen: design thinking and Facebook. The purpose of the research was to evaluate the potential of design thinking and Facebook in climate change education. This paper reports on the educational experience of the Ourika women and analyzes its results in light of the objectives of EE: awareness, knowledge, attitudes, skills and participation.

2. DESIGN THINKING

In 2006, IDEO popularized a creative problem-solving approach: design thinking. Design thinking is a creative and collaborative way of working during which intuition matters, solutions are numerous, experimentation happens quickly and users' needs are taken into account (Brown, 2009). Design thinking takes place in the following stages: 1. Observation-inspiration: a survey is conducted to understand the people affected by the problem and the situation. 2. Synthesis: the problem is defined repeatedly and in various ways. The solvers look for information and various perspectives on the problem. The information is synthesized to pose the problem in a few statements, using visual representations. 3. Ideation: many ideas are formulated and a number are chosen. 4. Prototyping: prototypes are quickly constructed, illustrating the proposed ideas in order to share these ideas with others and to assess their potential. 5. Tests: the prototypes are evaluated by looking for the opinions of experts, novices, users. Winning prototypes are refined. 6. Communication: the product is publicized (Brown, 2009). Seidel and Fixson (2013) summarize the process of design thinking as follows: thorough research of user needs; brainstorming to produce multiple ideas; and prototyping to test and choose the best ideas. However, the process is not linear as the designers' attention flows between the problem-space and the solution-space, while the empathy for the needs of the consumer expands and the winning solution is refined. Divergent then convergent, the process is centered on human needs. Prototypes, made quickly and without seeking perfection, act as "playgrounds" to discuss and learn about certain solutions (Liedtka, 2015).

In this research project, design thinking was chosen as a support tool for Moroccan women because of the high-level skills it can develop in participants: information seeking, empathy, creativity, communication, collaboration ... and because of its construction of meaningful learning (Scheer et al., 2012).

3. FACEBOOK

Traditionally used as a distraction and communication tool, Facebook is actually the most popular social media (Newsroom.FB, 2017). Beneficial for interaction, collaboration, information and sharing of resources, Facebook would also have educational potential (Wang et al., 2012). The Facebook group is particularly popular and useful for discussions around common interests (Park et al., 2009). In Facebook groups, users form real communities of practice in which they seek to solve a common problem. A Facebook group would therefore have the potential to facilitate collective action, but real actions in the field are crucial factors that strengthen the group's self-efficacy. Actions show the tangible results of the digital discussions (Narozny-Barborska et al., 2016). However, the use of Facebook, for public participation in community projects, is just beginning to be explored in research.

In this study involving Moroccan women living in geographically spaced villages, the Facebook group was chosen because of the education and community involvement benefits mentioned above. The design thinking process was enriched by the Facebook group's exchanges when the participants were each in their village. From home, they could continue to define the flood problem, and propose, prototype and evaluate solutions.

4. THE DESIGN THINKING AND FACEBOOK EXPERIMENT

The exploratory case study was conducted in Morocco with 12 women from the poor region of Ourika. The GIRE-

PSE Project's women, chosen for their minimal reading and writing skills, came from six isolated douars, located more or less 35 km from Marrakech. In this region, the economy is mainly based on agriculture. Since 2011, the floods of the wadi Ourika have increased in frequency and importance, in connection with climate change. These floods have devastating effects on the landscape, agriculture, human capital, infrastructures and food security. Women, guardians of their families while their husbands work in Marrakech, are facing floods and must protect their families.

The interventions with the women took place over three years, from March 2015 to February 2018. During the project, three minor floods of the Ourika occurred. The design thinking process dictated the activities of the 10 workshops organized with women and a private Facebook group (GIREPSE Women) was used regularly as a networking tool when women were at a distance.

At the first stage of design thinking (observation-inspiration), individual interviews were conducted with women to invite them to describe the problem of floods and their needs in the face of this disaster. A Journey Map, that is to say a visual representation summarizing their experience before, during and after a flood, prepared by two researchers, allowed the construction of the first synthesis of the problem of flooding. The women said that before the floods, they stored forest wood and essential food in case of road closures. They put plastic on the roof of their house to prevent water from seeping in. During the floods, they stored the goods in a room that was not subject to immersion and some took refuge with the neighbours. After the floods, they encountered problems of drinking water supply. At that time, the water of the wadi, laden with sediment became an alternative of drinking water and was placed in containers for deposit debris towards the bottom. After decantation, the water of the wadi was then consumed or used for various purposes.

In August 2015, during the first two workshops with the women gathered, the stages of the design thinking process, observation-inspiration and synthesis, were again applied, animated by the researchers. The women were invited to comment together on the previously prepared Journey Map reporting their experiences of the flood. They were also trained in the use of tablet computers, the Internet and Facebook. They then chose to work on a narrower problem: the quality of their drinking water after the floods. The Facebook exchanges then began, in September 2015, the women communicating with each other and with us, about the floods and the sub-problem of the quality of water. Initially, women were invited to post photos, videos and comments on local floods on Facebook. Subsequently, weekly specific questions were asked of women on Facebook inviting them to define the sub-problem of water quality after the floods: Where? When? Why? What are the impacts? What are the solutions? etc. Women had to observe the problem at home and answer questions with Facebook tools: comments, videos, photos, emoticons, etc. Workshop 3, held in November 2015, brought women back together for one day for the realization of the synthesis (2), ideation (3), prototyping (4) and testing (5) stages of design thinking on the sub -problem of water quality. During this workshop, a summary of the elements of the problem of drinking water and solutions proposed on Facebook was first realized. The water from the wadi collected in the villages was then tested with the women, to check the quality: ph, coliforms, bacteria, etc. The women were then invited to invent prototypes of filters using domestic materials: cloth, coal, plastic bottles, sand, rocks, etc. They had to check the capabilities of these filters to clean the water. After the workshop 3, the Facebook exchanges resumed, from November 2015 to January 2016, planned according to the stages prototyping (4), tests (5) and communication (6) of design thinking. The women built their own filters at home and they shared their essays on Facebook, receiving criticism from their peers. On Facebook, a general assessment concluded the process of prototyping filters.

Subsequently, a return to the definition of the problem (observation-inspiration) was carried out during a workshop in March 2016. The question asked was: How could we prevent the water of the wadi from being contaminated? A new ideation phase followed and the participants proposed solutions: search for better water sources, treat well water with chlorine, sensitize neighbours to avoid dumping their waste in the river, build solid pipelines, place wells away from flood areas and reuse waste to reduce its amount, including composting leftover food. The solution "to sensitize the neighbours not to throw their waste in the river" was then tried at home, by the women, without much success. On the Facebook group, an analysis of domestic waste followed, with women invited to publish photos of their household waste. Among the waste, the group found the significant presence of food and plastic bottles. The project team then decided to provide the women with composters and teach them how to make compost (in September 2016). As the compost matured, the women asked questions on Facebook for advice. At the same time, photos of plastic bottle reuse ideas were placed on Facebook, first by our team and then by two women. Various themes of possible recovery have been explored: reuse of bottles for the garden, decoration, art, jewellery or as utilitarian containers. Women reacted to the possibility of applying these solutions at home and for the next workshop (April 2017), they chose to create, prototypes of jewellery, candy boxes and under-plates made with plastic bottles. As a result of the workshop, they responded positively to our invitation to start a women's cooperative specializing in waste recovery, the products of which would be jewellery and compost. During a workshop (August 2017), they tested their prototype jewellery by consulting community people about their creations. In October 2017, a first sale of jewellery of the cooperative was organized in Rabat. The Facebook group was used to plan the event by providing tips on jewellery arrangement. The women published on Facebook the prototypes of the best-selling jewels. In November 2017, the women took charge of their cooperative and registered at a local fair in Marrakech.

During the design thinking process facilitated by Facebook, individual interviews with women (in the middle and at the end of the project) and their Facebook postings were exploited. The purpose of the research was to evaluate the potential of design thinking and Facebook as approaches to environmental education and for co-creation of adaptations to climate change. The first individual interviews were conducted after the first year while the second in-

Interviews took place in the last year of the project. The analysis of the first individual interviews is not the subject of this article because these results were published in Pruneau et al. (2016). This article discusses the final interviews in which the interviewees were invited to draw and comment on their experiences before, during and after the project. Similar interviews were conducted with three stakeholders from the project. The interview data were analyzed using conceptualizing categories by two researchers who worked individually and then in confrontation. The goals of EE (UNESCO-UNEP, 1977) served as broad categories from which sub-themes emerged. For the Facebook group, a bi-monthly table of women's publications was first prepared, summarizing the participants' actions and non-actions (in person and on line) and qualifying and quantifying their types of publication: presence on the group, images and videos, comments, emoticons and "likes". A 10-page compiled table, made by a researcher and then completed by another researcher, reduced the data to make sense of the women's participation.

5. RESULTS

During the final interview, the women described some aspects of their experience before and during the GIREPSE Women Project.

Participation: A core of 8 women remained active throughout the project. About 75% of them actively participated in the workshops, providing elements of the problems, proposing solutions and experimenting and testing prototypes. In their community, they carried out actions: filming the floods and their impacts; sensitize their neighbours to the harmful presence of waste; create an alert system to warn communities of a flood; test their soil; study the composition of their household waste; make compost; make jewellery with plastic bottles; start a cooperative; sell jewellery; experiment with a high-speed composter; register for and participate in a craft fair. Through these actions, periods of passivity have been observed. Women were less involved in times when they had less confidence in their abilities, in times when they met personal limits (having a child, being sick ...), or when too much time passed between the on-site workshops. Given the language limitations of women writing, their comments on Facebook remained short: a brief opinion, many "thanks", several "likes" and other emoticons. Women often used images to express themselves on Facebook and sometimes videos filmed with their tablet. Facebook's "personal conversation" feature has been used extensively as well as the Whatsapp digital tool for exchanging news and information.

Awareness: Before the project, women said they were aware of the nuisance of floods, which they associated with natural causes and not with climate change. They knew that there was waste in their village and that their environment was not healthy, nor their quality of life. During the project, they say they have become aware of various dimensions of floods, waste and the impacts of these two problems on health.

Knowledge: Before the project, they admitted that they could barely read and write in Arabic and that they knew little about technology. They had not heard about climate change, waste reuse and flood adaptations. Their knowledge of the other villages of Ourika was very limited because they had never or almost never been there. They had few friends outside their village. During the project, they say they have known other regions, cultures and made new friends in Ourika and in other countries (thanks to the Internet). They learned to reuse waste, and to make filter water, compost and jewellery. They better understand the variability of floods from year to year as well as their impacts. They have some means to get out of their misery.

State of mind: Before the project, they perceived themselves as unconfident and inactive. They used their time to take care of their families and to listen to television. During the project, they say they have gained greater self-confidence and pride because of their participation in the project and because they help the environment. They say they like to learn. They are keen to go to school, find a job, learn to read and write better, learn about ICTs and diversify the cooperative's products.

Skills: Before the project, they did not know how to use ICTs. They say they learned to use an electronic tablet, to search the Internet (for images, recipes, drugs, jewellery ideas, solutions to environmental problems ...), to use new ICTs (YouTube, Whatsapp ...), to solve problems and to make crafts.

6. CONCLUSION

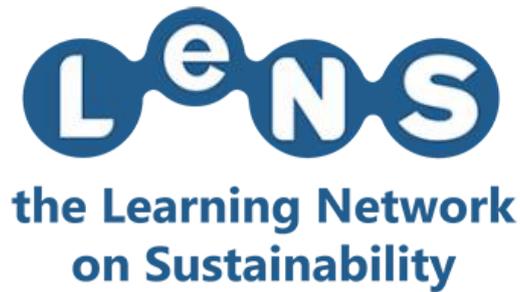
Design thinking helped to broaden the description of the flood and waste problems, according to the participants' needs. Several solutions were proposed, tested and implemented in the field. The women became aware of the causes of the floods and their impact on health. They now can use technologies for learning, finding ideas and solutions, meeting new people, communicating. They know flood adaptation solutions and they apply some of them. They say they have increased self-confidence. Their social networks have expanded. Facebook has proven as a powerful tool for learning, problem definition, ideation, building self-efficacy, planning, prototyping and decision-making. Facebook has also expanded geographic and time boundaries. Thanks to continued work on Facebook, the women have had more time than workshops to analyze problems and find solutions. Facebook has provided updates and images of disasters and empathy with those affected by them.

In this project, it can be argued that participating women went through the first four stages of the change process described by Rochlkepartain (2001): 1) receptivity (cultivating openness to change); 2) consciousness (emphasize the possibility of change); 3) mobilization (organizing for change); 4) action (implement some change). As for the

fifth stage of the process, namely continuity (making sure that change becomes a way of life), the future will tell if the women's personal skills and if the local culture will be supportive enough to favour these women's further commitment in adaptation to floods.

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DESIGN FOR SOCIAL SUSTAINABILITY: DECOLONISING DESIGN EDUCATION

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ABSTRACT

In the sphere of sustainable design, a holistic design approach emphasises the context of a larger system of environmental, social, cultural and economic components and how these four components interact with one another. In the higher education context of South Africa, these components might not be enough to make an effective impact on the way in which lecturers, students and industry react to or actively engage with sustainability. Social sustainability is complex and specifically the political (or socio-political) aspects, apart from the environmental, socio-cultural and economic components, should be taken into consideration. Without understanding the complexity of the inter-linking or often opposing aims of the social, cultural and political, it would be difficult to facilitate deep learning for a more sustainable way of being in the world. Engaging critically with theories such as critical citizenship, social justice and decolonisation can facilitate understanding of the complexity involved in socially sustainable and decolonised design education.

Key Words: social sustainability, decolonisation, design, higher education.

1. INTRODUCTION

A strong argument is made in the design field for taking into consideration environmental sustainability, but also social and cultural sustainability. In the book *Design for environmental sustainability: Life cycle design of products*, Vezzoli (2018, p. xiii) argues that the focus is not only on technological or production solutions, but also on “promoting new qualitative criteria that at the same time are environmentally sustainable, socially acceptable and culturally attractive”. According to Vezzoli (2018, p. xiii), environmental sustainability entails “facilitating the capacity of the production system to respond to the social demand of wellbeing, while using drastically smaller amounts of environmental resources than needed by the present system”. Vezzoli, Kohtala and Srinivasan (2014, pp. 13–14) argue that sustainability has three (interlinked) dimensions, namely the environmental (planet), socio-ethical (people) and economic (profit) dimensions.

Yiannakaris and M’Rithaa (2016) refer to Shedroff (2009, p. 8), who also argues for a more holistic design approach where designers look at a problem within the context of a larger system of environmental, social, cultural and economic components and how these four components interact with one another. Our argument is that these components might not be enough to make an effective impact on the way in which lecturers, students and industry react to or actively engage with sustainability. It is more complex, and specifically the political (or socio-political) aspects, apart from the environmental, socio-cultural and economic components, should be taken into consideration. Without understanding the complexity of the interlinking or often opposing aims of the social, cultural and political, it would be difficult to facilitate deep learning for a more sustainable way of being in the world. Engaging critically with theories such as critical citizenship, social justice and decolonisation would facilitate understanding of the complexity involved.

Design is not only social, cultural or environmental, but also political. Teaching design is a political act, hence the design curriculum should include theories of critical citizenship, social justice and decolonisation. Firstly, political aspects of teaching and learning will be discussed, followed by an investigation into the way in which critical citizenship, social justice and decolonisation could contribute to a deeper understanding of the political side of design education. In conclusion, the importance of decolonisation as a political act in the design curriculum will be considered.

2. EDUCATION AS POLITICAL ACT

Pinar and Bowers (1992) refer to major theorists such as Freire, Giroux, Apple and McLaren as prominent authors who emphasise the political aspects of curriculum engagement. Freire in his books *Pedagogy of the oppressed* (1996) and *Pedagogy of Hope: Reliving pedagogy of the oppressed* (1998) argued that the curriculum should position at its centre the social, cultural, political, economic and “philosophical critique of dominant power”. Giroux (1985) and Apple (1990) focus on the curriculum as medium of cultural and ideological reproduction and resistance. Because education has powerful persuasive abilities, and because lecturers can be used as the carriers of these powerful messages, any education project is political by nature. The politicisation of education is evident in the presenters of knowledge (lecturers), the hidden nature of the curriculum and the political power related to colonial and apartheid pasts.

It is not only the transformation of the individual that will enable a society to transform, but also the ways in which the individual will influence others to transform. With the statement “the political is always pedagogical”, Helfenbein and Shudak (2009, p. 8) suggest that lecturers have the duty to teach students to care, and also to teach them what to care about; to “engage in the battle ... of ideas”. As a lecturer one has to accept this burden of “intellectual and moral responsibility concerning the instruction in and of democracy” (Helfenbein & Shudak, 2009, p. 8). If education is political, educators are also politicians – a responsibility that is not always considered, because educators are seldom held accountable for their ‘political’ activities. Apple (2010, p. 658) argues that education is not a “neutral, technical activity. Rather, as an act of influence, it must be seen as an ethical and political act”. Therefore, responsibility for enabling social transformation not only lies with the politicians or people who decide on policies and write educational white papers, but also with the person who interprets those policies and papers. The agency of lecturers is therefore crucial, because the lecturer acts as the medium or translator of the curriculum messages. These informal teachings are not written into the formal curriculum but can be hidden. Apple (1990) emphasises the hidden curriculum that has the potential to perpetuate inequalities of race, class and gender.

A curriculum is shaped in complex and subtle ways by cultural perceptions and political expectations. Barnett and Coate (2008) even postulate the existence of a curriculum within a curriculum. The curriculum in theory and the way it is presented in practice can be two very different entities. Parts of the curriculum are therefore consciously or unconsciously hidden. When arguing for a socially just design curriculum, a deeper understanding of the hidden issues involved in teaching, learning and engagement with communities is necessary. Education and educational institutions are often infested with political power structures that are hidden and that will not come to the surface if not unpacked and addressed in a critical manner. The deep roots of colonial imperialism and the apartheid system that followed it have left traces that were not wiped out by a new South African constitution after the first democratic elections in 1994.

Hargreaves (1998, p. 836) emphasises how the sociological, political and institutional influences “shape and reshape the emotional landscapes of teaching for good or ill”. In the colonial and apartheid pasts, Western culture was

seen as the norm, and all other cultures as a deviation from that norm. This is still valid to a certain extent in some contexts today. The culture that is considered 'normal' is seen as a backdrop against which all other "values, culture and knowledge are to be measured" (Apple, 2010, pp. 658–659). Currently, Western culture, associated with capitalism, materialism and consumerism, is advertised and disguised under the notion of popular culture and still dominates other cultures in South Africa. Systems therefore work much better for students who identify with the 'normal' culture, especially if they already possess cultural and economic capital (Apple, 2010, pp. 658–659). Engagement with education as a political act in design education can be improved through investigating theories of critical citizenship, social justice and decolonisation.

3. CRITICAL CITIZENSHIP

According to Johnson and Morris (2010, pp. 77–78), citizenship education is based on the promotion of a "common set of shared values (e.g. tolerance, human rights and democracy), which prepare young people to live together in diverse societies and which reject the divisive nature of national identities". Citizenship education "contributes to the promotion of social justice, social reconstruction and democracy" (Johnson and Morris, 2010, pp. 77–78). However, what is lacking in this definition is a critical perspective. Johnson and Morris (2010, pp. 88–90) mapped relevant citizenship and critical concepts in a framework for critical citizenship education, as explained in Table 1. This framework could be used as a guide for critical citizenship education. The word 'critical' is added to citizenship education and therefore includes critical thinking and critical pedagogy (Johnson & Morris, 2010, pp. 77–78). Critical thinking in general refers to higher-order thinking that questions assumptions or facilitates a willingness to look from different perspectives.

Johnson and Morris (2010, pp. 77–78) place emphasis on political aspects such as oppression and injustice, power structures and macrostructural relationships. They emphasise the social aspects of critical citizenship as well as the self as responsible in thought, emotion and action. The design process is political and subjective and cannot be separated from the self. To enable sustainability to succeed, the self needs to be taken into consideration as well. Zembylas (2007, p. 67) states that "emotions play an important political role in enabling resistance and transformation". In South Africa, for instance, the colonial and apartheid pasts have left scars of different degrees and forms on both black and white people in South Africa, and those scars can potentially have a positive or negative influence on learning. From a curriculum point of view, these scars need to be considered by looking at the type of content that is presented, the way it is presented and the environment in which it is presented. If the content, way of presentation and environment are taken into consideration, but the student is not psychologically ready to participate, learning will not take place. A critical citizenship approach to design education takes into consideration the social justice aspect of social sustainability.

4. SOCIAL JUSTICE

Social sustainability includes concepts such as social equity, community development, human rights and social justice. The social sustainability field is facing numerous challenges in terms of vagueness, lack of actionable approaches and debate over different sets of values (Missimer, Robert, & Broman, 2016). Missimer et al. (2016) propose the following requirements in a socially sustainable society, people are not subject to structural obstacles to (1) health, (2) influence, (3) competence, (4) impartiality and (5) meaning making. In addition, Missimer et al. (2016) identify the following aspects of the social system as essential to sustain: trust, common meaning, diversity, capacity for learning and capacity for self-organisation. A socially sustainable approach to design education will include teaching for social justice.

The concept of social justice can be unpacked using the three-dimensional approach of Nancy Fraser toward her goal of social justice as 'participatory parity', where all can interact as peers in an equitable manner in their social lives (Bozalek & Leibowitz, 2012). Fraser (2009) defines social justice in three dimensions: distribution of resources, the politics of recognition and the politics of representation and belonging. According to Fraser (2009), all three dimensions should be included to enhance social justice. Fraser (2009, p. 165) uses the phrase "no redistribution or recognition without representation". Teaching for social justice begins with the idea that every human being is of equal value, entitled to decent standards of justice, and that violation of these standards must be acknowledged and fought against (Ayers, 2004).

Social justice education incorporates that which is included in the curriculum as well as the manner in which the lecturer practises social justice. Importance lies not only in what is taught, but also how it is taught and the results of teaching and learning. Education as an ethical and political act (Apple, 2010) is once again emphasised when teaching for social justice. Within socially sustainable design education, lecturers should include concepts of redistribution, recognition and representation (Fraser, 2009) in the curriculum in order to enhance awareness of social justice. A commitment to social justice highlights the need for decolonisation.

5. DECOLONISATION

Decolonisation is a concept that takes on different meanings across different contexts. According to Mackinlay and Barney (2014), decolonisation resists Eurocentrism and acknowledges the contributions of colonised populations across the globe; it emphasises a moral imperative for righting the wrongs of colonial domination and an ethical stance in relation to social justice for those peoples enslaved and disempowered by persistent forms of coloniality. In addition, decolonisation is the interrogation of how Eurocentric thought, knowledge and power structures are implicated in the marginalisation, exploitation and exclusion of colonised people and groups, and it aims at reimagining modernity as a project of violent epistemic and territorial expansion to clear its past and point towards different futures (Mackinlay & Barney, 2014). The concept of decolonisation as it relates to socially sustainable design education includes the following topics: coloniality/decoloniality, knowledge production and South African higher education.

'Coloniality' is not the historical process of colonisation. Rather, it refers to the lasting effects of colonisation in the form of unequal relations of power, knowledge, race, gender, language, culture, time, space and resources controlled and reproduced in the name of progress and development (Mignolo, 2011). Coloniality makes possible the marginalisation of everything that does not fit into this epistemological structure (Mignolo, 2011). It creates an apparent totality in which all are included, but not all have the right to include. Its process of epistemological construction is located in highly verticalised power relations (Mignolo, 2011). Decoloniality can best be understood as a call for a type of cognitive justice based on an overhaul and expansion of the Western knowledge canon. The call is also for knowledge pluralisation, which refers to incorporation of the complex ways of knowing of subaltern and all previously excluded groups (Fataar & Subreenduth, 2015). Aslam Fataar (2018) argues that decolonising education requires the full incorporation of humanity's knowledge systems into the knowledge selection systems of universities. Fataar (2018) offers three types of decoloniality: Firstly, an ecologies of knowledge approach, which challenges the hegemony of Eurocentric theories, concepts, canons and perspectives; secondly, the knowledge and identity claim, based on productive recognition and restoration of the full dignity of subjugated people and to unearth their full human potential; and finally, knowledge relevance and contextualisation viewing curriculum knowledge as epistemological connection to the knowledges of people, their contextual life circumstances, indigenous knowledge systems, literacies, languages and ways of knowing. Decoloniality is therefore achieved through changing the ways in which knowledge is produced.

Knowledge production and curricula should be decolonised. A Eurocentric canon that attributes truth only to Western ways of knowing needs to be decentralised and as a result, the university classroom and the way knowledge is taught need to be decolonised (Mbembe, 2016). Higher education institutions should foster the horizontal process of knowledge production that is open to epistemic diversity (Mbembe, 2016). However, aims to decolonise education run the risk of essentialising complex knowledge formations, rendering a false dichotomy or moral evaluation between (good) 'African' vs. (bad) 'Western' knowledge (Zembylas, 2017). It is more important to take African experience and theories seriously rather than claiming a uniquely African epistemology, as there are complex entanglements between knowledge formations. Given the diversity of the world and its knowledges, there is no sense in attempting to grasp the world by any single general theory. According to Sousa Santos (2005), any single general theory will always presuppose the monoculture of a given totality and the homogeneity of its parts. The alternative to a single general theory is the view that all knowledges and cultures are incomplete and need to be translated dialogically through and with one another (Sousa Santos, 2005). Epistemic universalism in the Western modern tradition is rooted in epistemic racism, because if universal reason and the universal truth can only originate from a white, European, masculine, heterosexual subject, and if the only tradition of thought with a supposedly universal capacity with access to the universal truth is Western, then there is no abstract universalism without epistemic racism (Grosfoguel, 2007). Educators should construct educational spaces where coloniality can be opposed and where the social, cultural and spiritual scars of colonial history can be healed (Gaztambide-Fernandez (2012, p. 42, as cited in Zembylas, 2018). The project of decoloniality and decolonisation of knowledge production is relevant in the South African higher education context.

In South Africa there is renewed interest in decolonising higher education after the #RhodesMustFall and #FeesMustFall¹ movements. These movements were triggered by some of the many problems faced in higher education, as noted by Badat (2016 para.7). These problems include:

... debt burdens, high drop-out rates, poor throughput rates, inadequate facilities and accommodation, largely unreconstructed epistemologies and ontologies, questionable quality of learning and teaching to ensure meaningful opportunities and success, and alienating and disempowering academic and institutional cultures that are products of colonialism, racism, and patriarchy.

When higher education does not fulfil the promise of contributing to social justice, economic and social de-

¹ In 2015 the student movement called #RhodesMustFall, at the University of Cape Town demanded the removal of the statue depicting Cecil John Rhodes from campus due to the disenchantment with colonial figures and colonial culture at higher education institutions. By late 2015 and early 2016, issues such as the decolonisation of universities, the low number of black South African scholars and colonial institutional culture were raised at universities across the country. These issues were overtaken by demands of students at the University of Witwatersrand and elsewhere to decrease/eliminate tuition fee increases and student debt towards the ideal of free higher education. This led to the protest movements named #FeesMustFall.

velopment and democratic citizenship, it becomes an organisation of social exclusion and injustice (Badat, 2016). Transformation in the South African higher education context involves the social, cultural and economic development of the country by addressing the legacies of apartheid. This political process of transformation was initiated with the establishment of the National Commission on Higher Education in 1995. Two decades later, the efficacy of this transformation process is questioned as a result of the prevailing incidents of racism, lack or inability of universities to implement policy and barriers to access for disadvantaged students at South African universities (Botes & Costandius, 2018). Access to higher education also includes cultural access for students and lecturers where they can feel a sense of belonging in the spaces of teaching and learning (Mbembe, 2016a). The social justice aspect of decolonising education should not only include redistribution, but also representation and recognition (Fraser, 2007). Being understood or heard (recognised and represented) in the academic context is epistemological and political. It is inseparable from the question of having one's knowledge recognised as knowledge. In an attempt to decolonise spaces of higher education in South Africa, it is important to promote an 'ecology of knowledges' in contrast to 'single thinking' (De Souza, 2018).

6. CONCLUSIONS

In the field of design, an argument is made for taking into consideration environmental, social and cultural sustainability, but also the political aspects associated with design. A critical engagement with theories such as critical citizenship, social justice and decolonisation facilitates understanding of the complexity involved in socially sustainable design education. Design is not only social, cultural or environmental, but also political. The politicisation of design education can be seen in the way it is taught (those who teach it), the hidden nature of the curriculum, and colonial and apartheid pasts responsible for certain political powers. Teaching design in higher education is a political act and therefore the design curriculum should include theories of critical citizenship, social justice and decolonisation in order to address the various aspects of social sustainability. The political nature and the subjectivity of the design process cannot be separated, therefore the self needs to be taken into consideration when aiming for socially sustainable design education. Lecturers should include concepts of redistribution, recognition and representation (Fraser, 2009) in the curriculum in order to enhance awareness of social justice. The importance of environmental, social and also political aspects of design should be emphasised. A key part of this emphasis lies in decolonisation as a psychological, social and political process that aims to dismantle unequal power relations to enable social justice in design education.

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A SUSTAINABLE DESIGN-ORIENTED PROCESS FOR CONVERTING AND SHARING KNOW-HOW

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ABSTRACT

Explicit knowledge and tacit knowledge compose the Human Knowledge. While explicit knowledge refers to information sharable through communicative media (i.e. speech), tacit knowledge – also known as ‘know-how’ – is harder to be shared due to it is linked to experience mediated personal learning processes (i.e. learning by doing); moreover, know-how is useful to deal daily practical situations. This condition produces a dichotomy: people have know-how but they are unable to share what is mediated by their experience. Many studies evidence that know-how is a sustainable value that should be shared. While emerging opportunities arose from the last economic crisis have pointed out a large number of new chances for the use of know-how, there is a lack between the human sharing’s will and the need of solutions to convert, share and learn know-how. This study proposes a design-oriented process for converting know-how, which can be applied to emerging and developing contexts, as well as to all issues concerning social innovation, inclusion and knowledge development.

Key Words: Know-How Sharing, Design-Oriented Process, Knowledge-Driven Sustainability, Communication.

1. INTRODUCTION

'Know-how' – also known as tacit knowledge – is a specific form of knowledge used by people to deal everyday situations that require the use of experiences, skills and practical abilities (Garud, 1997). Accordingly, know-how is a form of knowledge gettable only via direct exposition to factual events (i.e. playing piano, knot the shoelaces, etc.) and, as such, it is difficult to be shared at interpersonal level due to the experience-based acquisition is unstructured and mediated by personal learning processes and direct acquisition (i.e. learning by doing) (Storkerson, 2002).

Although know-how is characterized by an intrinsic complexity, at the general level it can be examined using two main analytical lenses, which help to understand potentialities and limitations. The first one is linked to the cognitive and communicative aspects. Know-how is the result of incessant learning processes and cognitive improvements that determine its intrinsic incommunicability (Polanyi, 1966); as know-how is acquired by direct exposition to events (i.e. observation of phenomena), the human cognition is not prepared to share it using traditional communicative media (i.e. speech), preferring other analogical ways of learning, such as: emulation, iteration, learning by doing, etc. The second one considers the role of know-how a form of economic asset, and its conversion into shareable value as a form of organizational competitiveness (Stevens, 2010). In this case, the Knowledge Management literature recognized the economic relevance of information sharing and many studies have documented the value of the communication and its potential during sharing activities (Nonaka, 1994).

In Design, only few studies have explored the value of know-how, and its implications in the increasing level of sustainability and social inclusion. In general, such studies have examined how know-how can be assumed as a design element in the productive contexts. Nevertheless, the analysis of literature in the area of Design for Sustainability shows that the issue of know-how sharing can meet many current research lines, such as: the creation of social innovation in rural and emerging economies, the inclusion of emarginated groups within social and productive networks (Leadbeater, 2008), the enhancement of degraded productive and residential places (Monteiro and Bartholo, 2008), the creation of hybrid networks for the exchange of self-produced goods (i.e.: reuse of craft-related skills), the creative learning aimed to the protection of threatened local heritage, the reinforcement of craft-based practices for new forms of collective wellbeing (Manzini and Jégou, 2003), the use of sustainable ways of thinking to link forms of production and knowledge sharing (Marano, 2010) and, finally, the use of Design to improve the level of 'sustainable' personal wellbeing (Nonaka and von Krogh, 2009).

Considering intrinsic complexities and design opportunities characterising the sharing of know-how, the issue of interpersonal communication is crucial to meet needs of communication expressed by people, with the chance of sustainable development that can be produced from them. This issue is also assumed as the most relevant, as well as it is one of the most difficult to be treated and implemented (Nonaka, 1994; Polanyi, 1966).

Within the current scenario of knowledge sharing's methods, it is believed that the creation of a new processes able to convert – in a unique 'flow' – the know-how into explicit knowledge learnable by all people, could be useful for all those situations where the use of human knowledge can help the development of sustainable forms of living, wellbeing and production, as well as to support the global transition toward the sustainable society (Rossi, 2014).

2. AIMS

This paper aims to propose a new sustainable design-oriented process for converting and sharing know-how. Starting from results developed within Knowledge Management domain, the proposed process explains the procedures needed to convert tacit knowledge (know-how) into explicit one and, then, how to design and develop a wide range of new products, services and design tools to make it shareable and learnable at interpersonal level.

While explicit knowledge is already a sustainable asset (i.e. shareable data), the main goal of this work is to make sustainable all other forms of knowledge owned by people, for whom there are not tools able to drive and support the conversion and the communication processes. As such, this work sustains a new idea of knowledge-driven sustainability and innovation (Rossi, 2014).

3. METHODOLOGY AND RESULTS

The sustainable design-oriented process for converting and sharing know-how has been developed using traditional Design Research's methods. In particular, the structure of this paper is divided in two main phases:

The first phases concerns the literature review; a detailed analysis of main references, theories, methods and tools concerning the sharing of know-how is used to know and understand the phenomenological aspects concerning the sharing of knowledge at interpersonal level, and their possible limitations (3.1. and 3.2.).

The second phase concerns the proposal of the sustainable design-oriented process for sharing know-how (3.3. and 3.4.). Here a new model has been developed and implemented for design-oriented applications.

3.1. Literature Review of Models and Tools for Sharing Know-How

While Design literature mainly focused the attention on the implications of explicit knowledge for new products and services development, in the field of Knowledge Management a number of theories, models and tools have been

conceived to describe the processes of knowledge sharing at interpersonal level.

In terms of models, one of the most important results developed in last thirty years is the SECI Model ('Socialization', 'Externalization', 'Combination' and 'Internalization') (Nonaka, 1994; Takeuchi, 1996) (Figure 1). According to Ikujiro Nonaka (1994), SECI's aim is to describe how the social dynamics working at the basis of the creation of knowledge in organizations are articulated; the model allows to understand what are the modalities that allow people to convert their knowledge from the incorporated form into the shareable one. Knowledge creation starts with 'Socialization', which is the process of converting new tacit knowledge through shared experiences in day-to-day social interaction; tacit knowledge is articulated into explicit knowledge through the process of 'Externalization' where it can be shared using concepts, images, and written documents; explicit knowledge is collected from inside or outside the organization and then combined, edited, or processed to form more complex and systematic explicit knowledge through the 'Combination' process; finally, explicit knowledge created and shared throughout an organization is converted into tacit knowledge by individuals through the 'Internalization' process, where knowledge is applied and used in practical situations and becomes the base for new routines.



[Figure 1] The SECI Model (Nonaka, 1994)

On the other hand, the literature showed the existence of an incredible number of tools and techniques that can be used to process knowledge at various levels (KST, 2012), which are classifiable for general purposes, for example: planning (i.e. SWOT Analysis), monitoring and evaluation (i.e. After Action Review), gathering of inputs (i.e. Discussion Forums, Photo Sharing, RSS), stakeholders' participation (i.e. Storytelling), support of communities and networks (i.e. Communities of Practices, Tagging and Social Bookmarking), collaborative actions (i.e. Brainstorming, Role Cards, Knowledge Fairs), meeting (i.e. Discussion Forums, Wikis, Mind Mapping), content sharing (i.e. CMSs, Photo Sharing, Community Interactive Theatres), advocating (i.e. Rural Radios), learning and training (Discussion Forums, Wikis, Group Facilitation, Peer Assists, Knowledge Fairs, Storytelling, Communities of Practice, Face-to-Face Meetings), and improvement of the impacts of knowledge (i.e. Learning Alliances, Blogs).

However, none of them are fully able to manage the complexity of know-how sharing and, then, to address the development of design-oriented solutions for know-how sharing (Rossi, 2014); a new solution able to convert, in a unique iteration, know-how into explicit knowledge is needed and can be used for sustainable-oriented applications.

3.2. Limits of Current Models and Tools for Sharing Know-How

Even though SECI Model describes the process of knowledge conversion, it does not provide clear and detailed information about the specificity of each stage. In addition, it seems inapplicable for design implementations, design tools and collaborative networks – it is not conceived for them.

In the perspective of design-oriented applications, an additional analysis must be done on the communicative aspects of these methods and tools. The people's inability to properly express what they know generates additional considerations also on the social, cultural and economic points of view (Foray, 2004). The communicative problem underlines additional relevant issues about the phenomenological learning of the subjects to be shared, for example:

The 'proximity': the need to reduce the physical distance between who holds knowledge and who demands it (i.e. emulation through direct phenomenological observation).

The 'linguistic compatibility': the communicative, relational and socio-behavioral compatibility between who shares knowledge and who receives it (i.e. when people come from different cultures, ethnic groups or when they have very different social behaviors in learning and communication).

The 'differences': the anthropic, cognitive, attitudinal and interpretative diversities of stakeholders.

The ‘protection of heritage and cultural identities’: the need to protect traditions and rural specificities, which are passed down through iterative and emulative learning models based on practical knowledge.

The ‘design of products and workplaces for the fulfillment of practical activities’: the relation between people and the environment where the process of sharing is made.

However, the creation of a new design-oriented process for know-how sharing can start from the lesson developed by Nonaka and, then, from its implementation with the results recently developed in other areas of Knowledge Management and Strategic Design Research, to integrate its idea and enable people to address the design on new knowledge-driven solutions

3.3. A New Process for Converting and Sharing Know-How

The new design-oriented process for converting and sharing know-how is based on the SECI Model. However, it has been said that SECI Model is a descriptive model and, therefore, it is not able to explain, in detail, all specific conversion phases needed for transforming know-how into sharable knowledge. Accordingly, it is necessary an early operation of transformation of the four SECI phases; this operation can be carried out from the analysis of the purposes contained into the Nonaka’s studies (Nonaka, 1994; Nonaka and von Krogh, 2009). From the analysis of data belonging to the socio-organizational theory, it is possible to implement the four SECI phases in new seven sub-phases, which clarify the SECI’s aims and allow to understand more in depth how each stage really works.

The structure of the new SECI-based process (Table 1 and Figure 2) shows the results of this process where to each SECI’s phase a number of new sub-phases and related specific aims have been created in order to detail the information contained into literature with practical descriptions that will be useful during the design phase.

[Table 1] Structure of the new SECI-based process for converting and sharing know-how (Rossi, 2014)

SECI PHASES AND RELATED AIMS	NEW SECI-BASED PROCESS AND RELATED AIMS
SOCIALIZATION Phase 1: from Tacit Knowledge to Tacit Knowledge Aim: sharing notions and concepts	Sub-Phase 1: Tacit Knowledge Creation Aim: observation and interaction
	Sub-Phase 2: Tacit Knowledge Sharing Aim: communication and Capture
EXTERNALIZATION Phase 2: from Tacit Knowledge to Explicit Knowledge Aim: creating metaphors, analogies, concepts, hypothesis or models about notions and concepts	Sub-Phase 3: Tacit Knowledge Conceptualization Aim: reflection and organization
	Sub-Phase 4: Involvement (from Tacit Knowledge to Explicit Knowledge) Aim: collaboration and formalization
COMBINATION Phase 3: from Explicit Knowledge to Explicit Knowledge Aim: systematization of notions and concepts	Sub-Phase 5: Explicit Knowledge Organization Aim: reconfiguration and systematization
	Sub-Phase 6: Explicit Knowledge Dissemination Aim: communication and sharing
INTERNALIZATION Phase 4: from Explicit Knowledge to Tacit Knowledge Aim: translating and/or learning notions and concepts	Sub-Phase 7: Socialization and Learning (from Explicit Knowledge to Tacit Knowledge) Aim: communication and learning-by-doing



[Figure 2] Graphical representation of the new SECI-Based Model for converting and sharing know-how (Rossi, 2014)

For the purposes of this study, this result is relevant because it produces significant improvements, in particular:

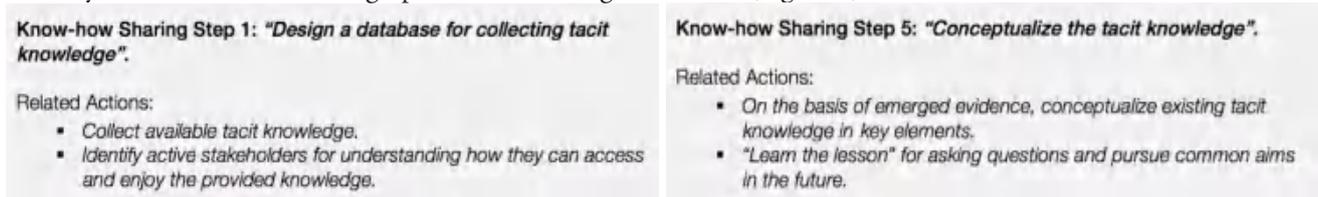
- It is coherent with with the communicative flows belonging to the human’s knowledge communication.

- It is based on the communication processes used to share knowledge-based information, rather than on organizational and socio-behavioral ones.
- It introduces a number of focused suggestions about the nature of information, which are now less tied to the social sphere of the relational dynamics within organizations and more oriented toward the design domain, for further explorations and product-service developments.

3.4. Design-Oriented Characterization of the Process

The phase of design-oriented characterization, needed to convert the process into a communicative framework applicable to the design of communicative solutions for sharing know-how, has been done using twelve different methodologies and tools currently used in Knowledge Management (KST, 2012), but not yet applied in know-how sharing. These methodologies and tools are: After Action Review, Community Interactive Theater, Communities of Practice, Critical Moments of Reflection, Experience Capitalization, Good Practices, Knowledge Fairs, Mind Mapping, Most Significant Change, Peer Assists, River of Life, and Tagging / Social Bookmarking.

This interpolation allowed to identify twelve 'Know-how Sharing Steps' able to describe, with an high grade of accuracy, a devices-oriented design process for sharing know-how (Figure 3).



[Figure 3] Samples of 'Know-how Sharing Steps': 'Design a database for collecting tacit knowledge' (for Sub-Phase 1 – Tacit Knowledge Creation) (left) and 'Conceptualize the tacit knowledge' (for Sub-Phase 3 – Tacit Knowledge Conceptualization) (right) (Rossi, 2014)

5. CONCLUSIONS

As discussed, the problem of sharing of know-how offers the real opportunity to work on new and unexplored design issues, only marginally considered today. This claim reveals an immense potential, if we consider the positive effects that explicit knowledge and clear information have on the economic, technological and social dimensions.

The results here synthetically presented introduce a new design-oriented process for converting and sharing know-how at interpersonal level, composed by twelve 'Know-how Sharing Steps'. In the perspective of the transition toward the sustainable culture, know-how can surely play a new strategic role for extensive innovations, evolving the notion of skills from personal asset to collective and systemic intelligence. Accordingly, this work introduces a holistic process usable by all for the development of a wide range of solutions – products, services, product-service systems and design strategies – that can drive the exploration of knowledge-driven innovative innovations.

Moreover, this study shows a high impact on Sustainability because it proposes an original and easy-to-use process for convert, share and learn know-how, which can be applied to all emerging and developing contexts, as well as to all new issues concerning social innovation, social inclusion and sustainable economic development.

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FASHION DESIGN EDUCATION AND SUSTAINABILITY. A CHALLENGE ACCEPTED.

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ABSTRACT

Fashion is one of the most relevant phenomena to describe contemporary cultures and societies (Fioraai, 2006; Bertola, 2018).

Despite this, fashion has always been a marginal topic within the design scientific debate. Fashion design education has been a small niche within the whole academic system. Nowadays, this exile, that could be considered both forced or voluntary, is ending. Fashion is strong of its recognized impact on global economies, society, culture, and is conscious of the need for it to engage, as for all other sectors, in guiding a coherent transition of the surrounding world towards a more sustainable paradigm.

In view of this, this exploratory paper, developed within the scope of the author's doctoral research, present an initial analysis of the current state of the art in practices across Europe, mapping existing and emerging practices within university level institution and industry, to identify approaches and practices that could be amplified, and implemented to contribute to a sustainable paradigm for fashion design education.

KEYWORDS: Fashion Design Education, Transformation, Fashion Design for Sustainability, Design thinking.

1. FASHION DESIGN FOR SUSTAINABILITY CHALLENGING FASHION DESIGN EDUCATION.

Design, as discipline, is referred to the reading of contemporary culture, both in its tangible and intangible expressions. The design practice aims at identifying cultural evolutions, their motivating forces and patterns of change, and, then, at planning a possible new cultural environment that can acquire the new proposed meanings to lead socio-cultural innovation and, therefore, innovation of products and services. Fashion, as a domain, is the mould of the contemporary culture, in its ability to join the dynamics between individual and society. "Today fashion, that has always been a multi-dimensional universe, is not just a change, a trend, the spirit of the times, the succession and combination of styles. Fashion is the most complete expression of a post-modern industrial culture" (Fiorani,2006).

Nowadays innovation in fashion is driven only by functional and economic drivers and that the last business innovation, fast fashion, has made fashion the second most polluting industry and emptied it from its socio-cultural role of criticism, condemnation, protest, progressivism that it had in the XX Century (Laurent,2016).

Fashion should abandon the designer-centric approach in favour of a collaborative approach, a project-based approach instead of a collection/garment focus, an entrepreneurial attitude instead of a corporation monopolistic strategy, a sustainable core instead of a fast pace to face (and possibly suggest feasible solutions to) all issues the very fashion created. It should see beyond the mere reshoring of production (Fashion perspectives on educational programs, 2017). In this crucible we are assisting to the beginning of a slow change from the current fashion design system to a sustainability-led one. Sustainable fashion can be defined as clothing, shoes and accessories that are manufactured, marketed and used in the most sustainable manner possible, taking into account both environmental and socio-economic aspects. In practice, this implies continuous work to improve all stages of the product's life cycle, from design, raw material production, manufacturing, transport, storage, marketing and final sale, to use, reuse, repair, remake and recycling of the product and its components. From an environmental perspective, the aim should be to minimize any undesirable environmental effect of the product's life cycle by: (a) ensuring efficient and careful use of natural resources (water, energy, land, soil, animals, plants, biodiversity, ecosystems, etc); (b) selecting renewable energy sources (wind, solar, etc) at every stage, and (c) maximizing repair, remake, reuse, and recycling of the product and its components. From a socio-economic perspective, all stakeholders should work to improve present working conditions for workers on the field, in the factories, transportation chain, and stores, by aligning with good ethics, best practice and international codes of conduct. In addition, fashion companies should contribute to encourage more sustainable consumption patterns. (Green Strategy, June 2014).

There are challenges presented by this transformation, because even if the fashion design is already design-centred, as a consolidated and domain, fashion has also been deeply transformed by the impact of globalization processes. This transformation has generated several organizational models and approaches to markets and has concluded with the success of the fast-fashion paradigm that has deeply affected the whole sector (Bertola,2018).

In the first decades of the XXI Century, major fashion companies have followed strategies of outsourcing and delocalization to take the advantages of globalization and looking for low-cost production. Now, they are facing the downside of these short-term advantages, as their inability of controlling and certifying the production chain, many top product companies have already started reshoring operations, but they are expensive and intricate. Furthermore, the regions of the old continent, which were formerly expert in fashion and textile manufacturing, have been impoverished and disconnected from their traditional knowledge losing touch with their own material and industrial culture. As result the fashion lost its inner vocation of meaning innovation. It often happened that companies involved in the mass market have payed dramatic environmental and social costs in the countries of their operations. An example of this is the dramatic incident that happened in the suburbs of Dacca, in 2013 when more than 300 women, who worked in the textile industry, lost their lives.

In this scenario, there is a growing interest in the university level education institutes and the need to reshape their role and nature to accept and win these challenges.

In consideration of what is explained above, a deep transformation of education is needed. With reference to this transformation, many studies have been focusing on the impacts of universities on their surrounding contexts, showing the relevance and positive feedback on the growth of regional and even national systems, whereby academies are able to build connections and interact with their external environment (Saxenian, 1995). Academic institutions should break their internal boundaries, within disciplines, schools, and departments, but also open to the external to all actors of economy, culture, and the civil society. This to react to the maturity and turbulences of contemporary markets, and to increase awareness of their impact on a larger social, cultural, and environmental scale (Peters, 1999; Weik, 1995; Chesbrough, 2005).

The aim of this paper is providing, trough an embryonic research, some opportunity to think about the fashion design education transition and how it will be possible integrate sustainability in the fashion design schools.

2. METHODOLOGY

The research applied the case study method to support the idea that the fashion education institution should evolve according with its context and adopt a new framework which should integrate the principles and practices of the fashion design for sustainability. To collect data in developing case studies, the research integrated multiple meth-

ods, which include desk research – looking at company reports and government publications – and field research – semi-structured interviews and observations (Yin, 2008).

The case study was the selected method for different tactical reasons. First of all, case study method using primary data is suitable in a situation where the existing knowledge base is limited to examine proposing questions (Yin, 1994).

Secondly, case study method best gives back the rich, real-world context in which the phenomenon occurs (Eisenhardt and Graebner, 2007), that is otherwise difficult to evaluate using other methods such as surveys (Yin, 2008). For this reason, the investigative nature of case study provides the opportunity to extrapolate a qualitative data that is what the research aims. Lastly, the use of the case study method allows to declare specific assertions that are supported by the experiential knowledge that prevent from generalization, based on an individual case, but through different case studies, and result in the development of interpretative models (Nixon and Blakley, 2012).

It follows that this method leads to develop an interpretative model, which could be used in the future research.

2.1 CASES SELECTION

The multiple case research methodology should be more robust than a single study (Yin, 1994), as it lets comparison and contrast within the selected cases and detect whether an emergent finding is simply idiosyncratic to a single case or consistency replicated by several cases (Eisenhardt, 1991). The research aimed to compare the different cases to identify the trend and codify the practices.

Diverse case selection strategy emphasizes its primary objective in achieving maximum variances, different engagement qualities, along relevant dimensions or themes, integrative digital technology adapted by fashion retailers, in this case. For this reason, when setting the parameter of the study, the selection included representative cases from the different types of fashion design institution and companies, who play key actors in the current fashion system. The research then examined the most appropriate cases, within the presented cultural model, where design education should be oriented towards growing professionals who are able to guide fashion into a new paradigm, centred on principles harmonized with the collective aim of pursuing a sustainable development, on a social, cultural, and economic point of view. Milano Fashion Institute and Progetto Quid have been identified as the most suitable cases for this study among fourteen European cases within institutions and companies. Both the cases are working on a process-based / projects-driven education where all fashion processes are integrated--balancing traditional know-how, and sustainability urge and because of which the final goal is not the production of a single garment but re-appropriation of meanings that a fashion design activity produce both of an economic and socio-cultural level. (Fashion perspectives on educational programs, 2017).

3. UNIVERSITY CASE STUDIES: MILANO FASHION INSTITUTE

Milano Fashion Institute (MFI) is an interuniversity consortium for the higher education in the fashion industry founded in 2007 by three Milan universities: Bocconi University, Cattolica University and Politecnico di Milano. MFI aims to create an international multi-disciplinary training centre of excellence. The founding universities are the three most important Milanese universities that already worked on the fashion industry. In particular, Bocconi University is ranked 6° Worldwide, Masters in Management, by Financial Times, 2018; Cattolica University is ranked among the first 100 Universities in the world, 2018; and Politecnico di Milano is ranked among the top 20 Universities in the world in all three areas: 16° in Engineering, 11° in Architecture and 6° in Design, by QS, 2019. Through their experience, these three universities established themselves in the international scene as leaders in providing research and training activities for businesses in the fashion sector in the fields of management, communication and design. MFI trains professionals that are skilled with the interdisciplinary competences provided by the universities involved. Thus, Milano Fashion Institute is a one-of-a-kind European reality. The academic programme involves faculty members in Economics and Management disciplines from Bocconi University, in Social Sciences and Communication from Cattolica University, and in Design from Politecnico di Milano. Generally, fashion industry programs involve only one or two of these disciplines and that is why is difficult introducing students to the broad range of issues related to the creative, production and communication processes involved in fashion businesses. The teaching activity of MFI sets out to prepare students for the interdisciplinary skills they need to succeed in the entire design, production and communication process of fashion products. In 2011 Milan Fashion Institute introduce the international process for the post graduate Masters. In 2012, the MFI model became a case study presented at “Design Asia 2012 Conference” in Hong Kong, a key international event for teachers, researchers, trend analysts and designers, organized by the Hong Kong Polytechnic University. Milano Fashion Institute is the first interuniversity institute in Italy for the higher education in the fashion industry.

3.1. New Sustainable Fashion Short Course: Crafting Innovative Business Models Through Sustainability.

Today, sustainability is rethinking the structure of the fashion industry. It is necessary working on responsible innovation, starting the integration of ethics and aesthetics into the value chain. Nowadays, industries need to redesign their business model in favour of a new sustainable one, answering the needs of the future generations.

The short course “New Sustainable Fashion” (NSF) aims to train graduate and graduating students, young managers, professionals and young entrepreneurs to face the complexity of the fashion industry by providing tools and sharing business practices. It provides the participants information and examples on innovative business models

in fashion & luxury. “The course focuses on the driver of sustainability for the creation of shared value. Creating shared value in fashion means being able to answer the needs of many stakeholders: the environment, society, institutions, art, culture, territory and the consumers. As responsible fashion company have already started the long and complex journey of integrating ethics and aesthetics into the value chain, in constant balance with all the stakeholders”¹.

During the lectures, class discussions and company visits NSF explores: circular economy, recycling, upcycling, prosumer-creation, open-source, crowdfunding, wearable-technologies, online-offline integration, transmedia-storytelling, B-corporations and open-innovation among others.

NSF shares with its participants the most updated information and interesting examples on innovative business models in fashion & luxury. It also prepares the participants to face the complexity of responsibility in the fashion industry; giving proper tools to learn how and where selecting innovative fibres in fashion, how to build branding strategy in sustainability, how to create and apply some good responsibility guidelines, how to structure a good sustainability report, how to structure a good business plan in sustainable fashion; sharing inspiring business practices in both mass market, premium and luxury segment, for the different business models.

The course is suitable for graduate and graduating students, young managers, professionals and young entrepreneurs that will deal with the challenges of responsibility in the fashion industry. Specifically, NSF is built around the professional figures of junior brand managers, product managers, retail managers, PR & communication managers that want to understand the potential of sustainability, future CSR managers and young entrepreneurs that plan to start business initiative characterized by sustainability.

4. INDUSTRY CASE STUDIES: PROGETTO QUID

Progetto Quid is an Italian fashion brand which employs women from vulnerable social groups in the production of clothes and accessories. Their products are made from high quality textiles donated by some of Italy's top fashion firms. Progetto Quid was founded in 2013 by five friends associated by their interest not only in the fashion but also in the meaningful social issues that are behind this work system. In the last five years the brand has drawn attention from both critics and public providing a rapid rise in his market.

It is been selected to be studied for its commitment in the economic and social sustainability field that provides an opportunity to advance new understandings about the research inquiry.

Their vision of design as a mode of social, economic, cultural and environmental change, can be related to an extensive tradition of design, with scholars such as Victor Papanek, Nigel Cross, Ivan Illich and Stuart Walker drawing attention to design as ‘a process of re-consideration of the present as part of the creation of shared futures.’

As a sustainable economic reality, it was able to answer to the dominant discourse of SDG - Sustainable Development Goals as a measure of economic health. Their practices are designed to guarantee decent working conditions for their whole working force to avoid disparity. The purpose is to create a virtuous economic circle with a fair access to financial services to manage incomes, accumulate assets and make productive investments.

As a sustainable social reality, they developed the ability of their community to interact and collaborate in ways that create and exemplify a flourishing social cohesion. As for all the aspects of sustainability, they refer their work to present and long-term futures, as social sustainability considers places, communities and organisations, formal and informal. In addition to exist as an independent brand, Project Quid — in its ‘Quid for ‘Project — produces ethical lines for Italian fashion companies, such as the Calzedonia, to raise awareness in relation to sustainability issues environmental and social responsibility. In a context where FDfS lays his claim to be more that designers telling other people how to live. It's about the co-creation of tools and enabling platforms that make it easier for people to share resources.’ As a social enterprise, Quid tries to be a changemaker, providing a safe environment for each worker to grow and develop professionally and personally.

4.1 Progetto Quid: Impact Model.

Quid aims to interpret the fragility of female work not as a limitation but as a starting point to repaint a world more inclusive and therefore more resilient. The innovative approach that Quid is carrying on led it to be awarded with the first prize at the European Social Innovation Competition in 2014, the Momentum For Change of the United Nations and the Civil Society Prize of the European Commission employment and Social Affairs in 2017. Quid concluded the 2018 with sales of 2.8 million euros and 118 employees with 15 different nationalities faces the 2019-21 biennium with an ambitious growth plan to maximize social impact and commercial.

4.2 Progetto Quid: Mission.

Italian labour market is among the least inclusive in Europe (OECD Employment Outlook 2017), in Italy the category most affected are women. In the 2018, on a global scale Italy was at 70th place for gender gap, 4th in Europe and the rate of female employment is just 55% (WEF – Global Gender Gap Report 2018). For those who, in addition to be a woman, has a past or present of vulnerability — invalid, prisoners and former prisoners, recovering addicts — the employment rate does not exceed 25%. Foreigners, asylum-seekers, victims of trafficking often glide on the black market while the crisis has made women over 55 and young girls a fragility in the market.

Progetto Quid was founded with the purpose of meet the requirements of the market including disadvantaged

categories of female workers, who would otherwise be excluded. The employment of these women allows them to play an active role in the creation of beautiful fashion items and, at the same time, encounters the market demand.

Also, the brand name was a precise choice. The word Quid in Latin means “something more” and was used to indicate the will of the brand of offering more than other competitors. Behind this short, simple word they express their firm commitment to fighting the problem of social exclusion.

The founders wanted to organize an empowerment model for inclusive growth. The project aim was to nourish the unexplored talent of women who overcome personal vulnerabilities and that, exactly thanks to their fragility, were able to develop a unique set of skills distinguish by an extraordinary resourcefulness and resiliency.

4.3 Progetto Quid: Future Goals.

For the next two years, 2019-2021, Quid wants to reinforce its social impact. With a view to achieving this goal, the cooperative will create specific programmes for asylum seekers, refugees and victims of trafficking, meeting the needs of the territory, and also leadership programs and integration in the workplace that will make more effective the location of job placement and training programs. By 2020, there will be 150 Quid employees counselling desk and the company will provide educational opportunities. The impact of these new tools will be monitored monthly. Quid force is its ability to support the social impact with their commercial dynamics. The growing sensitivity to ethical fashion by consumers and companies suggests the presence of a strong growth potential for Quid in Italy as well as abroad: to express this potential tomorrow, Quid needs new tools today. Strategic investments in new spaces, new tools and new strategic partnerships will sustain a growth of production volumes and sales, catalyzing the positive impact on the world of fashion.

5. LIMITATIONS AND CONSIDERATIONS.

The embryonal state of the research, which started in November 2018, makes the body record insufficient to be able to define any consistent theory on how to drive academia into new paradigms. Even if the methodology was efficaciously applied across the cases, data collection and analysis for the development of additional case studies is necessary and will be performed in the next six months. However, the current data allow some points of reflection. Firstly, fashion design education is successfully incorporating multidisciplinary research questions and problems coming from the real world, interacting in a dynamic balance with external players, such as companies. (Etzkowitz & Leydesdorff, 2000; Etzkowitz et al., 2008). Secondly, the fashion design education is finally obtaining the credit for its role in leading all the sectors through an innovation of meaning that is intrinsic in its DNA, within process of enhancing cultural heritage (Csikszentmihalyi, 1991). This is happening when the globalisation and its related delocalisation are decontextualizing and depriving the products of their signifier and meaning. Lastly, the transformation is already in place in some advanced institutions, and it can be described as a process of transition “from being knowledge centred to becoming problem centred; from hard body of knowledge to soft skills; from passive teaching and learning to active interaction; from producing knowledge to becoming learning organizations” (Bertola, Hillen, & Swearer, 2016; Bertola, Ceri, & Vacca, 2016).

In view of the above, this paper focused on a broad but precise topic and left an open end which the author sets out to investigate through her doctoral research, in the next three years.

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TRANSITION DESIGN – PRESENTATION AND EDUCATIONAL APPROACH

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ABSTRACT

In the wake of Richard Heinberg and Rob Hopkins’s theories, the concept of Transition Design has found its place at the EESAB-Brest. It has been put in place to offer a curriculum to future designers with the aim of responding with a personal and creative approach to social and environmental issues related to the energy transition induced by the depletion of fossil fuels. This paper presents our approach, based on developing and transmitting resources on eco-friendly materials, multidisciplinary cooperation, local actions, the recovery of traditional know-how, methodologies for analysing and exploiting features of a specific territory, thinking about the adaptation of local knowledges to other territories, respect for others, moral and intellectual integrity of project partners and respectful and empathic communication. We conclude by presenting student projects to give concrete examples of our educational actions.

Key Words: Design, Transition, EESAB, Curriculum.

TRANSITION DESIGN – PRESENTATION AND EDUCATIONAL APPROACH

RESEARCH GOALS

This paper presents an educational programme in sustainable design and a research platform based on the Transition principle, both developed in our art school (EESAB-Brest (École Européenne Supérieure d'Art de Bretagne - European Academy of Art in Brittany), France) and named Design de la Transition (Transition Design).

The goal of our research at the EESAB is to elaborate a teaching programme to train designers to address societal and ecological challenges related to transitioning from fossil fuels to more sustainable energies and even to prepare them to become agents of this transition. Our approach is forward looking and we are trying to build on past experiences while also proposing innovative solutions.

The ambition of this communication is to share our experience and to create a dialogue on issues of energy transition and sustainability, both ecological and societal, in order to consider ways to rethink education.

At a time when scientific publishing has become a commercial enterprise, where international access to public research results is becoming increasingly complex, and where the value of a career is being played out over the number of so-called official publications, we are delighted to join our voice to yours by publishing through Creative Commons.

We hope to get in touch with new partners and to work for the development and consolidation of sustainable thinking for the human being and the environment.

THEORETICAL BACKGROUNDS

This project is based on Rob Hopkins and Richard Heinberg's theories about the necessity to start a voluntary transition toward a fossil-fuel-free society.

Thanks to works such as *The Party's Over* and *The End of Growth* (Heinberg, 2003 and 2011) Richard Heinberg severely challenges the relationship of Western and even global cultures to fossil fuels and the economic principle of growth. Heinberg outlines the limitations of current energy exploitation models and predicts their impending end due to depletion, resulting in the emergence of a crisis for all related activities, that is, virtually everything that is part of our western ways of life (object production, transportation, means of communication, agriculture, health).

In response to this problem and to the inaction of a majority of governments and industrialists, several citizen initiatives have emerged, such as Rob Hopkins's famous "Transition Towns," initiated in the city of Totnes in England. The idea is to rethink the modes of interaction between individuals and their environment in order to anticipate the end of the use of fossil fuels and the abandonment of the economic principle of growth and therefore of overconsumption (of energy, of objects, of humans). A growing number of publications and documentaries on the subject have emerged, resulting in the diffusion of the Transition principle developed in books such as *The Transition Handbook: From Oil Dependency to Local Resilience* (Hopkins, 2008).

As the movement grows, some professors of the EESAB-Brest design option have wished to take on the social and environmental issues of our century and to join the Transition movement.

PRÉSENTATION OF THE SCHOOL

The École Européenne Supérieure d'Art de Bretagne (EESAB) is a public institution of higher education training students in various practices of creation. It is governed by the national Ministry of Culture and it prepares for two degrees: the Bachelor's degree Diplôme National d'Art (DNA) and the Master's degree Diplôme National Supérieur d'Expression Plastique (DNSEP). The school offers three distinct options for each diploma: Art, Communication and Design.

The EESAB is spread over four sites throughout Brittany (27,000km²): Brest, Lorient, Rennes and Quimper. It is thus the largest art school in France in terms of numbers. Each site offers a curriculum that is specific to the research interests of its professors and its socio-cultural and geographical environment.

The team in charge of the Design option of the Brest site has decided to orient its pedagogical path to best meet the social and environmental issues related to Transition, and to make the designer, as a thinker of space and objects, a major player of this transition.

THE DESIGNER AND HIS/HER SOCIAL RESPONSIBILITY AS A CREATOR

The issues of sustainability and transition have to be addressed in art schools and even more so in a design option. In the past decades, art schools have abandoned their traditional approach based on the model of the artistic academy and have become experimental sites where artistic practices and societal models can be called into question and transformed. Art schools are often pictured as engaged, experimental, and posing a challenge to the institutions in place. These principles are obviously not systematic, far from it, but they can find in these establishments an appropriate conceptual and human breeding ground.

The context of Brest is also conducive to the development of the idea of Transition. Far from major French urban and cultural centres, such as Paris or, on a smaller scale, Nantes and Rennes, its position allows artistic questioning based on a local socio-cultural context and close to its territory. Thus, the reflection on art by local creators can go further than a search for recognition by legitimating authorities. To put it another way, the remoteness from cultural centres forces a more direct and concrete dialogue with a wider and more mixed socio-cultural diversity than that of the artistic microcosm.

As far as the designer is concerned, his/her role is too often reduced to that of a thinker of forms and colours valorizing and demarcating a product or a space by adding a symbolic and aesthetic value, for the benefit of an industrial structure within a competitive consumer economy. This is one of the many possible roles for the designer, who can accomplish more than what is pictured in this simplistic vision. Indeed, the Arts and Craft and Bauhaus - post biological turn (Michaud, 2003, p. 53) - present the designer as one who can intervene on reality through space and objects. That is to say, the designer would have the capacity to modify human beings and their behaviours in a global societal, even political, perspective. At the time of the development of theories such as those of peak oil, degrowth, Transition and the questioning of overconsumption and therefore of the production of objects, it is obvious that designers can again reinvest the social and societal principles that are the pillars of the great conceptual and historical movements of design.

To put it another way, the role of the designer is not to give shape *to* objects or places, but to give shape to a life in common *through* objects and places. In this sense, it seems clear that the designer can become a major player in the transition and that it becomes relevant to better equip future designers to move in that direction.

TRANSITION IN DESIGN

So, at a time when environmental issues are at the centre of our concerns, and when production issues can no longer be considered without also looking at the required resources and the resulting waste, the Transition Design concept seeks to rethink design practices to incorporate these concerns, with particular emphasis on local and regional dynamics.

The educational project within the Design option at the EESAB in Brest places the priority on context and emphasises the need for design to draw on local research.

The geographic location of the city makes Brest a peninsular territory rich in social and environmental biodiversity, but also one with a certain fragility, where the human impact is measured on a short time scale. It is against this backdrop that the program Transition Design has been established in order to understand this territory through the kaleidoscope of transition and to lay the groundwork for discussion on the implementation of resilient design.

The region's geographic location on the coast combines a social biodiversity with a rich and fertile natural environment. The region is based on a balance of different environments - urban, rural and maritime -, the outlying location of which requires a certain amount of consideration in terms of self-sufficiency and adaptability.

In addition to the region's various preservation efforts, including the Armorique Regional Natural Park, which spans 44 towns, and the Iroise Marine Park, which spans over 3,500km of coastline, there is also a large community network that is working to achieve greater adaptability and self-sufficiency, lots of third places that promote multi-disciplinary and collaborative projects and centres of excellence in maritime and coastal scientific research.

Supported by a regional network of design schools, design practices have been redefined at regional level through a localised approach that highlights the importance of taking the designer's location into account.

In a transitional context, the designer will then seek to adopt an approach that takes both global issues and contextual factors into account as part of a dynamic working process. These global issues might, for example, take the form of politically identified indicators for initiatives designed to promote sustainable development

The global vision therefore outlines the perfect direction to take and a series of initial evaluative components, but it is out of touch with the complex and unique reality of real-life contexts. Projects implemented in real-life contexts generate the most concrete data but mostly at a later date. A real-time feedback relationship between the global and local components is therefore vital.

Projects developed using a Transition Design approach are developed using different resources and to different ends. Some adopt a sustainable development approach, whereas others adopt a retro-innovation or even circular economy approach. Depending on the context, these frameworks of action can be implemented simultaneously and do use certain methodologies.

HOW TO TEACH TRANSITION

How do we teach this emerging approach to design? When Rob Hopkins underlines the forward-looking nature of the transition approach by indicating that “[p]eople who are engaged in Transition Initiatives [...] are part of one of the world's largest research projects” (Hopkins, 2010, p.186; our translation), he induces that no outcome is predictable and that everything is an act of creation of new models. How, then, can we put in place an effective and coherent pedagogy?

This is exactly the kind of questions we are currently trying to answer at EESAB-Brest. And our strategy is to apply the methods of creation in art: the dialogue with matter and reality to bring out the unexpected. Thus, experimentation and analysis with feedback on experience are at the basis of our work and teaching dynamics. We place the student at the

center and apply principles of respect (of the other, of the environment), of openness and of collaborative work.

In this way, transition is not an exclusively “technical” response to resource-related issues, but also a human-centred approach based on moral values and principles.

Our educational program and our research platform - through a multidisciplinary, collaborative, inductive, iterative and socially inclusive approach - aim to make our school an involved actor of the Transition principle on its territory.

Technically, this will be enacted by developing or by transmitting resources on eco-friendly materials; multidisciplinary cooperation; local actions; recovery of traditional know-how; methodologies for analysing and exploiting features of a specific territory; and reflection about the adaptation of local knowledges to other territories.

Morally, the approach wishes to encourage behaviors of inclusion, respect for others, moral and intellectual integrity of project partners, respectful and empathic communication in order to think community and relationships. This seems obvious and should be the case in any context. However, it is clear that sometimes competition, differentiation and the ego of the creative artist are sadly at the core of art education.

Yet, in what regards the educational structure, art schools are fortunate in comparison with French universities. Indeed, the pedagogy, as well as the administrative and technical structures of the school are traditionally turned towards the development of each student’s personal project. The teaching staff is therefore accustomed to adapting its pedagogy to the concerns of each student.

The real change happens in the networking between our students and professors and local partners who can work on a unique and specific project, as well as in the development a territory and its specificities in the global and local dynamics presented previously. Such projects require cooperation between players and a certain transdisciplinarity and are, for example, developed with the Fablab at the University of Brest’s Faculty of Science and Brest-based schools of engineering, which are working with us to set up this educational program. From design, biology and sociology to electronics and IT, the accumulation and hybridization of skills and expertise are vital to the emergence of these new design practices.

We also use biomimicry as both a language, allowing us to communicate with other disciplines, and of course as a research process to draw inspiration from the living world when it comes to designing and innovating. Our biomimetics training module is certified by the Senlis European Centre of Excellence in Biomimetics. These are a few examples of projects we have worked on in the Finistère region.

Just like in an interindividual relationship, with the triptych student, professor and external partner, the result does not pre-exist the interaction and is partly unpredictable. It is the interaction between the different actors of the project that will allow the emergence of a specific pedagogy and its evolution. With this approach, the professor is no longer the holder of a vertical knowledge to transmit; he co-creates knowledge with the student and the partner, in a research-creation dynamic. The legitimacy of the professor is then much more closer to what Rancière addresses in the *Maître ignorant* (Rancière, 1987). This obviously has the effect of creating atypical and extremely different profiles after graduation.

We even have the ambition to consider our teaching as conducive to exceeding the degree and tending to induce the student to a process of perpetual learning.

In conclusion, our approach consists of a teaching curriculum and a special working environment designed to promote the development of transitional projects across the Finistère region. Its aim is to help students adopt an active learning methodology and multidisciplinary project management skills and to introduce them to the scientific fields relating to the issues they are dealing with alongside their artistic training.

To facilitate an easier and more professional dialogue with the environment and partners outside the school, we have developed an action research laboratory, the Designlab, to support students and young graduates in local professional integration through work in real conditions, by assisting with research contracts in real-world situations, with an incubation program to support business start-ups and by heralding a support channel for the production and circulation of student projects.

STUDENTS’ PROJECTS

In order to make our approach to teaching and our actions more legible and concrete, this part is dedicated to the presentation of projects developed within the framework of the Design option of the EESAB-Brest site.



Corentin Vitre dealt with waste from the fishing, auction and canning industries, which discard large quantities of fish skin. Working alongside Sophie Menguy, a student biologist at the University of Western Brittany, they developed a plant-based tanning technique and succeeded in obtaining a technical and aesthetically-pleasing material that required no chemical treatment, resulting in the production of a leather referred to in tanning terms as ‘exotic’.

[Figure 1] Fish leather developed for the Krak'ën project © Corentin Vitre [Figure 2] Elec Green City © Alizée Gérard

This project won the support of the Armorique Regional Natural Park, which works to promote circular economic flows, with a local auction house providing the raw material. The university’s Fablab helped with adapting traditional tanning techniques, whilst local dressmakers expressed an interest in this sort of fish leather.

The Elec Green City project was the brainchild of Alizée Gérard, who describes herself as a bio-inspired designer. She took on the challenge of a city at the end of the network, namely Brest, which is not very resilient in energy terms, the idea being to create living walls on the facades of social buildings using a modular system and using the bacteria from the plant substrate to create a current to harness and amplify.

Current amplification is a technical innovation developed jointly by 2 electronic engineers from the university’s Fablab, Christophe Bars and Julien Raoul. The electricity generated is proportionate to the planted surface and could locally and renewably power special temporary urban lighting that is better distributed than it currently is. This research is awaiting funding for a prototype.

A-Ven is a collaborative project run by Cédric Le Breton and involving research into efficient usage in micro-contexts and a more resilient approach to coastal sailing. The mini-catamaran is lightweight, easy to dismantle and transport and designed for sailing in estuaries and rias. Plans are under shareable Creative Commons license and the vessel is made of bio-sourced composite sheets.

This is a primarily a sustainable innovation project. The material used is a cork, flax fibre and PLA composite and the catamaran is 95% biodegradable by industrial composting. The plans are designed for easy digital cutting at



[Figure 3] Dismantlable catamaran A-ven
© Atelier Z



[Figure 4] Recycled Surf fins developed in the Waste Factory project © Sarah Laubie

the Fablab, for example, and assembly involves a so-called conventional ‘stitch & glue’ technique.

This final project, run by Sarah Laubie, is called Waste Factory. On the one hand, it involves using low-tech tools to categorise, grind and recycle used plastics recovered from the sea, and on the other hand, a designer who comes up with relevant uses and designs for the material produced. Waste Factory has produced this collection of bio-inspired surf fins.

Waste Factory has been supported by and granted access to equipment at various academic research centres to develop the project. Sarah can gather her raw materials locally and has also identified a regional target for the goods she produces. She is now seeking to complete her own production facilities to ensure the project is based on a circular and sustainable economic model.

CONCLUSION

The practice of design, both for the theoretical principles developed by the historical figures of the discipline and the concrete fields of action today, is an ideal space for the concrete beginning of a response to the Energy Transition and for the anticipation of new social and environmental issues that will develop in the 21st century. The idea of transition also made it possible to consider new teaching approaches within the EESAB thanks to a teaching structure conducive to its development in art school. As you will have seen, a prospective approach based on a specific territory and involving transdisciplinary partnerships in good intelligence allows the emergence of innovative projects.

Our main question is now how to consolidate and develop this dynamic and evolving pedagogical model to make it both perceptible, reproducible and sustainable. There is also the question of the economic and legal model of such approaches, because of their collaborative dimension with partners with multiple statuses.

All these questions are currently being addressed within the school and we will be happy to discuss them with

anyone interested in sharing knowledge and sharing ideas.

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SOCIAL INNOVATION THROUGH DESIGN IN THE TRAINING OF YOUNG APPRENTICES: EXPERIENCING SOCIO-EDUCATIONAL PROJECTS

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Marco Antonio Weiss

Luiz Fernando Gonçalves De Figueiredo

ABSTRACT

Considering design as a culture and a practice that suggest ways of living, its applications aim to launch different meanings to society. Social innovation through design, in the context of apprentices' learning shows new life perspectives and instigate their creative skills for transforming daily routine through innovative solution generation. The objective of this article is to describe the extension project experience that had as motivation instigating a new way of perceiving apprentice practice, suggesting new articulation and internal problem solving of their own institution concerning socioeducational materials for pre-primary children's education. The project enabled a thinking and process assimilation of designing from the youngster's perspective, who have identified new possibilities of applying the acquired knowledge for future use in diverse contexts. Furthermore, to the younger children, it has given the opportunity to access the diverse and creative material, under the light of designing.

Key words: social innovation design; socio-educational materials.

1. INTRODUCTION

Design artefacts, being tangible or not, are all about social interventions (Coutinho; Lopes, 2011) that can reach social innovation¹. By aiming to innovate and propose life-changing interventions, one must consider the socio-cultural implications and the new meanings generate by it (Franzato et al., 2015). It is important to highlight that the innovation process demands a location and favourable conditions (Franzato et al., 2015). Due to the broadening of understanding of implications and potential of design role in society, it is a challenge to involve the characters of design problems in its solution, as well as to generate the favourable environment for innovation with new means of producing and consuming. According to Manzini (2017), the character's involvement guarantees that the designer's presented solutions dialogue with the community, generating meanings that evidence and reflect the sociocultural aspects of the community itself. At the same time, the designer has a mediator role in the innovation process aiming, with his own competences, positively transforming a context. The main interest of the extension project here developed is based, above all things, in social innovation and sustainability for a socioeducational institution that assists not only young apprentices but children from the Pre-primary Educational Centre (CEI as in *Centro de Educação Infantil*). It had as a proposition to articulate their own community in the making of socioeducational materials, through creative development and teenager capacitating in using design tools.

It is noted in Brazilian education context the need for exploring innovative ways of teaching and qualification of subjects that can handle the enormous social inequality (Coutinho; Lopes, 2011). Still, according to Coutinho & Lopes (2011), the basis of Brazilian education has developed from foreign experiences, including the imagetic universe of didactic materials that in their majority do not correspond to Brazilian reality. It is therefore seen the opportunity of proximity of design and education. It is believed that through design intervention in the context of learning, one can contribute to the proximity of the school and the 21st Century complexity (Alves; Borba, 2016; Zorzal, 2016), to the Brazilian reality and social transformation in the student's life, which can extend to the surrounding community.

Design is a transdisciplinary field, because it has as characteristics to work complexity and to synthesize it (Filtro, 2004) in this way contributes to a systemic view (Albuquerque, 2016), that is necessary to handle contemporary needs for better citizenship. Therefore, it is understood that design can create a favourable social innovation environment inside learning and educational environments, being formal or informal. Having those as premises, the present article aims to describe the experience of an extension project developed in the socioeducational environment. The project had as objective to instigate a new perspective towards the institution's apprentices, proposing a new articulation and internal problem solving regarding the demand for socioeducational materials for CEI's children.

The implemented project had as baseline the meaningful learning¹, bringing the project experimenting to the classroom, looking for real problem solution for real people. The teenager apprentices could experience design content learning in a practical way by applying concepts, methods and tools while looking for solutions for pedagogical needs pointed by the pre-primary teacher. In this sense, more than developing a product, the teenagers could experience the transforming potential of design.

The methodology used was applied research with a qualitative approach (Flick, 2009), having as objective to describe the extension project and its results to promote social innovation in the apprentice community and partner institution children. The implementation of the research was in the practical project which aimed to introduce design thinking, with its processes and tools, in teenager's upbringing and having as a result the development of didactic materials for the institutions' pre-primary education.

2. DESIGN CONTRIBUTION IN THE SIGNIFICATIVE LEARNING PROCESS AND SOCIAL TRANSFORMATION

Design is a field in which a professional uses fundamentals, specific tools and methodologies, and follows some principles for interacting in forming a material culture that orients society in conceiving new artefacts that interferes in it (Fontoura, 2002). Those new artefacts are generated through handling technologies and materials, which are provided with aesthetic, functional and practical meaning and dialogue in the environment that are inserted. By its configuration as a professional field, Fontoura (2002) defends that design becomes a complementary asset in teaching and education. It is added, therefore, the potential to contribute in meaningful learning. Still, the insertion of design in pedagogical proposals dialogues with the new educational philosophy due to the approach that instigates the diverse creative, critical, aesthetic thoughts and developing the senses, the perception and the motor coordination (Fontoura, 2002).

Sustained by a way of thinking and by the agile process that orients the project development (Alves; Borba, 2016), designing contributes in the capacitating and formal or informal education of people and communities, orienting them towards a sustainable development. For Manzini (2017), experienced designers could explore their skills and capacitate people for having a better understanding of their own design potentials and the contributions that they can give to a determined context, making them main characters of change and, consequently, generating social innovation. It is recognized, in this sense, the transforming potential of the field and de capacity of acting and contributing alongside teachers to achieve meaningful learning - marked by experimenting and problem solving though

projects- better articulating shapes and functions to fulfilling educational objectives, proposing innovative ways of presenting content and concepts to diverse users and in diverse contexts.

In the case of the present article, it reports the application of design in teenager apprentices' capacitating in the creative process of developing socioeducational material, destined to 5 and 6 year-old children. The relevance of this transforming, specifically, was to create an opportunity where both youngsters and children are part of a same institution, and youngsters have been qualified to make materials that help children's development. This connection wasn't noticed nor explored before the systemic view of design specialists.

3. METHODOLOGICAL PROCEDURES

The extension project described in this article was conceived through active-research, a method where the researcher participates actively with the group in which the project aims to solve a collective problem (Thiollent, 2008). The project parameters were aligning themselves during the meetings- called seminars in the active-research- among the NASDesign researchers and administration and pedagogical management of the partner institution who received the pilot project. The first interaction with the institution was through the principal, to whom the project was first presented and its intention to integrate de University and the institution's children. Since the first meeting, the institution was very receptive and presented some of the ideas that could meet the needs of the institution. The second meeting aimed to watch a pre-primary class with 5 and 6 year-old kids, so it could be observed the kids' routine during their arrival and permanence in the institution, use of didactic material by the class teacher, characteristic behaviour of the children and environment. After class observation two more seminars were made involving NASDesign researchers, the institutions' board, coordination and pedagogical counsellors. In these seminars it was observed the potential to involve the sections of the institution, defining that the project would capacitate teenagers from the apprentice sector so they could meet the demand for didactic materials raised by the pre-primary teacher, instigating empathy and social responsibility upon the teenagers. The next seminar would happen only among the NASDesign researchers to build the steps for the project's appliance.

The pilot project involved the NASDesign researchers as trainers and mediators, a class from teenager apprentice group with 7 integrants and a teacher and, a pre-primary classroom with twenty-five children and a class teacher responsible for them.

The project's application happened with the capacitating of the teenagers in seven encounters of four hours



each, totalling twenty-eight hours. For this purpose, the pre-primary teacher has provided a list of her student's interests and pedagogical needs to be addressed (Figure 1). From this moment on, the teenager's training started.

[Figure 1] Pedagogical requirements and children's interests. Source Made by the authors.

In the first six capacitating meetings with the teenagers - schedule presented in Table 1 - they were presented to concepts, methodologies and design tools to be applied to projects as a way of developing creativity. From start, they were presented to the problematic and the project's context they were initiating, as well as its particularities, characteristics and children's needs for which they were going to project. After that the teenagers were divided in three project groups and the practical part started: tools like brainstorming, persona, sceneries and semantic visual maps were presented to help in the problem solving. The teenagers also had alternative generating activities, planification, technical drawing, prototyping, vectorizing and laser cutting. All of these activities were developed during the meet-

ings, which has made possible for them to experiment the creating design process. By the end of the sixth meeting, each group had a prototype and a project built.

[Table 1] Activity schedule done with the teenagers. Source: made by the authors

Meeting	Activity Performed
1 st	Design concepts and applications
2 nd	Understanding and applications of Design tools
3 rd	Deepening and application of Design tools
4 th	Vectorization techniques; Prototyping
5 th	Vectorization techniques; Prototyping
6 th	Vectorization techniques; Prototyping
7 th	Application of the prototype in real context

So, in the last meeting the prototypes were tested in the real context with children, their initial objective. In that meeting, the developed products were evaluated by the NASDesign researchers, the pre-primary class teacher, the apprentice teenager program teacher and by each teenager, where each individual has filled in a



checklist to evaluate items related to ergonomic and cognitive requisites, aiming to understand the quality of the product facing the context and incentive teenagers to adopt a critical view over their own creations, making improvements possible.

[Figure 2] Testing prototypes in real context. Source: Elaborated by the authors

After the end of the capacitating, a group interview was made to verify the teenagers' and the teenager's teacher project perception. In this interview a retrospective of the activities developed was presented and then they were interviewed, being questioned and raising discussions about strengths and weaknesses of the capacitating project, class dynamics and activities performed, as well as a vision about which design vision has been internalized by each one along the meetings, and if they think they would ever use what they have learned through the project.

4. FINAL CONSIDERATIONS

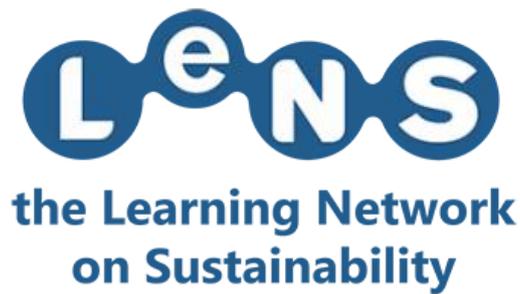
The social innovation through teenager apprentices' learning pints to a new perspective of life for these people and instigate their creative skills to transform life and daily routine through innovative propositions. With the extension Project, it has been offered the constructive attitude (Manzini, 2017) in the teenagers by being trained to propose socioeducational materials. This attitude has also been built by the connection and empathy generated towards the children, who live in the same contexts that the teenagers. By approximating the different ages, the teenagers have had a differentiated capacitating, since it makes them co-responsible for the development and capacitating of other beings, in more susceptible situation than they are- for being small children. The pilot project's experience highlights this factor as an interesting strategy in empathy generation, articulating different learning levels. Therefore, it has strengthened the institution's relationships ad it highlighted the opportunity to think about an environment where this practice could be nourished, as an incubator or start-up, where the teenagers can learn about how to work by demand of developing socioeducational materials for CEI.

The application of the project has inspired understanding and assimilation of design thinking and practice to the teenagers involved by experimenting the content learned in a real situation, in materializing a real product to a real public. By that, the Project had as result innovative and meaningful solutions, developed by students and to meet the needs of students. Lastly, through the feedback received by the end of the pilot project, it was revealed that made possible for them a deeper understanding about design's role in society and how design thinking can help in the search for problem solving not only professionally, by developing products, but also in several areas of their lives.

Some teens reported that, because of the project, they have found new skills that combined with the knowledge acquired had broadened their view for new possibilities in their lives.

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INSPIRING STUDENTS TO BE AGENTS OF CHANGE: A SOUTH AFRICAN PERSPECTIVE

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ABSTRACT

By reflecting on my experience as a Masters degree graduate, a university lecturer and a design mentor on a youth training programme in South Africa, I will provide evidence of how different pedagogical methods can either nurture or hinder a student's personal growth, therefore directly impacting their approach and ability as designers. I will discuss the importance of creating awareness among students about how their values, opinions and goals can affect their design decisions and influence what impact they make on the world around them. Moreover, this paper calls for a global teaching philosophy that recognises empathy and respect as devices for sustainable world making.

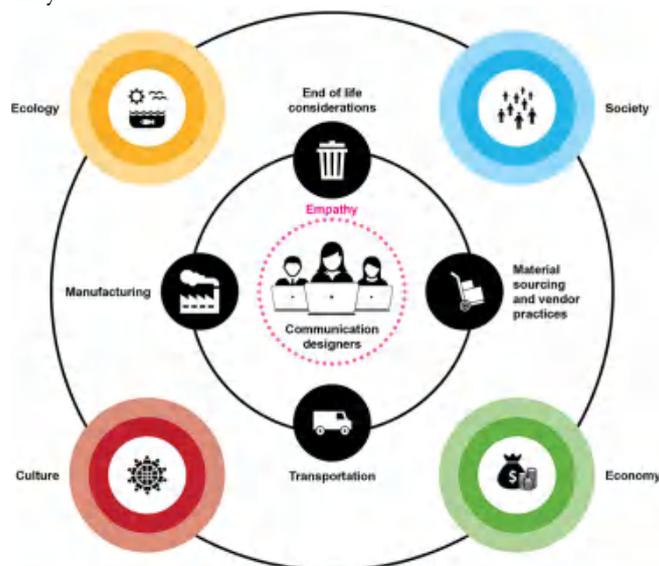
Key Words: Communication Design, Design for Sustainability, Education, Empathy

1. INTRODUCTION

Across the globe the increasing promulgation of the United Nations Sustainable Development Goals (SDGs) lends impetus to the need to address sustainability in a more urgent and holistic manner. As the needs of the world change, so too do the roles and responsibilities of design professionals. Communication designers, for example, can play a transformational role in the drive for change by conscientising the general public about the severe consequences of not addressing issues of sustainability with agency and urgency. If we consider that today's students will become future industry leaders the onus is placed on educators to prepare the next generation of designers with the requisite knowledge, skills and tools to make a meaningful impact not only on their profession, but also on the world at large. By reflecting on my journey, over the past decade, as a communication design practitioner, educator and mentor, this paper will explore my intervention into inspiring and empowering young designers to be the change agents needed to drive sustainability forward.

2. ADVOCATING DESIGN FOR SUSTAINABILITY THROUGH EDUCATION

Early on in my career I realised that through the messages we communicate, designers have the power to inform public opinions and can therefore influence positive change in attitudes and behaviours. With this power comes responsibility, but as a young designer in South Africa (SA) I did not feel equipped with the knowledge required to consciously and confidently embrace this role. After four years of practice I grew increasingly concerned by my industry's lack of awareness of the part it could play in environmental stewardship, social responsibility, cultural preservation, and boosting economic viability. As a result, in 2008, I enrolled in the Urban Sustainable Design Studio (USDS), a summer school hosted by the Foresight Design Initiative in Chicago, USA. There I was exposed to innovative ways in which to tackle the complexities of designing sustainably. The focus was not only on materials and production processes, but also on how to apply Design Thinking's collaborative and human-centered approach to solving design problems. To practically engage with our learnings we worked on live briefs. The project I worked on investigated possible solutions to lessen the barriers to employment for people with disabilities. By working closely with this community I learnt the importance of practising empathy, where empathy "is the capacity to step into other people's shoes, to understand their lives, and start to solve problems from their perspectives" (IDEO.ORG, 2016:7). The course highlighted that, right at the start of the design process, designers must think holistically about the entire life cycle impact of their proposed solutions. As the Sustainable Systems Thinking in Communication Design infographic below illustrates, designers are central to the decisions made within a larger system. The first circle surrounding the designers represents the empathic lens through which they must approach each design problem. Practicing empathy ensures that solutions do not only consider the end users' practical needs, but also their cultural and emotional needs (IDEO, 2015). The second circle represents four processes which are integral to the entire system: material sourcing, vendor practices, transportation, and end of life considerations (Yvette Perullo [sa]). The outer circle shows how every design solution exists within a larger interconnecting system relating to the four pillars of sustainability.



[Figure 1] Sustainable Systems Thinking in Communication Design Infographic (Adapted from Yvette Perullo, n.d.)

At the time of participating in the USDS, *Design for Sustainability* (DfS) was growing in popularity in the West, but in SA there was no clear understanding of what practising sustainably really meant, specifically within the context of communication design. There were no courses dealing with DfS locally, thus when I returned from Chicago I developed and taught an introductory course for communication design students at the Cape Peninsula University of Technology and the Ruth Prowes School of Art. This marked the start of my academic journey. My

goal was to share what I had learnt in a way that was applicable and accessible to South African designers because, as Giard and Walker (2013:1) attest, in order to be meaningful and effective, DfS has to be “attuned to place and context”. Over four years I curated an interactive and multi-dimensional learning experience that included theory lectures, guest speakers and field trips. With each cohort I integrated a live brief into the course to give students the opportunity to experience how their design decisions could impact the world around them. One such brief was to design a shark information signage system for Cape Town’s (CT) beaches. This was in response to a fatal shark attack that – upon investigation into safety measures on beaches – revealed information about shark behaviour was poorly communicated to beach goers. I therefore approached the City’s Department of Environmental Resource Management with a proposal for my students to design a solution that would create awareness about shark activity and promote beach safety. The students were enthusiastic to be working on such an important real world brief. The project was so successful that the City implemented several of the students’ ideas, in new awareness signage, across the CT coastline. Through such projects I was able to convey to students that they had a critical role to play in championing sustainability, not only through the materials and production processes they chose, but through the persuasive messages they communicated.

At the two institutions where I lectured there appeared to be little or no engagement with DfS outside of my course. A review of the other fourteen higher education institutions that offered communication design programmes in CT revealed that only four included concepts relating to sustainability in their course descriptions. This highlighted a major gap in curricula and I identified that this gap was echoed by the local industries poor uptake of DfS. Based on these observations I enrolled in a Masters degree programme. I wanted to unpack why a gap existed in curricula, and most importantly try to figure out how to overcome this gap. My research investigated the level of awareness, interest and engagement with DfS within the CT communication design fraternity. The title of my dissertation was: *Integrating principles of sustainability into communication design pedagogy at selected HEIs in Cape Town: towards an industry-responsive curriculum*. The table below explains the methodological approach that my research followed.

[Table 1] Masters Thesis Methodological Approach

RESEARCH DESIGN	Qualitative; Purposive sampling of the Cape Town communication design fraternity; Three HEIs that varied in size and course focus; Five communication design companies.
INFORMANTS KEY	Eight communication design educators: theory and practical; Eighteen communication design students: third year; Six communication design professionals.
EMPIRICAL DATA	Semi-structured interviews; Focus groups; Online survey.
THEORETICAL FRAMEWORK	Since there were multiple actors involved with this study, Activity Theory provided an analytical lens through which to view the interrelationship between the three different categories of actors who were involved in multiple, interrelated activity systems of teaching, learning and practicing DfS in communication design (Engeström, 1999:65).

3. MAIN RESEARCH FINDINGS

Through the analysis of the data I identified five key tensions that prevented the uptake of DfS into the communication design curricula: Tension one, DfS was misunderstood as an exclusively environmental issue; Tension 2, there was a lack of alignment between the theoretical and practical teaching of DfS; Tension 3, students were not taught how to practically implement DfS in the local context; Tension 4, educators were waiting for industry to champion DfS, rather than being the conduit to help drive change in industry; and Tension 5, to practice DfS the communication design fraternity wanted to be incentivised. These tensions resulted in students failing to get to grips with the interconnected environmental, sociocultural and economic impact of their design solutions. To address this I developed four main strategies – with input from design educators – for integrating DfS into curriculum and these strategies were shaped by ten guidelines.

[Table 2] Strategies and Guidelines for Integrating DfS into Communication Design Curricula

STRATEGIES	GUIDELINES
1. Introduce DfS as a core principle from the outset	DfS should be a formal inclusion in the communication design curriculum; DfS should be introduced as a subject from first year; DfS should be integrated as a critical lens into all theory and practical subjects throughout the curriculum; DfS should be assessed as a stand-alone marking criterion on every brief.
2. Expose students to pertinent information about DfS	DfS should be made relevant to the lives of students so that they can develop a personal connection with the subject; To stay abreast of advancements in DfS, HEIs should invest in the continuous professional development of educators by sending them on regular training; DfS industry specialists should be brought in as guest speakers and/or guest lecturers.
3. Allow students to engage practically	Students should work on live briefs, for real clients, which address sustainability issues in the local context.

4. Facilitate collaboration between diverse design actors	Students should collaborate in multi- and inter-disciplinary groups on DfS briefs; Educators from various HEIs should collaborate with local design networks to promote dialogue about DfS, and to develop communication design-specific resources to aid best practice in DfS.
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My research discovered that any inclusion of sustainability into pedagogy was linked to the educators’ and students’ personal interest in the subject. This related to the guideline that I believed to be most critical – making DfS relevant to the lives of students so that they could develop a personal connection with it. According to Sherin (2013:6) communication designers who choose to practice sustainably are “driven by values-based decision making”. This idea was supported by Benson and Napier (2012:213) who believed that the best solution to promote the uptake of DfS in communication design education was in “connecting issues of sustainability to the values of design students”. Sustainability itself can be understood as a value system that guides people towards more conscious behaviour within society. However, we cannot assume that all students’ values will necessarily align with sustainability principles. Through educational experiments, Benson and Napier (2012) realised that most students were in fact unaware of how their personal values, opinions and goals impacted their design decisions. It is therefore important for educators to encourage students to determine their personal values and then to interrogate how these values connect to the larger environmental, social, cultural and economic context in which their design decisions are made (Wals, 2014). While this does not suggest that students have to ascribe to the same values; it is important for them to be able to articulate what it is they believe in, and what they want to work towards as designers. Furthermore, if it is considered that a teacher’s personal values and views about sustainability can influence the way in which the subject is taught, it becomes even more important for students to be able to critically evaluate information and engage with it on a personal level (Cotton & Djordjevic, 2011). Educators therefore need to guide this process by engaging students in reflective discussions about their understanding and interpretation of what they have been taught and its relevance to their own lives and design practice.

The study viewed DfS as a key input for preparing students for more ethical practice once they graduate. It argued that only once young designers were able to critically evaluate the impact of their design decisions, as well as confidently define their role as designers in the world, would they personally take on the required responsibility of their profession.

4. THE REALITY OF PUTTING RESEARCH INTO PRACTICE

In order to promote the uptake of DfS amongst students, my study called for the early incorporation of principles of sustainability into curricula, so when - a few months after completing my Masters degree - I was tasked with developing and implementing a first year module on the fundamental elements and principles of design at the University of Johannesburg (UJ) I saw it as the perfect opportunity to practically apply my research findings. I was excited to take on the role of disseminating information about sustainability. Over the course of the first semester, however, I realised that due to many complex issues the vast majority of students were not ready or able to engage in topics relevant to DfS. As my research discovered, students’ backgrounds and schooling influenced how they connected with concepts such as DfS. The UJ students came from diverse backgrounds with some facing socio-economic challenges that impacted on their ability to meet the basic requirements of the course – attending lectures and submitting work. Other issues that drew attention to the students’ realities included their differing secondary education experiences and standards; varying levels of exposure to and awareness of the design world; varying literacy levels; and language barriers.

At the time of my involvement with UJ the South African education fraternity was being challenged to question what a democratic and decolonised education system should look like. This was in the wake of *Fees Must Fall*, a student-led protest movement that opposed increases in universities fees and called for the decolonisation of higher education institutions (Langa, 2017). The Design Education Forum of South Africa took on this challenge by hosting a conference themed *Decolonising Design Education*. Concerned with my students’ plight, I presented a paper titled *Reimagining Design Education Through Empathy*. In it I discussed three empathetic approaches to teaching that I believed could help overcome some of the inherited inequalities and disadvantages that design students and educators faced: tapping into and respecting the students’ situated knowledge; connecting with the students’ personal values; encouraging empathy; and shifting the relationship between lecturer and student to be one based more on mentorship. I was inspired by the writing of bell hooks, who advocated for a foundational and ethical restructuring of the way in which students are taught.

“To educate as the practice of freedom is a way of teaching that anyone can learn. That learning process comes easiest to those of us who teach who also believe that there is an aspect of our vocation that is sacred; who believe that our work is not merely to share information but to share in the intellectual and spiritual growth of our students. To teach in a manner that respects and cares for the souls of our students is essential if we are to provide the necessary conditions where learning can most deeply and intimately begin” (hooks 1994:13).

This quote speaks to pedagogy needing to be student-orientated and human-centered, and the key to this is empathy in hooks’ (1994) sense. If educators have a better understanding of their students’ realities, they can adapt how they teach so that design education becomes a more accessible and democratic learning experience. This idea was supported by IDEO who wrote in the *Design Thinking for Educators Toolkit*, that educators should use Design Thinking’s empathetic approach to reimagine the learning experience through the lens of the students’ needs and desires (IDEO, 2012:2). This links back to the importance of integrating DfS into curricula, because what is DfS if

it is not about reimagining what is possible.

At UJ I attempted to adopt this empathetic approach by reshaping the form and delivery of the course content in such a way that it became a more nurturing learning experience. Adapting the briefs to meet the needs and aspirations of the students also yielded much more interesting results. However, what my experience uncovered was that due to certain structural limitations – large class sizes, limited one-on-one contact with students and limited time for dialogue – I could not easily put into practice the concept of empathy within the formal academic environment.

5. LEARNINGS FROM A YOUTH TRAINING PROGRAMME

In my professional capacity I worked as a design mentor at Livity Africa, a non-profit youth development organisation. The purpose of the organisation was to “work with and for young people; to harness and accelerate their ability to create their own sustainable livelihoods” (Livity Africa, sa). An example of how this was achieved was through Live SA, a nationwide youth-run media channel. Live SA provided a platform for eighteen to twenty-five year olds to receive on-the-job training from professional mentors representing various disciplines including design, photography, videography and journalism. Every three months there was an intake of up to twenty-five young people who were responsible for generating relevant content in an authentic and creative way so as to inspire and engage the youth. The content covered a range of topics from music, art, fashion, relationships, career advice, politics, and news. My role as design mentor was not only to up-skill the trainees, but to better equip them for the changing working world by guiding them on a journey of self-discovery and self-actualisation. Rather than dictating what content they created, or how it should be visually communicated, my responsibility was to assist them in finding their own voice and personal means of expression. The key to achieving this was by encouraging the trainees to foreground their lived experiences, as well as challenge them to question how the content they created could enrich the lives of other young South Africans.

Right from the start, the trainees’ learning experience was shaped by a sense of equality that was realised through active participation and co-creation. This required that everyone who participated in the training programme needed to be empathetic towards one another’s lived experience. As mentors we made the time to accommodate the trainees’ situated knowledge into our knowledge and perceptions, allowing us to reflect on the context of where they were coming from, where they wanted to go and what was important for them to be able to succeed in life. We were inspired by each persons’ individual story and tried to tap into their passions as much as possible, in that way making them feel valued and respected.

Because the trainees were defining all of the content themselves, they were not only enacting their creativity, they were identifying with their own value system. Adding to this, the trainees’ involvement in producing content for a community that they empathised with allowed them to better understand what role they could play and what impact they could make in society. A good example of this was the content and collateral created for the #FreeToBleed campaign. The aim of the campaign was to put pressure on government to make sanitary products freely available to learners from under-resourced communities (livemag.co.za, 2017). The campaign was petitioned in Parliament and subsequently free sanitary pads have been distributed in schools across certain provinces. Tito Mboweni, SA’s finance minister, recently declared sanitary products tax free and announced a significant increase in investment towards the roll out of free sanitary pads (health24.com, 2018). By creating awareness around urgent health and economic issues, the campaign encouraged the trainees to see their potential role as active participants in the governance of their country.

Live SA epitomised the learning environment that hooks (2003:xv) envisaged the classroom to be: “A place that is life-sustaining and mind-expanding, a place of liberating mutuality where teacher and student together work in partnership.” There was a marked difference between the connection I developed with the design trainees and the first year university students. My experience indicates

that the empathetic approaches discussed throughout this paper play a key role in breaking down barriers and building meaningful relationships between educators and students. A summary of the approaches that educators can implement include: understanding and acknowledging the students’ cultural and academic backgrounds; being increasingly mindful of the various barriers that students face; enabling students to discover their voices and personal means of expression; encouraging open and respectful dialogue between students so that they become aware of each other’s realities; introducing design concepts in such a way that they are contextually relevant to the students’ own lives; setting design briefs that provide the opportunity for students to explore how design can positively impact their communities; and building confidence amongst students by identifying and promoting their interests and skills.

6. GROWING A COMMUNITY OF CONSCIOUS GLOBAL CITIZENS

At the beginning of this I year relocated from SA to India. These countries face many of the complex challenges that the SDGs attempt to address – poverty, unemployment, inequality, lack of formal housing, limited access to quality healthcare, and dependence on coal power. The associated negative impacts of climate change are also being felt with rising temperatures, as well as severe water shortages. As expressed throughout this paper, communication designers can use their skills to inform people about sustainability issues and inspire them to contribute towards a better future. For example, designers can lessen the negative impact of the above-mentioned challenges through:

raising awareness about important humanitarian issues; changing behaviour by encouraging people to use resources sparingly; motivating action to support local industries; or by uniting diverse cultures and directing people towards a common goal (Dougherty 2008:12; Perullos 2013:30). To adapt to the needs and daunting challenges of a rapidly changing world the communication design industry urgently requires change agents to lead the way. To ignite change, communication designers should recognise their potential role as design activists. The students of today will be industry's future leaders, and if properly prepared, they can fulfil this role effectively.

To drive action-for-change in the learning environment, educators must frame critical global issues within the context of the challenges faced by the students and communities in which they live. This is not an easy task, but inspirational resources can help to inform and motivate both educators and students. Global Citizen is a powerful example of this. It is a non-profit organisation championing an online activism campaign that aims to mobilise millennials to take action towards realising the first SDG – ending extreme world poverty by 2030 (globalcitizen.org, n.d.). The campaign creates awareness amongst young people; exposes them to the causes of extreme poverty; and encourages them to use their collective voice to take action against it. Actions are simple – sending an email, posting a tweet, or signing a petition. Actions are categorised into seven core issues: Girls and Women; Health and Education; Finance and Innovation; Food and Hunger; Water and Sanitation; Environment; and Citizenship. To reward people for taking action, a massive music festival is hosted in a different country every year and the line-up includes the biggest names in global music, as well as artists, activist and world leaders. Tickets to the Global Citizen Festival (GCF) are free, but are only rewarded to active citizens who have enough points to enter into the ticket draw.

Last year the GCF took place on the African continent for the first time, in Johannesburg. I was commissioned to curate a team of top young Southern African communication designers to create the visual identity for the GCF marketing campaign. The campaign had to communicate an authentic, inspiring and culturally relevant message to the local target audience so that they would be motivated to amplify their collective voices by taking actions to address issues of poverty. The campaign's impact was significant, it generated over 5.65 million actions which led to 60 commitments – from world decision makers – to the value of \$7.2 billion; and is set to affect the lives of 121 million people (ibid).

While Global Citizen believes that to create change we “need active global citizens who are engaged in the world, knowledgeable about its diversity and passionate about change”, they have also realised that to drive massive change young people want to be incentivised (ibid). Similarly, my Masters findings discovered that in order to implement DfS practice into their work students wanted to be incentivised, rather than adopting principles of sustainability to address real world challenges out of sincerity. Educators should therefore take inspiration from, and expose students to such campaigns as a way to assist them in defining their role in the world while being made aware of the relationship between their values and actions as designers.

In conclusion – to implement a sustainable and inclusive approach to design education, whether in SA or India – educators must adopt a philosophy of teaching that is founded on deep empathy and respect for students' needs, aspirations and motivations.

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THE TECHNOLOGICAL MEDIATION OF SUSTAINABILITY: DESIGN AS A MODE OF INQUIRY

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ABSTRACT

This paper investigates the possibility that the instrumentally rational nature of late-modernity restricts product design from contributing substantively to sustainability as this form of rationality views technological artefacts in neutral terms and discourages reflection upon the “ends” that technologies serve. The philosophical approach of postphenomenology is proposed as a lens for supporting product design students to address sustainability more substantively as postphenomenology emphasises the “ends” that technologies serve by understanding technologies as being active mediators of the relations people have with their world. A practice-based design research method is introduced, which aims to support design students to engage with postphenomenology *through* the activity of designing. This method involves the creation of conceptual objects that critique technologies and embody alternate values to those that typically drive technological development in late-modernity. Finally, distinctive aspects of the designing process associated with this method are identified that support students to address sustainability in a more substantive manner than late-modernity encourages.

Key Words: Postphenomenology, technological mediation, design.

1. INTRODUCTION

The period of modernity (circa 1500-1980) radically altered human comprehension of the world as traditional, religious understandings of it gave way to scientific understandings, characterised by empiricism and rationalistic thinking (Tarnas, 1993, p. 282). Consequently the world was transformed from being part of “a meaningful and value-filled cosmos [into] a vast aggregate of material objects in causal interactions” (Guignon, 2004, p. 22). As modernity progressed, the notion of progress, specifically economic and technological progress, became a matter of ultimate concern: an end in itself and a path to meaning (Taylor, 2009, pp. 715–716). McGilchrist (2009, p. 176) develops the thesis that during this period, the so-called “left brain hemisphere”, associated with rationality, reason, detached analysis, etc. achieved a position of dominance over the “right brain hemisphere”, which is associated with emotion, intuition, holism, etc. Hence, instrumental rationality emerged as the dominant form of rationality, which prioritises the selection of efficient, cost-effective and expedient means to achieve desired ends – without reflecting upon the value of those ends (Dryzek, 2005, p. 195; Feenberg, 2011, p. 865-867). Technologies are therefore understood in largely neutral terms, which conceals their world-building, world-changing capabilities (Davison, 2001, p. 95). The way we comprehend the world however has significant implications for how we perceive the world and engage with it; moreover, we can measure the consequences of how we comprehend the world by what happens to it, and by what happens to us (McGilchrist, 2009, p. 176).

Mounting evidence of unsustainability would suggest that continuing to prioritise the instrumentally rational “left brain hemisphere” in how we comprehend the world—and subsequently develop technologies—may be counterproductive to developing more sustainable ways of living. Despite this however, the dominant approaches to addressing sustainability are themselves instrumentally rational, advocating that technological advancement will pave the way for consumption-heavy lifestyles to continue unabated via the development of increasingly efficient technologies. Consequently, there is a danger of a “rebound effect”, which occurs when consumption rises as a result of increased efficiency and reduced consumer costs (Berners-Lee & Clark, 2013, pp. 50–54; Verbeek, 2011, p. 93). Furthermore, the dominant approaches to sustainability tend to prioritise environmental issues such as the depletion and contamination of non-renewable resources, which whilst being undoubtedly critical, is overly simplistic and insufficient for developing more sustainable ways of living. The inter-related symptoms of unsustainability are broader ranging and more complex, incorporating (but not limited to), global poverty, widening economic disparity, the social, physiological and psychological pathologies of overconsumption, loss of cultural diversity, and disempowerment of women and indigenous peoples by development strategies (Davison, 2001, p.2).

2. TECHNOLOGICAL MEDIATION: POSTPHENOMENOLOGY

Considering widespread faith in technological advancement being the solution for addressing sustainability, Paredis (2011) notes that it is remarkable “the articles, books and policy debates on sustainability seldom explicitly draw in a discussion of the nature of technology, how technology influences society, and what this implies for sustainable development” (p.196). To this end, the philosophy of technology is committed to investigating the nature of technology, the consequences of technologies for society and how we should act in relation to technologies (Brey, 2010, p. 42). The approach of “postphenomenology” from the philosophy of technology particularly offers product designers a means of overcoming the instrumentally rational nature of late-modernity by providing a lens for considering the “ends” served by technological artefacts rather than viewing them as end-in-themselves, as tends to be the case in late-modernity. Postphenomenology is rooted in phenomenology but whereas phenomenology philosophically analyses the structure of relations between people and their lifeworld, postphenomenology studies these relations as being human-technology relations (Verbeek, 2011, p. 7). Postphenomenology is “post” to distance itself from the romanticism of phenomenological analyses, which tend to treat “technology” as a whole and consider it to be an alienating force (Rosenberger & Verbeek, 2015, pp. 10–11). Phenomenology therefore often opposes the worlds of science and technology, viewing them as presenting a reduced reality that lacks the richness of what the world actually is (Rosenberger & Verbeek, 2015, p. 11). By contrast, postphenomenology incorporates rather than opposes technologies, refuting the idea that we can “regain access to an original world that is richer in meaning than the world of science and technology” (Rosenberger & Verbeek, 2015, p. 11).

Postphenomenology understands technologies in non-neutral terms, as actively mediating and shaping the relations that people have with their world; the human-technology relation is, therefore, a human-technology-world relation (Ihde, 1995, p. 34). Importantly, postphenomenology views the character of these relations as emerging from the entanglement of subject and object – subjectivity and objectivity do not pre-exist these relations, instead they rely on each other’s possibility for being what they are and continually draw upon each other to be meaningful (Introna, 2008, p. 58). For Verbeek (2006, pp. 368–369) the postphenomenological view that subjectivity and objectivity emerges from technological mediation places technologies at the very heart of ethics because ethics is concerned with how to act and technologies-in-use appear to provide material answers to the question of how to act. Postphenomenology does not assign ethical responsibility solely to people or to objects; rather, moral actions and decisions are co-shaped in the mutual relation that arises between person and object (Verbeek, 2011, p. 58). Technological mediation therefore significantly influences our normative frameworks, values and responsibilities (Verbeek,

2016, pp. 200-201). Understanding technological artefacts in this way behoves those involved in their design to consider the character of the relations that may emerge from technological mediation – and crucially, reflect upon what that character might mean for developing more sustainable ways of living. Furthermore, understanding technological artefacts as mediators of human-world relations helps to overcome the late-modern propensity to largely view sustainability as solely an environmental issue, which allows it be only partially addressed.

3. THE METHOD OF CREATING “INQUIRING OBJECTS”

The design research method of creating “inquiring objects” aims to support design students to postphenomenologically investigate technologies; that is to investigate technologies as non-neutral, active mediators of human-world relations that, when brought into use, shape the character of the relations people have with their world. This method involves transmuting philosophical ideas about technologies into highly conceptual, tangible objects. Creating “inquiring objects” is therefore a form of Research Through Design, an approach that is increasingly being adopted in academic research for the unique contributions that design practice can make to knowledge – this is reflected in a rich and growing body of research in which the construction of objects is central to research activity (Bardzell et al., 2015). The method of creating “inquiring objects” aligns with the approaches of critical design (Dunne, 2005), propositional design (Walker, 2014) and critical making (Ratto, 2011). The creative activity of designing is harnessed to de-emphasise the forms of rationalistic, analytical thinking prevalent in late-modernity, to instead bring contrasting but important forms of understanding to the research process that modernity has neglected. These forms of understanding include subjectivity, intuition, originality, expressiveness, imagination, synthesis, contradiction and personal judgement, etc. (Walker, 2013b, p. 448). It is important to stress that “inquiring objects” are vehicles for learning; they need not function or indeed even be understandable to others and there are no claims of comprehensiveness or completeness. Rather, the objects can be understood as three-dimensional sketches that attempt to probe issues from the literature and encapsulate thoughts, impressions, questions, and aesthetic judgements in tangible forms.

Creating “inquiring objects” particularly aims to support design students in recognising the unconsciously held assumptions they may have about the design of technological artefacts, as even the most inexperienced design students bring deeply ingrained presuppositions to the design process about the nature of products that design educators cannot simply eradicate (Snodgrass & Coyne, 1996, p.87). Unconsciously held assumptions tend to result in incremental changes to how products are designed, rather than the kind of radical re-thinking that addressing sustainability more substantively will require. Moreover, they allow sustainability to be approached via the same instrumentally rational mindset that negatively impacts upon developing more sustainable ways of living. As Sengers et al. (2005, p. 50) note, “our very way of reasoning about the world is based on unconsciously held assumptions and perspectives that strongly condition what we see happening around us before we even begin to reason about it”. Creating “inquiring objects” seeks to illuminate unconsciously held assumptions in two main ways. Firstly, the designing process is informed by philosophical ideas about technology that are explicitly critical and secondly, the syncretical nature of design practice allows the practitioner to bring together factors such as function, aesthetics and materials in a creative process of discovery that can illuminate previously unrecognised relationships and connections (Gaver, 2012, p. 942; Walker, 2013b, p. 448).

3.1 Examples of “inquiring objects”

This section presents a small sample of “inquiring objects” from design practice undertaken by the author and a group of undergraduate design students that participated in this study. These objects investigate and problematise aspects of the contemporary digital world. The objects focus upon how personal digital devices and associated technologies mediate human-world relations that are potentially counterproductive to developing more sustainable ways of living.

Description: Google Diary is a leather-bound journal subtly etched with the “Google” logo on its cover. The content of the diary is a search history extracted from the author’s Google account covering a period of one year to reflect a traditional diary.

Issues being explored: The increasing use of the internet as a design solution and the significant role that the internet consequently plays in people’s personal lives.

Technological mediation: The internet can mediate fragmented, fleeting engagement and unreflective, distracted be-



haviours, which are unlikely to encourage and support human-world relations that are compatible with developing more sustainable ways of living.

[Figure 1] “Inquiring object” entitled Google Diary

Description: Anaesthesia is a tablet device and set of earphones placed inside a transparent medication bag.

Issues being explored: The possibility that personal digital devices act as a form of medication to protect people

against an unsustainable reality via the opportunities they provide for entertainment and distraction.

Technological mediation: Personal digital devices can mediate soporific human-world relations by detracting



from people's experiences of the "real" world, including how they relate to their immediate physical environments and other people in those environments

[Figure 2] "Inquiring object" entitled *Anaesthesia*

Description: Transparent Smartphone is a transparent piece of plastic shaped to resemble a smartphone. An eye and a map of the world is etched onto the plastic.

Issues being explored: The largely unseen "big brother" nature of global digital communications corporations.

Technological mediation: Smartphones can mediate human-world relations that conceal hidden corporate agen-



das relating to the use of personal data. Smartphone users are therefore vulnerable to the intentions of large global businesses, which are often not compatible with developing more sustainable ways of living.

[Figure 3] "Inquiring object" entitled *Transparent Smartphone*

4 THE DESIGNING PROCESS OF "INQUIRING OBJECTS"

This section reflects upon the process of creating "inquiring objects" to draw out distinctive elements of the process that support design students to address sustainability in a substantive manner. Design process knowledge is defined by Walker (2013, p. 455) as knowledge that is distinctive to designing that cannot be acquired through non-design means. Three key aspects of the designing process were identified from the author's practice: A disruptive designing process, meaningful engagement with philosophical ideas and a different "end" for design. These themes were corroborated by the experiences of the students and new sub-themes were identified from the students' practice.

4.1 A disruptive designing process

Using design practice to explore and critique how late-modern values such as efficiency, utility, technological advancement and economic growth inform and become manifest in technological artefacts necessitates sourcing and configuring materials that appear incongruous with technology. This incongruence disrupts normal assumptions about design as the familiar is transformed into the strange, allowing the practitioner to see technological artefacts in new ways through a lens of materials, aesthetics and configurations not generally associated with their design. Consequently, a critical distance is created in which the practitioner is supported to consider radical alternatives.

Disruption was experienced by the students in two additional ways. During the initial phase of the project, the students frequently sought clarification that their object need not function in the typical, utilitarian sense, indicating that they experienced difficulties in disregarding late-modern understandings of function. As this tension eased, students reported experiencing a heightened sense of creative freedom, which encouraged new understandings that challenge the late-modern nature of technological artefacts. This finding suggests that despite design being an inherently creative activity, addressing functional concerns can inhibit creativity. Secondly, the students' preconceived ideas about what it means to be a designer created further disruption. Many students struggled to disregard the client-focused nature of design and experienced difficulties in accepting that there were no real or imagined stakeholders specifying the outputs of their designing process – and perhaps importantly, sharing responsibility for them. This resulted in participants appearing to experience a degree of exposure as alternate values to late-modernity began

to concretise through the emerging artefacts. This degree of exposure was however advantageous for raising student awareness that values become embodied in the outputs of their practice.

4.2 Meaningful engagement with philosophical ideas

The process of creating “inquiring objects” invites the practitioner to grapple with philosophical ideas (which can be both difficult and time consuming to understand), through the activity of designing. Philosophical ideas are therefore contemplated and absorbed in a very different manner compared with more traditional, rationalistic means such as reading, memorisation and writing. By contrast, the activity of designing allows the practitioner to develop understanding of these ideas in a relatively emotional, spontaneous, intuitive, and holistic process that is concerned with aesthetically bringing together ideas from a range of sources, including one’s own lived experiences of technologies. The designing process contextualises the abstract philosophical ideas being investigated, which deepens their relevance to design by supporting the practitioner to consider the ideas in terms of specific technologies.

The students experienced meaningful engagement with philosophical ideas in two additional ways. Firstly, the designing process served as an effective means of learning philosophical ideas about technologies as it mitigated against the students feeling “lost” when attempting to learn complex ideas by solely reading literature. Secondly, a sense of empowerment emerged as students felt able to assert and express themselves as critically-aware designers due to their emerging knowledge of the philosophical ideas under investigation.

4.3 A different “end” for design

Like many conventional design processes, creating “inquiring objects” develops transferable, practical designing skills, such as developing making expertise, sourcing appropriate materials, problem-solving and developing creative skills. The process of creating “inquiring objects” however directs these skills towards the development of generative, conceptual objects that represent a different “end” for design, which is that of a beginning. The artefacts look backwards and forwards, simultaneously framing critical questions about how technologies are designed and proposing alternate answers to those questions. These answers are expressed via the artefacts’ aesthetic sensibilities, forms, material combinations and patterns of use, which can be interpreted to support the design of technological artefacts that mediate more sustainable human-world relations.

For the students, creating “inquiring objects” also represented a different “end” for design in that the process served to expand their sense of designing for sustainability beyond the design of energy-efficient, marketable products. Instead, students began to recognise that the impact technological artefacts have upon people’s daily behaviours and values are critical to addressing sustainability more substantively. Consequently, a heightened sense of ethical responsibility to “do the right thing” through design emerged, which was rooted in new understandings about the non-neutral ways in which technologies mediate human-world relationships.

5. CONCLUSION

This paper has argued that the philosophical approach of postphenomenology can support the design of technological artefacts that mediate more sustainable human-world relations. The method of creating “inquiring objects” was introduced and distinctive aspects of the designing process were identified that support design students to address sustainability in a more substantive manner than late-modern conventions allow for. This paper concludes therefore that design education can contribute more substantively to addressing sustainability by developing and embedding methods that support students to engage with philosophical ideas about the nature of technology. Importantly, the development of such methods should seek to de-emphasise the modern propensity to favour the rationalistic, analytical side of human nature, which appears detrimental to developing more sustainable ways of living, in favour of emphasising the emotional, intuitive, holistic side of human nature that has been neglected during modernity.

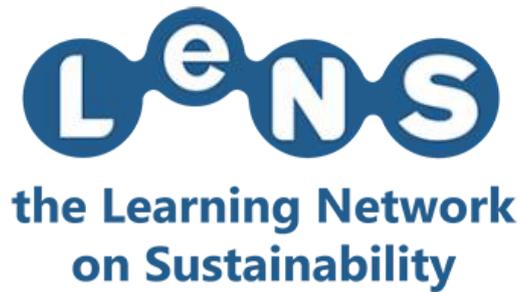
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DESIGN FOR SUSTAINABILITY. STATE OF THE ART IN BRAZILIAN UNDERGRADUATE COURSES

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ABSTRACT

During two centuries the development model based on industrial production was responsible for a significant reduction of many non-renewable resources. The idea of design as a field of knowledge has been a notable participant of this context which started in the 1970s and since that it has been corroborated by some leading authors, such as Victor Papanek, Gui Bonsiepe, Ezio Manzini, Michael Braungart and Janis Birkeland.

Along with this concept, studies from the International Council of Societies of Industrial Design (ICSID) indicate that about 80% of the environmental costs of a product, service or system is generated in the design phase. It clarifies the importance of inserting this theme in the field of design in both academic and professional spheres.

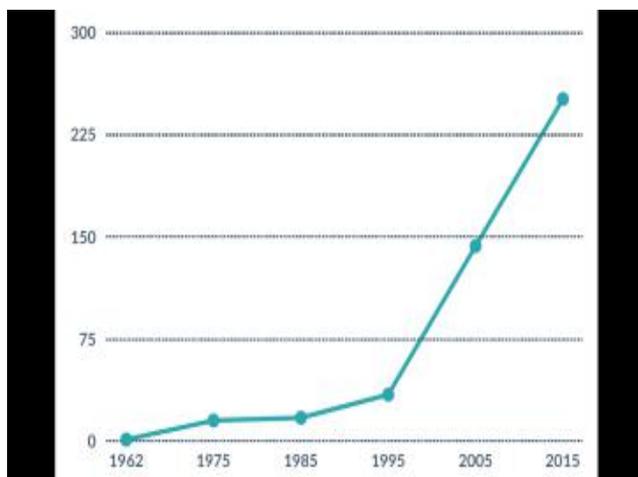
Based on that fact, this research aims to bring an understanding of the approach of teaching design for sustainability in Brazilian undergraduate courses.

From a set of data obtained in public official documents from the Institutes of Higher Education (HEI) researched in Brazil and in Europe, together with a bibliographical survey of relevant contemporary publications, this paper uses content analysis tools to map the recurrence and articulation among those documents. The results present the state of the art of design education for sustainability in Brazil in comparison to European educational institutions and the scientific community agenda.

1. INTRODUCTION

The Brazilian higher education model is fragmented between public institutions (federal, state and municipal spheres) and private institutions. This model was consolidated mainly by the Brazilian 1988 Constitution and the Law on Brazilian Education Guidelines and Bases (LDB) of 1996 (CNE/UNESCO). Above all, since the 1990s the implementation of the LDB and the beginning of the promotion of universal access to higher education policies in Brazil have intensified measures to support the expansion of programs and slots. Such great expansion in the last two decades was more evident in the design field.

The chart below presents the historical series of the number of programs offered in Brazil between 1962, when the first design school in Brazil was established — the Higher School of Industrial Design (ESDI) in Rio de Janeiro



— and 2015, when the most recent National Education Census for undergraduate courses in design happened.

[Figure 1] Historical series of the number of Brazilian undergraduate courses in design (Source: INEP/MEC)

However, even with this significant increase, it is worth mentioning that access to higher education in Brazil is still limited to a minority share of the population. According to the 2010 national census, less than 7% of Brazilians, whose estimated population at that time was 190 million people, attended higher education. This corresponds to about 6.8 million people. The number of Brazilians with graduate degrees is even lower. In 2010, this number (790,000 people) corresponded to only 0.42% of the population. From this total, 54,000 people have a degree in design, and approximately 1,300 have a master's degree or PhD (IBGE).

This context of recent expansion is where this research is inserted in order to answer this question:
How do the main design schools in Brazil approach sustainability?

2. METHOD AND RESEARCH GOALS

This research is supported by qualitative analyses of three different textual corpora (Brazilian universities, European universities and scientific articles produced during the last five years) according to two tools: Similarity Analysis and Confirmatory Factor Analysis (CFA).

The Confirmatory Factor Analysis (CFA) shows the frequency of use and the concentration among terms applied in a textual corpus, while the similarity analysis demonstrates the articulations between different terms and their co-relations with the main subjects of a textual corpus. For this paper the IRAMUTEQ open software was used as the main tool for the development of chart analysis.

The data used were obtained mainly on the websites of higher education institutions selected from indicators such as: teacher qualification, academic production and government assessments.

The main goals of this study are:

- 1). To understand the state of the art of undergraduate design courses in Brazil, especially those regarding the approach to sustainability in their programs;
- 2). To compare the state of the art of Brazilian institutes with that of the European schools and with the contemporary scientific publications in the design for sustainability field.

3. THE STATE OF THE ART

Among the universities we have studied, the majority of them changed their program in the last ten years. Thus, their curricula already dealt with sustainability issues in specific disciplines, once this debate has emerged strongly in the last decades in the design field (figure 2).

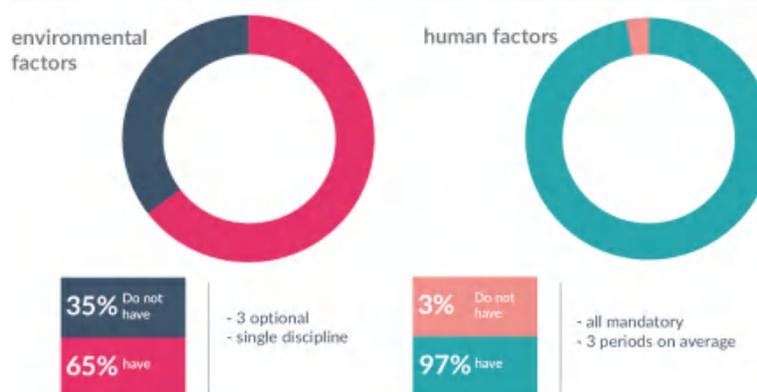
In addition to the more recurring “design for sustainability” and “eco-design”, there is a number of disciplines dealing with environmental issues, such as “environmental management”, “design, and nature” and “environmental science”.



The number of institutions that approach the environmental issues are, therefore, the majority within the universe we have researched. However, when faced with the number of classic disciplines offered, it is still smaller.

[Figure 2] Disciplines related to environmental factors (Source: The authors)

The example used in this study was the comparison of the number of offered disciplines that deal with environ-



mental factors and the number of disciplines that deal with human factors (figure 3). The reason for this comparison is explained by the fact that both can be treated as specific subjects, but are essentially inherent to the design practice.

[Figure 3] Comparing subjects (Source: The authors)

The debate on environmental factors in a systemic way corroborates the idea that their insertion occurs within the scope of the project. However, there are eminently technical factors that precede the project phase — for example, the legislation aspects. That is, regardless the way the discussion of environmental factors occur within the university course, the time taken for its approach should also include technical and interdisciplinary elements.

4. RESULTS

The first stage of the process is an analysis of the institutional documents of the design for sustainability (and related) courses of the Brazilian public universities selected for this study. The Confirmatory Factor Analysis (CFA) makes clear that there is a concentration of the main terminology. This means that there is a recurrence in the use of terms in most of the courses, which represents the unity of thought about the subject “design for sustainability”. On the other hand, it shows the superficiality of the discourse used to approach this theme.

The repetition of the words “design”, “environment” and “sustainability” reinforce this understanding. Other words that stand out are “product”, “material” and “ecology”.

According to Madge (1997), in the 1980s the concept of “eco design” could be applied to product development and used as a guide. This anachronistic approach still remains in texts of some courses.

Sustainable design, however, is more complex and converges the scope of design towards social conditions, development and ethics.

Among the less recurrent terms used in a few institutions, it is possible to recognize those that are more related to the life cycle and production management, such as “production”, “logistics” and “management”.

From the analysis of similarity is noticeable the existence of three sets of main relations from “design”, which is the most repeated term. The first vector points to sustainability, linked to terms such as “ecology” and “development”. The second one moves to the word “environment” and is related to the terms “impact”, “industrial” and “quality of life”. Finally, the third vector indicates the word “product”, which relates to “production”, “system”, “cycle” and “services”.

The comparative CFA analysis between Brazilian and European institutions shows that while there is a smaller area for the use of the main terms in Brazilian university courses, it doesn’t happen in the chart of European institutions courses (fig. 4). In this case, the terms are scattered throughout the chart, which demonstrates different approaches between those different programs.

The second stage of this analysis process was a comparison between the data collected in Brazilian universities with a set of data collected in European universities and with a third set of data obtained in some of the most rele-

[Figure 6] CFA analysis 2 (Source: The authors)

This can be demonstrated by the comparative analysis between Brazilian courses and contemporary scientific production from the CFA analysis (fig 6) and similarity analysis. The absence of articulation and even citation of relevant topics in the Brazilian programs, and mainly, intrinsic to the discussion of sustainability, as “economy” and “social” is noticeable.

Words related to them, such as “distribute” and “consumption”, in addition to others such as “innovation” and “politics” also appear more frequently in the evaluated papers.

4. CONCLUSIONS

Institutional pedagogical documents such as course syllables have a peculiar language. They feature characteristics like being short texts with broad approach of the main subjects that will be dealt in the classroom by the period of the course. Therefore, a comparison between this type of text and those prepared for scientific papers should take this into account.

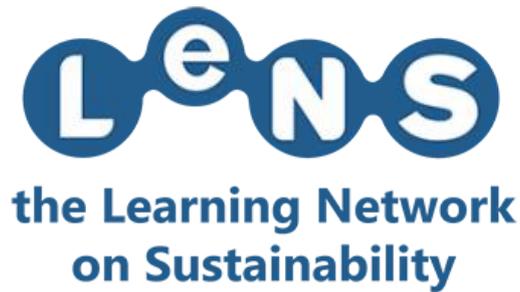
Having said that, it is evident that the Brazilian courses do not deal with the theme of sustainability design with the same depth and variety of themes found in European course programs and, mainly, in scientific publications. Thus, it is possible to conclude from this preliminary analysis that:

- The main difference between the programs surveyed in European and Brazilian courses concerns technical issues. The use of the terms “tools” and “practices”, often presented in the European texts, almost do not appear in the Brazilian documents;
- Some topics that are intrinsic to the study of sustainability and which have notable adherence to the field of design, such as “economics” and “society” are absent or almost not broached.
- Issues related to terms such as “politics” and “innovation” are poorly treated;
- Despite its relevance, energy is also a subject discussed in few courses;
- Finally, the discussion about consumption does not find space in the programs of most Brazilian courses.

Therefore, there is room for the deepening in the approach of the design for sustainability in the courses offered by the Brazilian universities. As this study refers only to documents available on the websites of researched institutions, a new study from in-depth interviews may contribute to a better understanding of the current context.

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SUSTAINABLE DESIGN TRENDS WITHIN CREATIVE LEARNING ENVIRONMENTS

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ABSTRACT

This paper discusses planned and on-going research on understanding how we aim to increase awareness of sustainable design trends within the interior design curriculum framework in the context of creative learning environments. The findings of the research will support the case that creative learning environments are pivotal in the development of design innovation within education.

Key words: sustainable design, interior design, creative learning environments, design education

1. INTRODUCTION

Developing focused interior design curricula within a fast-paced evolving design environment is challenging. How do we as educators stay up to date with global sustainable design trends? How do we incorporate these trends into our learning outcomes and curriculum in a timely manner? With a focus placed on formative learning through industry-based assessments, we encourage critical design thinking similar to industry interior design practices. Although environmentally sustainable interior design (ESID) has become a major issue in interior design practice, according to the literature the frequency with which interior designers make sustainable choices in real practice is still limited, particularly where materials selection is concerned (Hayles, 2015).

Many interior architecture schools have already included some theoretical sustainable design courses in their curricula. However, theoretical courses alone are not enough to teach students how to apply sustainable design in professional life (Karsli, 2013). This study looks at how we propose to develop the topic of sustainability within interior design trends in a global context as part of design curricula within the structure of a creative learning environment. The research has the ability to aid educators in developing an approach and awareness of sustainability within interior design and design trends to allow for impact in the design education framework and design innovation for every student's learning journey.

2. THEORETICAL BACKGROUND

Sustainable interior design is defined as design and practices that significantly reduce or eliminate the negative impact of interiors on the environment (Karsli, 2013). Whereas, in response to the role of the interior designer, the International Federation of Interior Architects and Designers (IFI) consider their basis of understanding in their declaration, "Interior designers and interior architects determine the relationship of people to spaces based on psychological and physical parameters, to improve the quality of life" (IFI, 2011).

If we are in continuous pursuit of improving the quality of life in the technical sense when it comes to design, then sustainability is not an academic pursuit or even a professional activity: it is a way of life affecting everything an individual does. Knowing what kind of a relationship we want to have with the global and local environment is the first consideration. Then, we should address how to achieve this relationship. To move from theory into practice, it is necessary to understand the impacts associated with our work- and life-related activities (Sassi, 2006).

A study investigating the effect on interior design studios engaging with students to teach principles regarding the use of sustainable choices within design applications revealed that the studio experience enabled a heightened awareness that sustainability was a multidimensional concept that required critical thought processes and further recognized that environmentally responsible design was imperative in education (Gürel, 2010).

In a framework for an integrated approach to sustainable interior design the idea of knowledge creation is discussed as outcomes of learning. To create a proper sustainable design framework for the educational setting knowledge creation as a learning process is conjoined with the core ideas of integrated design processes from the built environment practice community alongside the science and business communities (Lee, 2014).

Numerous studies have focused on the importance of sustainability (Ruff & Olsen, 2009) and incorporating sustainability into the design curriculum, however there is little research on understanding of what kind of teaching environment would offer the greatest success in future interior designers making sustainable choices in practice that reflect current global design trends.

A study on collaborative learning and sustainable design recognized the studio environment as the ideal pedagogical structure (Gale et al., 2014) however, theoretical learning objectives alongside practical tutorials often overestimate the ability of students to fully understand the application of information and skills. A creative learning environment plays an essential role in facilitating the creative thinking process of learners (Lau, 2015). When we place students in a creative learning environment how is the individual learning journey impacted with sustainability in mind and with respect to trends forecasted? Are the students able to see the outcome?

For the purpose of this initial phase of research we define the 'creative learning environment', with respect to global design trends, within the quintessential hub of design at the Salone (Salone Internazionale del Mobile also known as Milan Design Week) in Milan, Italy as shown in Figure 1. The Salone incorporates business, culture, the history of design



with the future of design. It is a global platform with an emphasis on innovation (Salone del Mobile Milano, 2019).

[Figure 1] Milan Salone del Mobile 2018, Edra

Our research intends to identify the importance of the role the creative learning environment plays within interior design trends – where sustainability is key to the focus of critical thinking and understanding within design education and design curricula.

3. RESEARCH METHOD

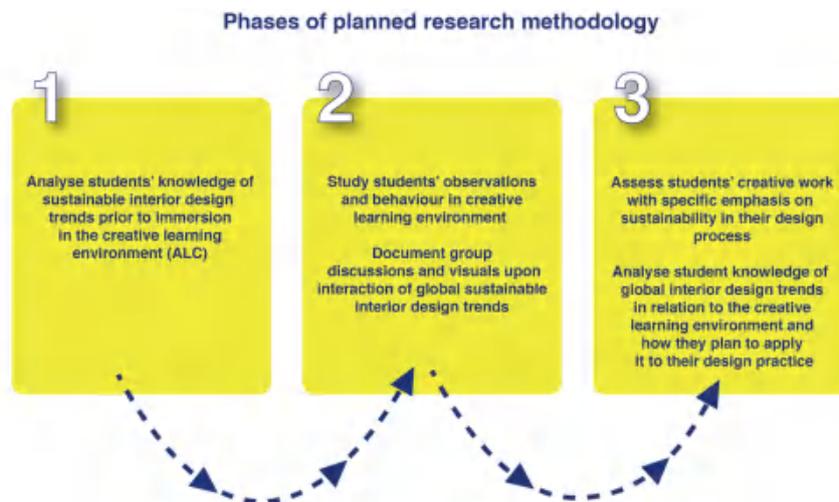
In 2018, we set to formulate the appropriate creative learning environment, the first of its kind in our design curriculum. The practical component is a qualitative ethnographic study that employs observation, the use of a survey (based on perceptions and reflections), discussion and formative evaluation of design work, which will be produced after engagement of the creative learning environment.

As all participating students are the active learners in our creative learning environment, it is important to note that the creative learning environment acts as the active learning classroom (ALC) and the well-documented educational trends recorded in the rapid growth of the ALC should aid us in understanding if the environment itself helps the learner discover, invent, solve problems and create knowledge in their sustainable design process (EDUCAUSE, 2018).

In April 2019, we aim to study four diverse groups of students within the same creative learning environment. The first group are undergraduate design students studying a bachelor of design arts from Melbourne, Australia. The second group are undergraduate students undertaking a bachelor of interior design from Barcelona, Spain. The third group of undergraduate students are undertaking a bachelor of interior design and architecture from Costa Rica, South America and the fourth group are postgraduate students currently completing a Master's degree in Interior Design from Milan, Italy.

To obtain relevant objective results we ensured that the participating students' profiles, in the respective four groups of students, are all diverse in age, geographic location, education level and ethnic background. The common key criteria are that the students are all studying an interior design tertiary degree and are all being immersed in the same creative learning environment. Ethics clearance for this study is important to ensure that the research documented from the participating students is accurate, independent and verifiable.

In our process outlined in figure 2 below, the three phases of research are divided into our methodology.



Through these three phases of study we are able to critically analyse our findings at various stages of immersion of the creative learning environment to understand its relevance within the design process of the student.

[Figure 2] Process mapping of planned research methodology

In phase one, we have developed a questionnaire for the students to complete that focuses on their understanding of sustainability within interior design and their knowledge of how this impacts global design trends. This will be completed prior to the students being immersed in the creative learning environment in their respective home countries. The questionnaire will be available in their mother tongue to ensure clarity and comprehension of information.

In phase two, they will be observed on immersion of the creative learning environment. We will be observing the students' behaviour, interaction, actions and selection criteria of global design trends. This will be documented daily for the duration of the Salone using video recording with audio. Some students in the study are actively taking part in an international project within the Salone itself. This will be further observed to understand how their results could differ to those students not involved within the creative work of the learning environment, but rather using the creative learning environment as their ALC. Within the observation immersion phase of the study we will document visually, through video and audio group discussions of the students' responses to their interaction with new global design trends and how they understand and perceive sustainability.

In phase three, the students undertaking the project, and on completion of the Salone, will be asked to create work within their field of study. The work will focus on what they have taken away from being immersed in the cre-

ative learning environment. This work will form part of their formative evaluation in a design unit as part of their assessment. All students in the study will also be given a second questionnaire to analyse how their individual approach affects their ability to develop their awareness of sustainable design within their design process. Elements of content and context will be analysed.

The planned research methodology will be beneficial to the creation of a communication support system (CSS) focused on the nature of creativity, which could be extended into a PhD study.

4. RESULTS AND ANALYSIS

Analysis of the students and their understanding at various stages of their learning trajectory will enable us to record the impact of the approach.

In phase one, we expect the students to provide an elementary understanding of the perception of sustainability in relation to interior design. This will be similar to the response we anticipate when asked the question in a standard classroom setting. The student recognizes the terminology and theory but struggles to understand how this is placed in the context of global design trends and its impact within the design process. In a representation of current design curriculum, when asked the question in a contextual design written assessment, “What does sustainable design represent to you as an interior designer?”, Figure 3 below is an example of a student’s individual response. We



expect to receive responses similar to this nature on completion of our questionnaire.

[Figure 3] Interior Design student's response to "What is sustainable design?"

In phase two, we expect to observe the students, immersed in the creative learning environment, discovering new sustainable design trends, in practical applications from various global designers, business communities and installations. The group of students undertaking the International project will have had discussions in a one-on-one environment with designers from around the world to examine, analyse and understand their sustainable design response as part of a global design event (the Salone). We expect these discussions to be more robust, specific and transformative as they will be more than learners in the creative learning environment, but contributors to creation of the ALC itself.

By phase three, all the students will have had sufficient time in the creative learning environment to have developed a substantial understanding of newly presented sustainable global design trends. The formative evaluation of design work created will establish a clear understanding of what sustainable trends were applied in their creative design process. We expect the assessment measured through the rubrics to clearly reflect the application and awareness of said trends. The second questionnaire’s responses should reflect a clear understanding of the sustainable global trends, but more importantly, an ability to apply the trends actively in their design process.

5. IMPACTS ON SUSTAINABILITY

Through the three phases of research we anticipate to see a positive response in the understanding of sustainable interior design trends within the ALC. As this is still planned and ongoing research, it is too early to definitely say if the creative learning environment is the most successful method. However, the research indicates that the current methods are not as effective. Teaching methods on the concept of sustainability are frequently searched in interior architecture education. Students are asked to produce considered design concepts with a variety of global trends in their approaches to the design process. These decisions affect the health of current and future generations and the planet on which they live and work (Jones, 2008; Karsli, 2013). By immersing them in a creative learning environment we are able to change the way students learn, understand and approach sustainable design in context to design

trends. The importance of the creative learning environment is critical in their influence on understanding the impact of sustainable design innovation, environmentally responsible design and the impact they as designers have on future sustainable design trends.

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MODEL-MAKING COURSES AND APPROACHES IN TERMS OF SUSTAINABILITY: EXAMINATION OF INDUSTRIAL DESIGN SCHOOLS IN TURKEY

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ABSTRACT

Design education has been evolving to meet the needs of the future world which is shaped around the sustainability issue. Specialized courses about sustainability are integrated into curriculum but, the integration of sustainability into whole curriculum is vital to root sustainability in design profession. In this paper, model-making courses and approaches of design schools from Turkey are examined to determine the integration of sustainability into design education in Turkey. Six model-making instructors from chosen universities in Turkey are conducted semi-structured interviews to evaluate the relationship between sustainability and model-making courses. In the light of the findings, the solutions are offered in order to make the model-making courses more sustainable.

Key Words: Design education, sustainable model-making, model-making materials.

1. INTRODUCTION

With the increase of the awareness on ecological and social problems and global development, new opportunities emerge for design, design education and research. Design is challenged by new definitions and new roles to develop sustainable solutions for the future (Cumulus, 2008).

Sustainability perspective, a map to solve and handle the environmental, economic and social problems the world is going through, provides a great potential for industrial designers to decrease the negative effects of production and consumption which makes the design education even more important.

The relation of design curriculum and course approaches with sustainability aspects affects to what extent designers gain the ability of sustainable thinking. As a consequence of the increase in sustainability awareness in higher education, specialized courses focusing on sustainable design are integrated into design education. However, in order to make future designers internalize sustainability and make them interpret it right, the whole curriculum of the program should have the sustainable perspective rather than having only specialized classes about it. The integration of sustainability into whole courses offered in design education is significant to emphasize that sustainability is an integral part of design practice and theory today.

In this paper, the model-making courses in design programs of universities from Turkey are examined to understand the significance of the sustainability approach in the syllabus and also during model-making workshops.

Model-making courses mostly offered in the early semesters of undergraduate education and through the course, students experience different materials and production methods while building three dimensional presentation models to demonstrate their design ideas. Forming the materials manually is in the center of industrial design education since the Bauhaus (Evans et al., 2005; Heskett, 1980; Whitford, 1984). Through the physical interaction of designer with the material, the possibility of effecting the decision making and shaping the design development emerges (Evans et al., 2005). Also, model-making helps students on evaluating the structure, material and production methods (Hallgrímsson, 2012). Due to the nature of model-making process, students have to face environmental, economic and social issues, which force them to develop solutions to these problems. Physical model-making is an instructive tool to gather information about how to produce a specific shape with less energy, material and harm. Vezzoli points out the importance of material selection phase and emphasizes reduction of material consumption, nontoxic and harmless material selection, biodegradable and renewable material selection, and extending material lifetime (2014).

On the other hand, since sustainability is an approach considering the whole life cycle of a product which includes design process of products (Vezzoli & Manzini, 2008), the amount of consumed energy and materials during design process and their results are important, too. Therefore, the materials chosen for model-making, the amount of material consumed, and the end of life process of model are also examined to evaluate sustainability.

Within the light of mentioned views, this paper aims to determine sustainability perspective of design schools in Turkey through examining model-making courses in chosen sample universities offering product design bachelor's degree. Other goals of the study are to examine teaching practice and content of model-making courses in the context of sustainability, to state approaches and practices of model-making instructors on sustainability, and also to make suggestions to pave a more sustainable way to model-making process.

In the literature review part of the study, effects of sustainability agenda on education field are indicated from two perspectives. Firstly, the integration of sustainability into university curriculum is examined and effective declarations for this process are mentioned. Secondly, the integration of sustainability into operational practices of universities is investigated. For this purpose, sustainable campus networks and initiatives are examined that evaluate and guide universities to have more sustainable processes. After generally investigating the integration of sustainability into university education, the integration of sustainability into industrial design field is sought specifically to understand the effect and development of sustainability approach in industrial design. Approaches related to material usage are explained detailed which are minimizing resource consumption, selecting low impact resources and extending the lifespan of materials through recycling and reusing. The curriculums of industrial design programs from Turkey are examined to understand the place of sustainability in industrial design undergraduate education. And also, graduate courses and research areas are detected to see the tendency to sustainability in design research. The sustainability becomes more of an issue in design practice and education in industrial design programs in Turkey, since there are undergraduate and graduate courses focused on sustainable design.

After gathering information on sustainability and education, the methods, tools and materials used in model-making courses are 3odellinin terms of sustainability. In the context of the study, the courses offered for teaching model-making in industrial design education in Turkey were determined. After that, the literature indicating the relationship of model-making and sustainability is reviewed. Sample practices of design programs on model-making materials selection, reuse and recycle are mentioned to address the sustainability approach in model-making process. This part of the study indicates that there is a strong relationship between model-making and sustainability but there is not any common practice regulating which and how materials should be used during design education.

2. METHODOLOGY

As the main research method, semi-structured interviews with six model-making course instructors were conducted

to analyze model-making courses and approaches in terms of sustainability. In the sampling phase of this study, in addition to the universities from Turkey which are World Design Organization (WDO) members, the universities specialized in model-making and Mimar Sinan Fine Arts University, having the earliest industrial design department in Turkey, were chosen. Ozyegin University, Middle East Technical University and Istanbul Technical University were chosen among WDO member universities in Turkey. Kadir Has University and Anadolu University were added to the sample due to the FabLabs they have for model-making. The list of chosen universities is given in Table 2.1 sorted by interview date.

[Table 2.1] The chosen universities and instructors for the interview

University, City	WDO member	Instructor	Date of interview
Kadir Has University, Istanbul	No	Dr. Cinar Narter	17-4-2018
Mimar Sinan Fine Arts University, Istanbul	No	Asst. Prof. Oguz Eratac	18-4-2018
Ozyegin University, Istanbul	Yes	Inst. Fuat Ari	24-4-18
Middle East Technical University, Ankara	Yes	Dr. Mehtap Ozturk Sengul	27-4-18
Istanbul Technical University, Istanbul	Yes*	Inst. Mehmet Erkok	7-5-18
Anadolu University, Eskisehir	No	Inst. Zeynep Baskici Kapkin	16-5-18

* Istanbul Technical University's WDO membership has ended after the date of interview.

The instructors of the model-making courses were interviewed with the aim of understanding how the content of the course is related to the sustainability and finding out the approaches of both the instructors and the universities. Each instructor answered 12 questions which examine topics like the materials used during the course, model-making material research, approach on minimizing the effects of consumed materials, recycling and reusing abilities and thoughts of instructors for a more sustainable model-making class. During the semi-structured interviews, below questions were asked to the instructors:

- Which model-making courses do you teach? How long have you been teaching the course?
- Could you explain the course content briefly?
- Have you revised the course syllabus and added different topics to the course in time?
- Which materials are preferred mostly in model-making?
- Which characteristics of materials are more effective when choosing the model-making materials? Do you give advice to the students during material selection?
- Are there any forbidden materials in model-making course?
- Is there any forbidden surface treatment due to environmental or health effects?
- Are the students encouraged to discover different materials and methods for model-making?
- Does the course include topics about reducing environmental effects of materials?
- How is the process for remaining materials and physical models which are not needed anymore? Are the students directed to recycle and reuse? Is there any regulation and process of the university for recycling or reusing?
- How does the course affect students' habits of model-making material using, when the course is completed?
- What kind of topics and events can be integrated to the course for students to gain sustainable material using habits?

After the interviews, voice record of the interviewees were transcribed into text for the analysis.

3. RESULTS AND ANALYSIS

Firstly, the courses on model-making offered in design programs are listed according to the information gathered from instructors. Since the study is based on the sustainability in model-making classes, it is also given in Table 3.1 whether there are specialized sustainability courses and course content in the design program.

[Table 3.1] Model-making and sustainability courses in sample universities

Offered model-making courses	Offered sustainability	Courses	Sustainability integration into whole curriculum
Kadir Has University (KHU)	Mock-up and Prototype	Sustainability in Industrial Design	Unknown
Mimar Sinan Fine Arts University (MSFAU)	Model making-1, Model making-2	None	No
Ozyegin University (OZU)	Model making	Sustainable Design Research	Unknown
Middle East Technical University (METU)	Atelier and computer internship	None	Yes

Istanbul Technical University (ITU)	Model making-1, Model making-2, Advanced model making techniques	Sustainable Product Design	Unknown
Anadolu University (AU)	Model making techniques	Sustainable Design Atelier	Unknown

According to the expressions of course instructors, there are differences between model-making course syllabuses. After the comparison of model-making course contents, this study shows that courses generally focus on three alternatives: model and prototype, only presentation model or all model types that student needs during design projects including mock-ups. Based on the interview results, when model-making process is more focused on temperance quality of the model, this leaves the sustainability dimension of model-making out of concern.

After the analysis of the interviews, findings are gathered in main categories like materials used in courses, disposal of materials, safety and health issues in courses, the content of courses and the model-making instructors' approaches. In the following, the answers concentrating on model-making material preferences and relationship of model-making and sustainability will be mentioned.

3.1. Selection of Model-making Materials

According to the findings on material preferences of instructors, as seen in Table 3.2, paperboard and wood are the materials which used in all design schools. Aluminum, PS foam and plaster are widely used materials in four schools out of six.

Materials which are harmful for humans and environment are sometimes chosen for training model-making by instructors. Especially polyurethane (PU) foam is a debatable material containing carcinogenic ingredients but, due to easy and speedy forming ability of PU foam, the material may be preferred for physical models. Another easy shaped and widely used material is polystyrene (PS) foam, whose recycling is problematic due to high costs and materials' lightweight which result in environmental pollution.

[Table 3.2] Materials used in model-making courses

	Paperboard	Foamcore	Acrylic	Acetate	Forex	Aluminium	Poliester	PS foam	PU foam	Silicon	Ceramics	Clay	Wood	Plaster	Concrete
KHU	+		+			+	+			+			+		
MSFAU	+		+			+	+			+			+		
OZU	+	+		+	+			+	+			+	+	+	
METU	+					+		+	+				+	+	+
ITU	+		+		+	+	+	+		+		+	+	+	
AU	+	+						+			+		+	+	+

Although one instructor mentioned that it is forbidden to use hazardous materials both during the course and in their university (METU), it is seen in Table 3.3 that the most effective criteria when selecting material is the easy and speedy forming ability of the material. In two schools, PU and PS foam are not advised to use in model-making, not because of harmful effects of the materials, instead, due to the easy shaped nature of the foam which is acknowledged as difficult to control the geometry of physical model. Some instructors claimed that they adapted the model-making syllabus for avoiding hazardous processes like polyester molding and spray painting. In METU and AU, polyester molding is removed from the course syllabus because of emitted hazardous gases during molding. Only in METU, solvent based paints and adhesives are banned throughout the university, although there is a sufficient ventilation system in the model-making atelier. In other sample schools, a comprehensive regulation is not applied.

[Table 3.3] Factors for material selection and forbidden/undesired materials

	Most important properties affecting material selection	Forbidden materials	Undesired materials
KHU	Easy forming, possibility of fixing	-	PU and PS foam
MSFAU	Strengthening geometry perception, Suitability to form in various places	PU and PS foam	-
OZU	Easy access, Tools for shaping	-	Wood
METU	Easy forming, easy access, sustainability	Solvent based paints and adhesives	All environmentally hazardous materials
ITU	Similarity to final products material	-	-
AU	Easy forming, possibility of fixing, cost	-	Polyester

3.2. Sustainability and Model-making

The issue of recycling and reusing of materials is also problematic for some universities. In most of the sample universities, the recycling process is unclear. The waste is not separated in model-making atelier and it is believed that the waste is separated later in recycling area. It is seen that some waste emerged from model-making process is not recyclable, but it is not regarded mostly. In five universities, it is claimed that there are boxes or a special



room in ateliers for students to leave left-over materials, but it is also mentioned that the efficiency of reusing is not enough. Especially materials such as wood, acrylic, paperboard, PS foam are aimed to collect for reuse. In Figure 1, different material storing solutions in model ateliers for left-over materials after model-making process are seen. It is important to store these materials in separate boxes systematically, otherwise, reusing is not achieved properly.

[Figure 1] Containers for left over materials in ateliers

Four out of six instructors mentioned that they teach how to consume lesser material and reduce scraps in model-making, which is an important issue since students learn the methods of reducing material consumption.

Since the obligation of work safety regulations, the workspaces have been controlled to avoid injuries and unhealthy circumstances during working. In model-making courses the instructors care about these rules and take precaution to prevent students from having injuries during machine use in atelier. There are forbidden machines that students cannot use without the help of a technician or instructor due to safety reasons.

Another problematic area in the ateliers the efficiency of air conditioning, which is substantial to remove not only dust occurred during forming materials like wood and foam, and also gases emerged from casting polyester in atelier. For painting process, which is one of the dirtiest sectors in industry, specialized booth or paint oven is needed with an aspirator system. In most universities, there are not comprehensive solutions for painting process, which is argued by instructors. It is also mentioned by the instructor having the most sustainability-sensitive Godellingcourse that the existence of a good quality air conditioning does not mean that it is okay to use paints containing hazardous chemicals. In fact, this approach on air conditioning is unique, since in other universities a complete sustainability approach, regarding the environment as a whole, is not detected. Generally, hazardous materials and processes in model-making are not regarded in most universities, if there is an air conditioning system in atelier.

3.3. General Findings

In the following, the findings of the interviews are summarized.

a). Materials used in model-making courses:

The ease and fastness of shaping is important for material selection.

There are hazardous model-making materials for health and environment.

Universities may ban a material due to hazardous content.

b). Elimination of used materials:

How to dispose model-making materials is mostly unknown.

Scraps are thrown into containers without separating according to material type.

Some of the waste cannot recycle.

c). Syllabus of model-making courses:

In courses, instructors aim to show different kind of materials as possible.

The model-making course content and the focus is not same in all design schools. There are three alternative types: Model and prototyping, only presentation model or whole type of models.

In some courses, safety and work health topics are integrated.

d). Approaches of course instructors:

The syllabus of model-making course depends on the approach of the instructor. This causes different model-making course types having focuses such as safety, sustainability or appearance of models.

4. DISCUSSION

The model-making courses and approaches can be examined from two point of views. Firstly, the course can be regarded as a tool to raise awareness on sustainability issue through material and process selection. Design instructors usually direct students to prefer materials which are easily and fast taking form and due to the focus on rapidness, it is not regarded mostly how the materials produced, disassembled, disposed and reused (Gerber et al., 2010). Amount of consumed materials for physical models are ignored when compared to production processes. In fact, the main problem is the habit of consuming gained by students through courses (Gerber et al., 2010).

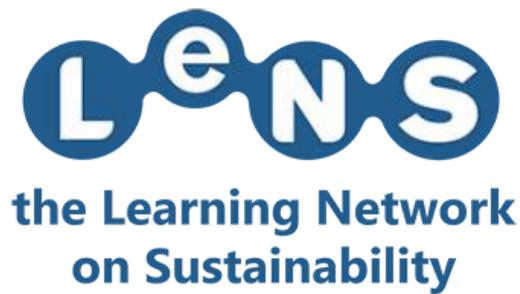
Since the students and also in some cases instructors do not have comprehensive information about the materials and techniques they prefer, there should be a material guide showing the hazardous materials with alternative materials and suggesting more sustainable methods for model-making from environmental, health and economic point of views. Subjects like resource minimization, recycling, reusing can be added to course content to raise awareness of students not only during model-making but also during deciding on materials and production methods, with which the students' first meet is in the modeling course mostly. One of the main objectives of model-making which provides an experience with real materials can be gaining the ability of choosing sustainability-oriented solutions.

Furthermore, the model must be regarded as a product consumed to demonstrate the design idea. The model-making course is naturally required to consume materials to build three-dimensional physical models but these models, in fact, have their own life cycle as products which means the materials of models would be better reused or recycled when the need for the product is over. From this perspective, the model-making can be reconsidered and re-designed caring the whole life cycle of the model. The processes preventing sustainable end of life options should be questioned. It is also necessary to find out new model-making materials having easy and fast forming ability, being recyclable and not containing harmful ingredients. Through new material research, new alternative materials should be added to model-making materials, which are superior from sustainable point of view (Hallgrímsson, 2012).

Since the approach of the instructor and the university is effective on the model-making course syllabus, some of the courses seem to care more safety regulations or sustainability than others. If there is a general guidance across the university for recycling and permitted chemicals to use, the model-making course reflects it in its syllabus also. One of the main results of the study is that there is an urgent need for complete sustainability approach covering whole curriculum and operations of the university. Only in that case, it is feasible to design a model-making course regarding safety, health, environmental and economic side effects. Otherwise, sustainability being a complete approach having environmental, economic and social points is not achieved truly.

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SUSTAINABILITY IN UNDERGRADUATE ARCHITECTURAL EDUCATION: A CASE STUDY FROM KAZGASA, KAZAKHSTAN

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ABSTRACT

The research explores the broad topic of sustainability in higher education institutions (HEIs) and offers unique country-based perspective by focusing on undergraduate architectural education in Kazakhstan. Specifically, it examines the Kazakh Leading Academy of Architecture and Civil Engineering (KazGASA), a leading HEI in Kazakhstan in the fields of architecture and design.

A thematic literature review includes sustainability in higher education, integration of sustainability in HEI, sustainability in architectural-design education; as well as the state of sustainability initiatives in the country's government and education system.

14 semi-structured interviews were conducted with faculty, administration and students of KazGASA. The interview findings helped to understand the level of integration of sustainability topics in KazGASA and identify barriers and opportunities for the integration of sustainability.

The recommendations are suggested based on interview findings, literature review, and secondary research on the education system in Kazakhstan.

Keywords: sustainability in architectural education, systems approach, education system in Kazakhstan, KazGASA.

1. INTRODUCTION

Since gaining independence in 1991, the Republic of Kazakhstan, just like other post-Soviet countries, went through extensive economic reforms and the challenge of accepting new social and environmental policies (Kukeyeva et al., 2013). In 2012, the government adopted the new Kazakhstan 2050 Strategy (Strategy 2050, n.d.). Also, in 2012 President Nazarbayev signed the United Nations 2030 Agenda and committed to its 17 Sustainable Development Goals (SDGs) (e.gov, 2017). The overall goal is to bring into action the interrelationship between government strategic programs and international commitments (Statistics Committee, 2016) through widespread economic, social and political reforms to position the country among the thirty most developed countries in the world by 2050. However, while being discussed on the government level, the sustainable development (SD) paradigm is still unfamiliar to average Kazakhstani citizens. SD is not considered as a priority by the Ministry of Education and Science (the MES), and there is little mentioning of SDGs in the MES strategic plan for 2017-2021.

Nevertheless, education is an essential factor to achieve the UN SDGs with its own dedicated goal #4 (UN, 2015). Due to the urgency of societal transition towards sustainability, within the architectural-design field, the education should be reformed to develop professional responsibility and individualistic ethics (Findeli, 2001) among future architects and designers regarding sustainability challenges.

Kazakh Leading Academy of Architecture and Civil Engineering (KazGASA) is a leading HEI in the fields of architecture and design in Kazakhstan and ranked first in the country. The academy is located in Almaty and has five main faculties: 1) Faculty of Architecture 2) Faculty of Design 3) Faculty of General Construction (Civil Engineering) 4) Faculty of General Educational Discipline 5) Faculty of Construction Technologies, Infrastructure and Management. Moreover, KazGASA heads the methodological union of 9 architectural schools in the country and has a significant influence on architectural education, affecting the entire architectural industry in the country.

Consequently, the empirical case study research looks into the state of the sustainability topics in undergraduate architectural education experience in KazGASA to glance into the broader issue of sustainability in the higher education system in Kazakhstan. The research is part of a master's thesis work for Master of Arts in Creative Sustainability programme, Aalto University.

2. THEORETICAL BACKGROUND

2.1. Integrating sustainability in higher educational institutions (HEIs)

Sustainability is a wicked problem, meaning that the challenges are difficult or even impossible to solve and there are no templates to follow (Rittel & Webber, 1973). HEIs contribute to wicked sustainability issues through the production and transmission of knowledge (Coincencao et al., 2006 as cited in Ferrer-Balas et al., 2010). Whether the contribution is beneficial or not at the moment, HEIs bear a moral responsibility to increase the awareness, knowledge, skills, and values needed to make a vision of sustainable future into reality (Cortese, 2003).

Cortese (2003) further argues that to integrate sustainability in HEIs, for areas of practice should be considered: 1) education -expanding sustainability themes in curricula; 2) research, including moving beyond specialized disciplines towards inter-, multi-, trans-disciplinary knowledge building; 3) university operations consisting of corporate social responsibility and campus operations; 4) finally, improving community outreach and partnerships. Sharp (2002) states that there should be a more in-depth understanding of universities as complex organizations with three distinct subcultures that have different decision-making practices, priorities and goals: students, faculty, and administration. Moreover, there are extensive barriers that HEIs face in terms of implementing sustainability initiatives such as specialized disciplines and fragmented knowledge (Cortese, 2003); lack of awareness and motivation to integrate sustainability topics (Velazquez et al., 2005); denial or resistance to change (Velazquez et al., 2005); misdirected criteria for evaluation and lack of clear evaluation indicators (Velazquez et al., 2005; Moore, 2005). Organizational change in HEIs towards sustainable development paradigm can happen when people from each subculture set up their own priority to make the change happen (Sharp, 2002), utilizing stakeholder dialogue and infusing sustainability in all decisions (Lidgren et al., 2006).

2.2. Sustainability in architectural-design education

Although, the awareness and responsibility regarding sustainability challenges are growing worldwide. Although the awareness and responsibility regarding sustainability challenges are growing worldwide in architectural field, there are challenges such as 1) an assumption that clients' demands are often driven by aesthetic appearance and cost reduction rather than by a commitment to sustainability (Altomonte et al., 2012); 2) focus on a solution rather than problem in the development of design (Altomonte, 2009).

In architectural education there is 1) an assumption that pro-environmental and socially inclusive factors are fundamental to the good design, implying that they are already part of education and there is no need to address them outside of standard theory and studio courses; and 2) extensive focus on technical subjects such as climate control (HVAC), occupational safety and comfort, energy efficiency (Wright, 2003). To transform architectural education, it is critical to focus on how to teach and what is being taught by transforming the curriculum, studio teaching, supporting student leadership, and integrating students and faculty into the planning of campus facilities

(Glyphis, 2001). Moreover, the educational experience should combine both technical and holistic issues of sustainability (Altomonte et al., 2012), and include sustainability topics as a continuous thread throughout all years of education (Iulo et al., 2013).

2.3. Education System in Kazakhstan

Since gaining independence, the education system in Kazakhstan went through 4 stages of major reorganisation (Kukeyeva et al., 2013), and the last step started in 2010 when the country signed the Bologna Declaration.

The MES is responsible for implementing unified state policy, coordinating activities of local executive bodies in the field of education, as well as manage the integration of international programmes in the field of education and science (EACEA, 2017). As a result, HEIs in the country have very limited independence, and the decisions regarding curriculum and organisational structure of institutions are dependent on the MES.

The MES strategic plan for 2017-2021 emphasises the importance of improving the quality of education and upgrading the organisational structure of HEIs to meet international market demands and increase the competitiveness of university graduates on the local and international level. However, considering the ambitious goal of joining 30 most developed countries in the world, there is a lack of attention towards education for sustainability in both Strategy 2050 and the MES Strategic plan.

Nevertheless, in 2018, the government of RK approved the first draft bill about expanding the academic freedom and independence of HEIs from the state standards established by the MES. The proposal will allow HEIs to define the content of study programmes independently, which offers an opportunity to increase sustainability activities within an institution without state coordination (Davydova, 2018).

3. METHODOLOGY

The research started with the questions: What is the status of sustainability initiatives in KazGASA? Who are the stakeholders in KazGASA? How does the decision-making process happen in KazGASA? What is the level of integration of sustainability topics in undergraduate architectural education experience in KazGASA? Where are the opportunities and barriers for integration of sustainability in KazGASA?

An empirical case study took place throughout one year and consisted of 2 field trips to Almaty and semi-structured interviews conducted with 14 people among faculty and students in the Department of Architecture, and academic administration in KazGASA. Interviews were anonymous and carried out on Russian and Kazakh. The conversations were recorded with the permission, and next transcribed or noted in detail depending on the content relevance. Afterwards, transcribes were translated into English by looking into the broader context and selecting words with most accurate interpretation.

Translated documents were further analysed to define core categories and sub-categories (Glasser and Strauss, 1967 as cited in Cousin, 2009). Only findings mentioned by several people were categorized in categories included such “understanding sustainability”. In the end, all the interviews were re-read to retain the narrative value (Cousin, 2009).

4. RESEARCH RESULTS

4.1. Sustainability in KazGASA

Participants had divided opinion about the level of integration of sustainability topics in undergraduate architectural education experience in KazGASA. Some teachers believed that pro-environmental and socially inclusive factors are fundamental to the good architectural design and are already part of the existing curriculum. However, at the same time, it was acknowledged that while sustainability topics are included in lectures, there is lack of practical application during the architectural studio course. Other teachers did not share the enthusiasm of their colleagues, highlighting that there is still a long path to take as there is no top-down initiative for the integration of SD on the organisational level and sustainability is not considered as a priority.

4.1.1 Energy-efficiency

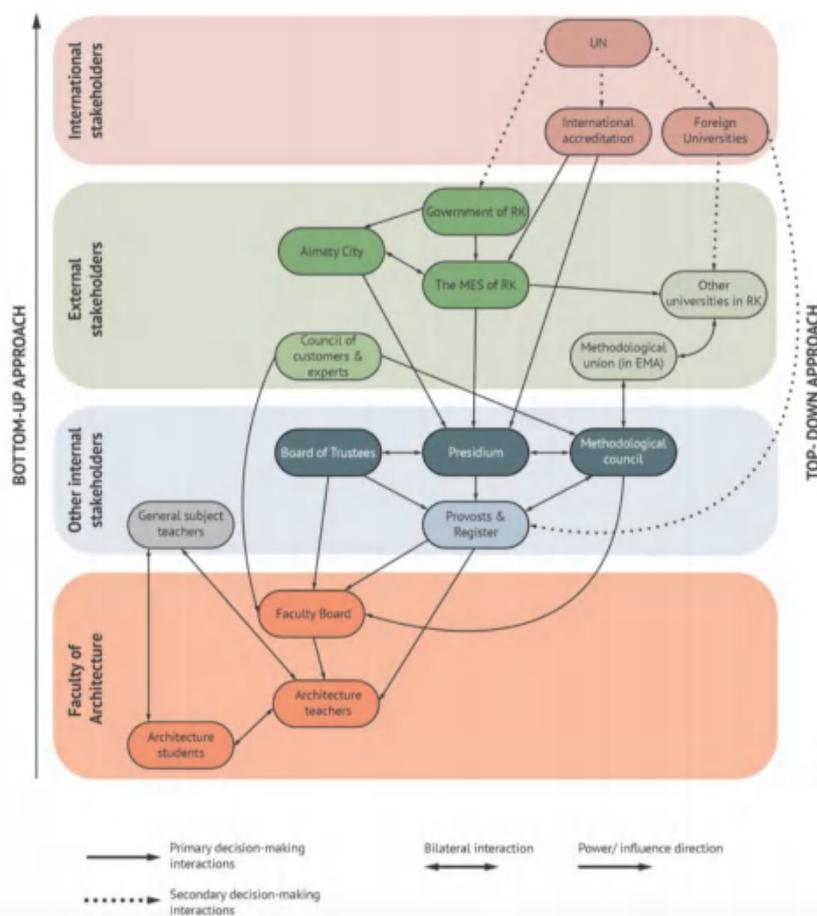
In 2012, in cooperation with UNDP KazGASA introduced a course on energy-efficient building design on the undergraduate level. “Design of energy-efficient building” course is taught during the 3rd year. Students learn about passive housing; energy efficient technologies in building design; LEED, BREEAM certification schemes; and examine global and local case studies. According to students, many of them learn about sustainability and energy-efficiency in architecture first-time during this particular course. However, the course aims to give practical and technical knowledge, without a holistic and systemic view of challenges.

4.1.2 Regionalism

In terms of cultural sustainability, Regionalism or Regional architecture is the principal academic focus in KazGASA. After the collapse of the Soviet Union, the interest in traditions and cultural roots have been increasing in Kazakhstan. KazGASA aims to teach students about the regional architectural character of Central Asia and what solutions are suitable for local climatic, social and cultural conditions.

4.2. Decision-making process in KazGASA

There is a complex interaction of stakeholders in the process of decision and change making in the Faculty of Architecture of KazGASA. Stakeholders could be categorised as internal and external. Internal stakeholders include architecture students, teachers, and faculty board; as well as other departments, presidium and Board of Trustees of KazGASA, and methodological council on the academy level. External stakeholders are Almaty city, the government of



RK, the MES, Council of Customers & Experts (or labour market), methodological union of architectural schools, and other universities. International stakeholders such as UN, international accreditation schemes, and partnering foreign universities have a collateral role in the process.

[Figure 1] Decision-making process and stakeholders' interaction in KazGASA from bottom up (primary decision-making interactions) or top-down (secondary decision-making interactions) approaches (Nsanbayeva, 2019)

4.3. Barriers and opportunities to the integration of sustainability initiatives in KazGASA

Barriers to integration of sustainability initiatives in KazGASA include:

- Bureaucracy and administrative bottlenecks in the education and overall government system.
- A formal approach to education both among teachers: filling paper for teachers and passing exams for students -instead of getting good knowledge (intrinsic learning).
- No mentioning of sustainability and sustainable development in the mission of KazGASA and no strategic decision to integrate it.
- Low level of primary education in terms of sustainability topics.
- A gap between theory and practical application of knowledge in the design process.
- The resistance to change among some teachers.
- High student/ teacher ratio: there are 25 students per 1 teacher, but it used to be 7 students.
- Communication barrier between teachers and students. Students have low trust in the academy and feel reluctant to share their opinions with teachers.

However, despite those barriers and complex decision-making interaction of stakeholders (Figure 1), a collaborative decision-making process exists in KazGASA. A single person or a group cannot make decisions in the academy without a dialogue that involves both internal and external stakeholders. Committed individuals are another strength of the academy. Teachers are passionate about their subjects. While sustainability is not a teaching priority, teachers are open to new ideas and opportunities, especially, due to the participation in international academic events.

Although students' influence in the decision-making process is indirect, student respondents showed interest in sustainability topics. Despite overall negative attitude towards the academy, students appreciated extra-curricular activi-

ties, such as Olympiads, scientific conferences and student competitions organised by KazGASA, that allowed them to work on design challenges beyond the standard study programme and communicate one-to-one with teachers.

5. DISCUSSION

The suggested recommendations below are based on interview findings (barrier and opportunities), literature review (integrating sustainability in HEIs), and secondary research on the education system in Kazakhstan (Nsanbayeva, 2019):

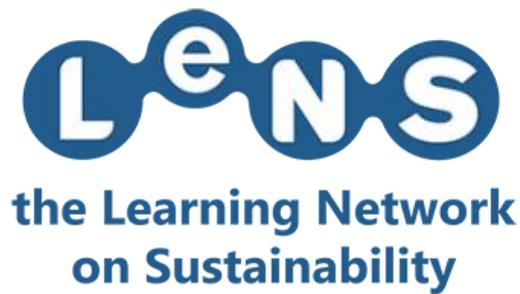
- Maintain quality of education despite increasing inflow of students by relieving the workload of teachers and increasing number of teachers.
- Suggestions: TA positions for students to help teachers with the workload and to instigate their interests in teaching.
- Improve trust of students towards the academy and remove the communication barrier between student and teachers.
- Suggestions: Have surveys result more open for discussion students and the general public to showcase that their voices matter.
- Next step in future: Based on the current surveying procedure, measure sustainability performance of the campus by having appropriate instruments for monitoring, analysing and controlling sustainability initiatives (Velazquez et al., 2006).
- Use the MES draft on academic freedom as the window of opportunity to develop strategies to implement sustainability in education, research, outreach and partnership, and campus operation.
- Improve stakeholder dialogue (Lidgren et al., 2006) by increasing the involvement of students in the collaborative decision-making processor
- Next step in future: Establish a sustainability committee (Velazquez et al., 2006).
- Avoid formal bureaucratic approach to education prevalent now in KazGASa by emphasizing intrinsic values of education (Sterling, 2010) such as the depth of learning experience and professional ethics and responsibility
- Next step in future: Include sustainability as one of the core values in the academy's mission (Velazquez et al., 2006) to reflect professional responsibility.
- Increase exposure to international academic and architectural community to challenge the existing mental models in KazGASA.
- Next step in future: Conceptualize sustainability (Velazquez et al., 2006) and what it means for the academy. Foremost, it is essential to define the terms sustainability and sustainable development in the academy's mission and policies.

However, the research was limited in terms of time spent in KazGASA, which restricted the number of interviews too. With only the limited snapshot, it would have been pretentious to propose a vision or development scenario for KazGASA. However, recommendations above aim to address both urgent issues in KazGASA in terms of improving the quality of education, as well as suggest future steps based on the literature review. Future designedly research could involve all stakeholders and organize co-design workshop to develop scenarios for the sustainable future of KazGASA.

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ENCOURAGING DFE IN DESIGN EDUCATION TO PROMOTE SUSTAINABLE MEDICAL PRODUCT DESIGN

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ABSTRACT

Without disputing the importance of eco-design and sustainability in design education, there is little evidence of work specifically targeting sustainable medical solutions. Developing medical devices is complex, financially risky, requires large upfront investment and involves long lead times to market. In global design education today, the rigour and necessary focus on safety and efficacy of medical devices has meant that efforts to minimize environmental impact are often deprioritized or postponed, but increasingly emphasising on providing guidance to firms.

This exploratory study aims at understanding how design education affects DfE implementation in the process of designing medical products. 54 healthcare and medical design programs were identified online and analysed based on the information they provide on their websites. The surveys and the following analysis of the data helped highlight some of the problems in design education and open the platform for future work in environment conscious design education.

Key Words: Design for Environment, Medical Design, Design Education

1. INTRODUCTION

As the understanding of design and its complexities increases, today we stand, a century after the birth of the Staatliches Bauhaus, with new challenges to the purpose and role of design in shaping the world around us. As eloquently put by Findeli, (2001) “..design could not only contribute to a sustainable natural world, but would adopt as a purpose something such as: “A balanced humankind in a balanced world,”...”. Here, he refers to the need to use design to address the concerns of our biophysical, social and cultural environment, and in effect address the human condition. To do this, the design curriculum should be developed using anthropology and cosmology as the two polar complementaries (Findeli, 2001).

The medical industry is highly wasteful in its processes and resource consumption. A study by Minoglou et al. (2017) observed the healthcare waste generated by 42 countries and their associated GDPs. The average amount of waste generated by a patient per hospital per day ranges from 0.44 kg in countries like Mauritius to 8.4 kg in the US. It was observed that countries with a higher GDP tended to produce higher quantities of health care waste (Minoglou et al., 2017). With the emergence of new markets and the rise of an ageing population, the industry is predicted to grow further (Deloitte, 2016). This may indicate a rise in health care waste, and associated problems. How does this waste impact the environment and human health? Apart from unregulated abuse of land, the toxic substances in the waste leach into the soil and the water table, and scavengers carry pathogens through the air. The poor ventilation of large piles of rubbish also leads to the production of Carbon di oxide and Methane, thus contributing to GHG emissions.

An exploratory study conducted by Moultrie et al. (2015) surveyed 34 medical device designers regarding the barriers to implementing Design for Environment (DfE) principles in the practice of designing medical devices. The survey indicated that one of the urgent issues to tackle in the medical device industry regarding this subject was the education of designers and clients to implement DfE (Moultrie et al., 2015). Although this does not indicate an absolute lack of sustainability education in design education for medical devices, it may indicate inconsistencies. According to the survey, currently the only institutes that are involved in educating the designers and manufacturers about sustainability are the regulatory bodies. Just like education in law and medicine is highly driven by the set protocols and regulations followed by the country, it may become important to educate students about regulations in manufacturing to ensure that students are up to speed with acceptable norms of practice in design for medical devices.

Back in 2007, Ramirez surveyed the inclusion of sustainability in design programs around the world (Ramirez, 2007). He concluded that although designers were well aware of the concept of sustainability, and it was actively taught in design programs at the higher education level, it did not have the importance and value that it needs (Ramirez, 2007).

In this study, we look at the emerging trend of specialised design programs catered towards healthcare and medical technology, and how they respond to the global need for sustainable solutions.

2. THE CURRENT STATE OF DESIGN EDUCATION IN HEALTHCARE

Today, there is a strong focus on design for healthcare and medical technology with many higher education institutes offering dedicated programs in this area. In this study, we have compiled a list of dedicated programs around the world offering design education for healthcare and medical technology. The list includes degree programs, certificate programs, and diploma programs. Multiple programs on bioengineering, bioinnovation and industrial design were found in which a part of the focus was on medical devices and healthcare, but these are not included in the scope of this paper. The list does not include short courses, courses within other programs or fellowship programs. The list also does not include programs that may be valid, but do not provide a relevant website for course information. This list was created by conducting google searches with the following four phrases ‘healthcare design program’, ‘healthcare design course’, ‘medical design program’, and ‘medical design course’. For the complete list, please refer to Appendix I.

The purpose of this list is to give the reader an idea of the emerging trend in design education catered towards healthcare and medical devices, and lay emphasis on how these programs pay attention to sustainability through their pedagogy. The purpose of this list is neither to exhaustively collate all healthcare-oriented design programs, nor is it to pin-point the triumphs and failures of specific programs in how they address the concept of ecological preservation. The course content of the identified programs was analysed and has been presented in this paper as a discussion.

The search resulted in the identification of 54 distinct programs. Out of the 54 programs identified, 26 programs were Masters level, 17 programs were certificate level, 7 bachelor’s level, and 2 each doctoral and diploma level. Out of the 17 certificate programs, 7 were online courses. 10 programs used the word ‘sustainable/sustainability’ in their program description. 9 programs mentioned ‘systems thinking’ in their description of taught modules. Two programs mentioned that they focus on lean thinking and six sigma principles. Two other programs emphasized on efficient use of resources. There were three programs that broadly looked at solving real-world problems. 21 programs had no descriptions that even vaguely focused on sustainability as part of the learning provided to the students. University of Leeds adds education in sustainability through the ethics module. But sustainability is only one of six examples of topics covered on their website. A word search on the program description pages of most of the other programs showed that they did not use the word ‘ethics/ethical’.

Most programs identified are based in English-speaking countries, with USA accounting for 22 programs

and United Kingdom accounting for another 14. In figure 2, the size of the dots used to locate programs is directly proportional to the number of programs identified in the city. There were 4 programs identified running just from Dublin, while another 3 were found in London.

3. THE 5 ASPECTS OF SUSTAINABILITY IN DESIGN EDUCATION

A study by Ramirez et al., (2016) explores the role of sustainable product service systems in industrial design education in Australia. Through case studies of student projects on climate and resource scarcity, mobility and health, Ramirez et al. show the embedded understanding of sustainability in these projects, and thus the permeation of sustainability in industrial design education. One can argue that sustainability becomes an embedded value in design when the need is apparent (as exemplified by Australia's scarce water resources), and thus it is taught purely as an ex-post practice. But what about design as an ex-ante practice, preparing for future scenarios and as an attempt to minimize the impact of our consumption today?

Although the Talliores Declaration (ULSF, 1990) did set the precedence for universities to acknowledge and commit to environmental sustainability in higher education, it was not enough to convince the signatories to adopt and implement impactful measures in their curricula (Ramirez 2015). As Ramirez (2015) clarifies in his elaborate survey on industrial design programs offered by the Talloires Declaration signatories, even though 80% of the degree programs do cover, or intend to cover aspects of sustainability in their programs, there is very little evidence in the form of student projects to validate this learning.

With the concept of sustainability not yet realised in industrial design education, where does sustainability in design education fit with healthcare and medical products? An important aspect of medical devices is sterilization. Every product, before and after its use, must be sterilized to ensure that patients do not get infected by exposed devices, and pathogens are not released into the environment from non-sterile equipment. The stakes are also very high in the case of the healthcare industry because medical negligence has a high cost associated, often causing lawsuits which can be financially demanding, and degrading the reputation of the organization responsible. At the same time, the waste generated from healthcare industries is highly toxic and pollutive. How can complex issues such as these be understood and resolved through design education?

Here we discuss five ways of strengthening the value of sustainability in design education, each bearing its own merits and implications.

3.1 Pedagogy of design in higher education

When looking at it from a pedagogical point of view, we must question how teaching can be structured in an undergraduate program of three years, or a postgraduate program of 2 years. It is also important to question the essentials of design education, what they should comprise of, and where does sustainability play a role. Is sustainability one aspect of the education, or is it fundamental to design as a subject? Is it an over-arching theme, or is it an essential part of the process? One way to encourage a holistic understanding of the context is to introduce systems thinking in design education. To encourage students to look beyond their skillset, and appreciate the complexity of the systems they live in, has shown to bring in concepts of sustainability and holistic decision making in the process. Of course, while design students and design teachers do acknowledge the role of sustainability in industrial forms of production and consumption, the reason it gets left simply as a keyword is that the subject in itself is far more complex than a lecture or seminar. It requires conscious practice, and imbibing it as part of the factors that impact its use and the context in which it is positioned. As Findeli (2001) mentions in his article, designers should be interested in the origin and destination of their project, and in doing so, be interested in the complexities of the end and the beginning. Only then will they get a glimpse of their impact and their thinking on a seemingly simple concept.

One way of introducing sustainability in design education is by creating relevant project briefs for students. Ramirez (2018) documents a Circular Economy Challenge that he had floated for third year Industrial Design students at UNSW. A survey questionnaire answered by the students at the end of the project showed that they were now more aware about the broader aspects of sustainability. The survey also showed that many students were motivated by this project to imbibe principles of sustainability in their own lives.

The 7 online courses identified in the study catered towards a theoretical understanding of the topic, and relied on the self-motivation of the students to apply the theory in practice. It is also important to mention here that each of these courses were offered by highly credible institutes and universities. More and more we see that students are less reliant on classroom teaching to understand theoretical concepts, and use their time at university to gain access to facilities that they may not get once they graduate from these institutes. In the case of design, especially in healthcare, online courses can be leveraged significantly, since healthcare and medicine are tremendously theory-driven, and require a good understanding of the regulations, healthcare systems, and the human physiology before attempting to find solutions.

3.2 Praxis, not limited to Poiesis

One of the many concerns of design education today is that, the teaching is focussed on the design process from idea generation to solution making. This covers essential concepts in the area of innovation and making, but it fails to address the role of the solution beyond its own use. Even the core definition of sustainability is not embedded in

design education today, because otherwise there would be a much stronger focus on how to sustain solutions. As the concept of value shifts from the product as an entity, to the agency it provides, the role of the designer must shift to finding a solution with or without making an object. “Making” is an important part of the job of a designer, but not the only part. “Not making” is an equally important part of a designer’s responsibility, if not more important sometimes (Findeli, (2001)).

3.3 Explicit or implicit

As observed with the course contents and program overview of the programs identified in the survey, most courses do not explicitly mention ‘sustainability’ in any form in their program. So the question here is, “should sustainability be made explicit in the course content of a program?”. Ideally, sustainability of solutions, be it social, environmental or technological, should be implicit in the designs produced. Sustainability is not a specialization or a silo of design education. It is a scientifically proven requirement in society and an ethical stance. Thus it, could be implicit in design education. But it is still not valued, as it involves rigour, time and money to create sustainable solutions. This dichotomy of making sustainability implicit or explicit in design education needs to be addressed. If sustainability is not a core focus of design, then it must be made explicit, to reiterate its importance.

3.4 The gap between design education and practice

One reason why sustainability in design education fails to follow through with professional practice is that the current industrial requirements do not emphasize on sustainable practices. There is a disconnect between the ethics of design practice and the industrial requirement. As the use-and-throw culture grows, there is less of a need for products to be easy to repair or recycle, and the focus remains purely on instant gratification and user satisfaction. Here, it is important to question the role of ethics in design education, and the transfer of design ethics to practice. It is important to emphasize the role of the consumer in wanting responsible and ethical practices in product design and manufacturing for it to seep into the requirements of clients and designers. As Moultrie et al. (2015) explain, the regulations are not stringent enough with medical devices when it comes to environmental impact, and result is that many devices use harmful quantities of toxic materials that degrade our environment after their use.

3.5 Sustainability of design education

So far we have discussed, how sustainability can be addressed in design education. But what about the sustainability of design education. While the concept of evaluations in most schools is still driven by individual efforts of the students, most designers end up working professionally in collaborative and team environments. The ability to use the individual’s voice for co-creation and constructive criticism is not developed when the focus of the education is on the individual. This lack of knowledge exchange between the students often means that the knowledge gained or created by an individual resides within the individual, restricting the transfer of knowledge to others in their environment. This could also be a reflection of society today, where the individual’s achievements are glorified over the team efforts to achieve mastery. To put designers on a pedestal of out-of-the-box thinking and masters of creativity is to isolate them and stifle the potential holistic development of a group. We are now beyond the age of silos of fields and disciplines, and well into the age of co-creation and inter-disciplinary value creation. The only way to encourage holistic thinking and include multiple perspectives is to encourage teamwork and interdisciplinary activities in design education.

4. DISCUSSION AND CONCLUSION

Sustainability is not an elective course or a hobby-subject. It is embedded in our concept of “living”. The term health is synonymous with sustenance. We can only sustain our lifestyle, our work, our activities and our thoughts while we sustain the physical and emotional manifestation of our individual identity. When health degrades, it affects everything we do and live for. This study not only indicates a growing focus in the role of design in healthcare, but also the need to relook at education in design, and how it affects us in different timescales.

We are the only species on this planet to have prolonged our individual lives, and hence our civilization by ensuring the sustained healthcare received by each individual. The same concepts apply to the products we build, the environment we live in, the people we cherish and the systems we create. While some things are inanimate, their sustenance, affects the larger consumption patterns we create, and these patterns have drastic effects on the delicate balance of the environment around us called Earth. To build sustainable solutions to our everyday problems is to build a sustainable future.

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APPENDIX I - GOOGLE SEARCH RESULTS BASED ON KEYWORDS USED

1. 'healthcare design program' (first 20 pages)
 - 1.1 Imperial College London (MSc Healthcare and Design)
 - 1.2 Royal College of Art (MRes Healthcare & Design)
 - 1.3 Kent State University (Master of Health Care Design)
 - 1.4 University College London (Healthcare Facilities MSc)
 - 1.5 New York School of Interior Design (Healthcare Interior Design)
 - 1.6 University of Minnesota (Health Care Design and Innovation Post-Baccalaureate Certificate)
 - 1.7 OCAD University (MDes Design for Health)
 - 1.8 University of Miami (Healthcare Design)
 - 1.9 University of Nevada (Master of Healthcare Interior Design)
 - 1.11 TU Eindhoven (PEng Healthcare Systems Design)
 - 1.12 Ball State University (Graduate Certificate in Planning Design of Healthcare)
 - 1.13 John Hopkins University (Design for Health)
 - 1.14 TU Delft/edX (Design in Healthcare)
 - 1.15 The New School (Human-Centered Healthcare)
 - 1.16 Texas Tech University (Health Care Facilities Design)
 - 1.17 Cornell University (Healthcare Facilities Planning and Design)
 - 1.18 University of Twente/Ahti/AMC (Healthcare Design)
2. 'healthcare design course' (first 20 pages)
 - 2.1 University of Dundee (MSc Design for Healthcare & Assistive Technologies)
 - 2.2 Staffordshire University (Graphic Design For Health Care PgCert)
 - 2.3 University of Nottingham/Future Learn (Designing E-Learning for Health)
 - 2.4 Harvard University/edX (Innovating in Health Care)
 - 2.5 Manchester Metropolitan University (Simulation and Technology Enhanced Learning in Healthcare)
 - 2.6 Clemson University (Architecture + Health)
 - 2.7 Muthesius University (Master's in Medical Design)
 - 2.8 University of Plymouth (MSc Healthcare Management, Leadership and Innovation)
3. 'medical design program' (first 20 pages)
 - 3.1 Johns Hopkins University (MS Medical Device Design)
 - 3.2 Keck Graduate Institute (Medical Device Engineering)
 - 3.3 University of Michigan- Biomedical Engineering
 - 3.4 University of Michigan- Biomedical Engineering (Graduate Design Program)
 - 3.5 UC San Diego (MAS in Medical Device Engineering)
 - 3.6 UCSC Silicon Valley Extension (Medical Devices Certificate Program)
 - 3.7 University of St. Thomas (Graduate Certificate in Medical Device Development)
 - 3.8 University College Dublin (Medical Device Design)
 - 3.9 UNC/NC State (Medical Devices)
 - 3.10 Ferris State University (BFA in Medical Illustration)
 - 3.11 UC Irvine Division of Continuing Education (Medical Product Development)
 - 3.12 University of Alberta (MSc Rehab Science- Specialism in Surgical Design and Simulation)
 - 3.13 Princeton University (Innovation and Design Application)
 - 3.14 University of Auckland (Master of Engineering Studies in Medical Devices and Technologies)
 - 3.15 TU Dublin (Medical Device Innovation)
 - 3.16 University of Southern California (Master of Science in Medical Device and Diagnostic Engineering)
 - 3.17 University of Newcastle Australia (Bachelor of Medical Engineering (Honours))
 - 3.18 Temple University (Graduate Certificate in Healthcare Innovation Management)

4. 'medical design course' (first 20 pages)
- 4.1 Keele University (MSc Medical Engineering Design)
- 4.2 Swansea University (BEng Hons. Medical Engineering)
- 4.3 NUI Galway (Medical Device Science)
- 4.4 Cardiff University (Medical Engineering MEng)
- 4.5 University of Bolton (BEng Hons Medical Engineering)
- 4.6 University of Dublin (M.Sc. Bioengineering with specialization in Medical Device Design)
- 4.7 Glasgow School of Art (MSc Medical Visualization and Human Anatomy)
- 4.8 University of Leeds (MSc BSc Medical Engineering)
- 4.9 Cork Institute of Technology (Biomedical Device Manufacture Part-time Certificate)
- 4.10 Osaka University (Medical Device Design Course)
- 4.11 University of Hertfordshire (MSc Health and Medical Simulation)
- 4.12 Griffith College (Postgraduate Diploma in Medical Device Technology and Business)
- 4.13 TU Delft/edX (Product Design and Health)



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INCORPORATING SUSTAINABILITY INTO RESEARCH PROJECTS

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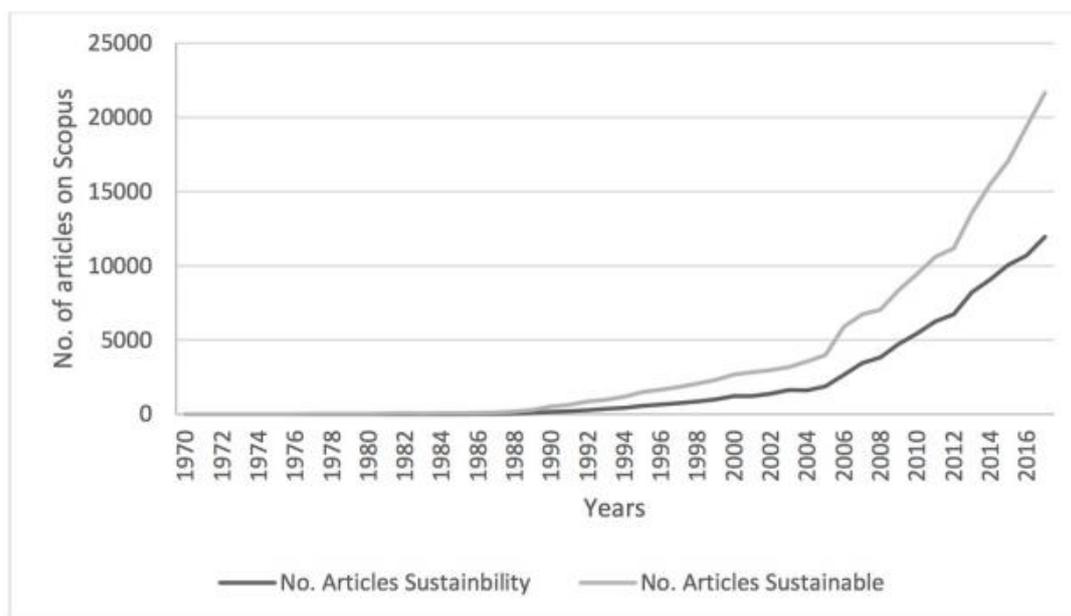
ABSTRACT

Since the 1970's scientific publication concerning sustainability have increased from one to 11,962 in 2016. Like all activities, the research behind these publications have an indirect impact on the environment (resource use, vehicles etc). Researchers in the topic of sustainability have an onus to account for their own impacts as part of their work and where possible, implement interventions. A life-cycle approach is currently the most advanced method of assessing the impact of a group or organisation. In this study an organisational life cycle assessment (O-LCA) approach was applied to a research project which focused on sustainability in the aquaculture sector. The objectives of the study were to (i) determine the impact of a research project, (ii) determine impact reduction opportunities, and (iii) to assess the use of O-LCA as a project management tool for academic research groups and projects. The results of this study indicated that commuting had the greatest impact, followed by conferences. The alternative scenarios analysed indicated that reductions of 5-16% in greenhouse gas emissions could be feasibly achieved and that O-LCA approaches could be applied to help sustainably manage such projects.

Keywords: project management, organisational life cycle assessment (O-LCA), sustainability, social responsibility

1. INTRODUCTION

The pursuit of greater knowledge on sustainability has created a significant increase in active research on the topic. Since the 1970's scientific publication concerning sustainability have increased from one to 11,962 in 2016 (Figure 1). As with all activities, the research behind these publications had an indirect impact on the environment in that, the data gathered to support the articles required the use of vehicles and resources. Researchers in the topic of sustainability have an onus to account for their own impacts as part of their work and where possible, implement adequate interventions. A major burden placed on the environment by researchers, apart from research activities themselves, is dissemination of results and networking (Ponette-González, 2011). Air travel emissions are one of the major hot spots in a research project (Achten et al., 2013; Caset et al., 2018), and recently an open letter was published by over 600 researchers in Danish Universities which called on their institutions to implement the necessary changes required to mitigate climate change (Andersen, 2018, November 19th). Given the momentum behind this body of work, it is appropriate that researchers, apply available techniques and objectivity to our own activities and investigate how to reduce negative environmental impacts of research projects while maintaining scientific rigour and meeting project objectives.



[Figure 1] The number of publications available on the academic database, SCOPUS (accessed May 2018).

In the context of an increase in the number of research projects funded investigating sustainability topics environmental social responsibility can be used by researchers as not just a concept but as a tool within their own work. Among all the sustainability metrics and tools currently available, a life-cycle approach is currently the best developed means of assessing the impact of a group or organisation (Forin et al., 2018; Martínez-Blanco et al., 2016). Life cycle assessment (LCA) was originally devised to assess the burden associated with production systems (Guinée, 2002), but its underlying principles and concepts have the potential to identify inefficiencies and promote positive changes in how organisations perform and the impacts associated with their operation.

In more recent years a technique called organisational life cycle assessment (O-LCA) has been developed with guidelines and technical documents having been published (Finkbeiner, 2016; Forin et al., 2018; Martínez-Blanco et al., 2015a, 2016; Martínez-Blanco et al., 2015b). As with any new techniques, the use of case studies to test the robustness and also to advance the concept are of the utmost importance (Forin et al., 2018). With this in mind, O-LCA was applied to a short-medium term research project investigating the topic of sustainable aquaculture in Ireland. The key objectives of this case study were to (i) determine the impact of a research project, by focusing on vehicle use and using a post hoc approach to (ii) determine impact reduction opportunities, during the life cycle of a research project by modelling interventions and alternative scenarios, and (iii) to assess the use of O-LCA as a project management tool for academic research groups and projects.

2. MATERIALS AND METHODS

2.1 Background

O-LCA provides a framework which allows for the quantification of environmental impacts and burdens associated with organisations whereby the underlying principles and approach of a process based LCA are applied to the organisation or group being studied. The differences between the two techniques occur in three areas (i) the object being studied is an organisation and not a good or service and is termed the reporting organisation, (ii) the unit of analysis

is referred to as the reporting unit rather than the functional unit and (iii) the system boundaries encompass all the activities of the organisation rather than focusing on a production system. For detailed overviews see (Finkbeiner, 2016; Martínez-Blanco et al., 2015a, 2016; Martínez-Blanco et al., 2015b).

2.2 Scope of assessment

The goal of this study was; (i) to determine the environmental burden associated with a two-year research project in Ireland, (ii) investigate impact reduction opportunities and (iii) investigate the use of O-LCA as a project management tool for research groups. The reporting organisation was the MOREFISH project, a multi-disciplinary research group, across two research institutions, that focused on enhancing the sustainability and production efficiencies of freshwater aquaculture in Ireland.

2.2.1 System boundaries

The system boundaries applied in this were focused on the associated travel activities of the project personnel within the reference period. The reference period for this study was the 01/01/2015-31/08/2017, the period for which the project was funded. The activities which were included in the collation of the life cycle inventory (LCI) were; commuting, fieldwork, conferences, training and meetings.

2.3 Life cycle inventory and life cycle impact assessment

Inventory data was collected from LCI databases, interviews with project staff and attendance records regarding working hours, digital and hard copy travel records and external stakeholder attendance at and travel to project workshops (Table 1).

[Table 1] The inventory for the project. The distance travelled was collected using questionnaires and mileage claims. Fuel use and direct emissions were calculated using the vehicle manufacturers figures. The terms direct carbon dioxide (CO₂) and indirect CO₂ refer to tailpipe emissions due to combustion of fuel and the emissions associated with the production of the fuel uses, respectively.

Personnel	% Time on Project	Total KMs	Total Fuel	Direct CO ₂ (kg)	Indirect CO ₂ (kg)	NO _x ¹ (kg)	PM (kg)
Principal Investigator 1 - PI1	10%	1,268	50	69	24	0.1	0.0
Principal Investigator 2 - PI2	10%	2,470	116	277	55	0.1	0.1
Research Fellow 1 - RF1	-	11,083	113	482	53	1.0	0.0
Post-Doctoral Researcher 1 - PD1	100%	43,790	1,972	3,321	1,109	1.7	0.0
Post-Doctoral Researcher 2 - PD2	100%	26,738	60	791	34	0.4	0.0
Project Manager - PM	100%	15,115	856	2,187	473	1.0	0.1
Postgraduate Researcher 1 - PG1	100%	24,075	808	2,105	382	5.2	0.6
Postgraduate Researcher 2 - PG2	100%	18,560	1,031	2,741	443	8	0.8
Stakeholder meetings		19,537	640	2,490	286	1.6	3.2
Totals		162,636	5,646	14,461	2,573	19.1	4.7

Life cycle impact assessment was carried out using the CML baseline characterisation factors (Guinée, 2002). The characterisation factors assessed in this study included; abiotic depletion potential (ABP) in both kilograms of antimony and megajoules (MJ), global warming potential (GWP), ozone layer depletion (ODP), human toxicity potential (HTP), freshwater aquatic ecotoxicity potential (FWAETP), marine aquatic ecotoxicity potential (MAETP), terrestrial ecotoxicity potential (TETP), photochemical oxidation potential (POP), acidification potential (AP) and eutrophication potential (EP).

2.4 Scenarios

Three scenarios were developed, to examine emission reduction potential. These were to assess the impact reduction potential of a modal switch to electric vehicles (EVs), flexible working arrangements and interventions in stakeholder workshops.

2.4.1 Reference Scenario

This scenario assessed the environmental impact of the MOREFSIH project is regarded as the reference scenario. This scenario essentially formed the LCI for the rest of the study.

2.4.2 EV scenario

This scenario considered the impact reduction opportunities if the project personnel operated electric vehicles (EV). For this scenario hybrid electric vehicles (HEVs), battery electric vehicles (BEVs) and plug in hybrid electric vehicles (PHEVs) were all considered. This scenario was considered likely as individuals who work in this area and people who possess advanced degrees are generally early adopters of new technologies such as EVs (Egbue and Long, 2012; Hidrue et al., 2011; Plötz et al., 2014; Ziegler, 2012). Vehicles operated by the project personnel were substituted based on the closest comparable EV. This was achieved by creating a matrix of projected vehicle value, vehicle class and the age of the vehicle operated during the reference period. Utility vehicles such as vans and SUVs were also substituted for the closest possible EV alternative.

2.4.3 Working from home

This scenario investigated the impact reduction opportunities which may have been available to the project due

to the recent trend of organisations offering their staff the option of flexible working arrangements, such as working from home (Kelliher and Anderson, 2009). As part of this, personnel who were working 100% of time on the project were modelled as working one day a week from home.

2.4.4 Stakeholder meetings

The stakeholder scenario considered the likely reduction in emissions, if attendees at these events were encouraged to use public transportation rather than private transportation. There were three such meetings which took place over the project, each with a greater number of attendees, distances travelled and associated emissions than the preceding meeting.

3. RESULTS

In total the distance travelled to achieve the projects aims amounted to 143,098 km. Fuel use for the project totalled 5,956 L, with tailpipe carbon emissions being 14,503 kg CO₂eq. The results of the reference scenario indicated that the bulk of the projects burden was associated with the commuting activity, at an average of 42% of the total burden across all impact categories. This was followed by conference and training events at 32% of total impacts, fieldwork at 16% and meetings at 10%. In the EV scenario there was an average reduction of 16% in the total impact across all categories when compared with the reference. A shift in rank was observed in the order of activities which contributed the most to the total impact. Commuting was displaced by conference and training, which increased its impact to 41%. Commuting impacts were reduced to an average of 37% across the impact categories. Fieldwork averaged 12% with meetings representing 11%. This shift in the contribution to impacts was due to the reduction in car related impacts as a result of reduced fossil fuels combustion and their production. The use of air travel in conference and training activities became the major contributor as a result.

The third scenario investigated if project personnel were offered flexible working arrangements. That is that they were afforded the opportunity of working from home at least one day per week. Across all impact categories there was a reduction of 5%. The rank structure was not affected in this scenario but there were increases in all other activities apart from commuting. Commuting had an average of 39% of total impacts, conferences and training at 33%, fieldwork at 17% and meetings at 11%.

The fourth scenario considered as part of this case study was that of a stakeholder intervention in the form of encouraging delegates attending a series of three workshops organised as part of the MOREFISH project to avail of public transportation rather than use their personal vehicles. The results of this scenario indicated that in terms of environmental burden and the time required to travel to the workshops that public transportation (bus and rail) was not the most environmentally informed choice. For the first workshop, which had an attendance of 4 individuals from industry, there was an average decrease of 49% in total impact. This was due to the relatively short and direct public transportation routes. However, time required to attend did increase by 9 hours. The second workshop saw an increase in attendance to 21 individuals, these individuals came from further afield and included attendees from overseas. As a result of this the alternative for this workshop saw an increase in the environmental burden across all impact categories of 140% compared to the reference. There was also an additional 38 hours of travel required for the individuals to attend. The third workshop in this series saw a total of 26 attendees. Similar to the second workshop there were attendees from overseas and remote areas of the country with indirect public transportation options. There was an increase of 304% across the impact categories and an increase of 106 hours travel time. The results of this scenario reflect the nature of the Irish aquaculture sector in that it occurs in rural areas away from major urban areas with well-developed public transportation routes.

4. DISCUSSION

Data availability determined the scope of this study. For instance, for the EV scenario the allocation of the closest equivalent alternative vehicle was based on the vehicle age, vehicle class and the projected price for a vehicle of that age.

The shift to EVs from traditional internal combustion engine vehicles, offers very real impact reduction opportunities by using currently available models. In terms of an organisation this would indicate that organisations which wish to improve their sustainability could propose that EVs can be hired or rented from a project budget in lieu of using private cars. Or organisations can mandate that for suitable trips in-house EVs must be booked and used wherever possible. Utility vehicles in this project accounted for 6892 km, 3,055.7 kg CO₂ and 476.9 L of fuel. By switching to the closest alternative commercial vehicles, the average reduction for tailpipe emissions was 85%.

Most research projects are financed through public funding. As such, there is a social responsibility for researchers and projects working on and researching the areas of sustainability and efficiency to conduct their work using the most environmentally sustainable and efficient means available. The introspective approach outlined in this study allows for an initial post-hoc approach to incorporate the concept of life cycle thinking and its application to a research project and its management using relatively simple and readily available information. The extent to which a research project can implement significant changes in its operation may be somewhat limited, as they are generally a smaller collective in a larger organisation. Research groups will generally not be in a position to purchase vehicles or other means of transportation from research budgets but can approach funding organisations and their own insti-

tutes with recommendations to phase the organisations vehicle fleet with the most environmentally conscious option when upgrading. Particularly for ICE utility vehicles such as vans and 4x4s as there are currently alternate EVs models available. Furthermore, an O-LCA should as a matter of course be implemented at third level institutions along the lines of Lo-Iacono-Ferreira et al. (2016). As these institutions house and promote the research of sustainability and its application to the wider world.

5. CONCLUSIONS

Applying an O-LCA approach proved to be an appropriate tool for assessing the environmental burden of a research group and that it has potential to better inform the management of academic projects and events. The use of O-LCA can allow organisers to better plan and implement more environmentally conscious choices through the identification of knowledge gaps and reduction opportunities, particularly in terms of workshop and event management. The ability of research groups and projects to enact changes is somewhat limited, due to their placement within a larger organisation, typically a higher education institute. Therefore, there is a requirement for universities to carry out O-LCA studies on themselves. It is recommended that principal investigators, organisations and funding bodies incorporate O-LCA into their practices to foster responsible and sustainable research practices.

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TEACHING DESIGN FOR SUSTAINABILITY BEYOND THE ENVIRONMENTAL DIMENSION: A TOOLKIT AND TEACHING STRATEGIES ENCOMPASSING THE CULTURAL AND ECONOMIC DIMENSIONS THROUGH DESIGN FOR SHARING

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ABSTRACT

Design for Sustainability (DfS) latest methods embrace the socio-technical systems, aiming to promote radical changes in societal needs. However, few studies investigate consumer behaviours, motivations and subjective practices as well explore teaching strategies for such approach. Therefore, this conceptual paper addresses the following research question: how to teach DfS beyond the environmental dimension of sustainability as an opportunity for developing solutions that are culturally desirable and economic viable? Its main goal is to present a teaching experience held along 2 years in 2 universities in Brazil. Drawing upon Vasques (2015), the toolkit and teaching strategies integrate de cultural dimension through the Consumer Culture Theory knowledge (CCT) and reflections on self, materialism and sharing. The economic dimension is addressed by questioning the scarcity economic model and developing a project from users' needs and challenges to change consumption patterns identified with CCT and explored with the AT.ONE Service Innovation Method and the Sharing Business Model Compass. Students had raised awareness and fostered critical thinking on the relevance of both cultural and economic aspects related to DfS, suggesting the significance of the approach through design for sharing.

1. INTRODUCTION

Design for Sustainability (DfS) has evolved quasi-chronologic from a product design approach (e.g. green-design, eco-design, emotional durable products, cradle-to-cradle, among others) to Product-Service System (PSS), to the spatio-social innovation level (e.g. Design for Social Innovation, systemic design), and later to the socio-technical system innovation level (e.g. system innovation and transitions, design for transitions) (Ceschin & Gaziulusoy, 2016).

According to Ceschin and Gaziulusoy (2016), the difference among these approaches are:

- Product innovation level: design approaches focussing on improving existing or developing completely new products.
- Product-Service System innovation level: here the focus is beyond individual products towards integrated combinations of products and services (e.g. development of new business models).
- Spatio-Social innovation level: here the context of innovation is on human settlements and the spatio-social conditions of their communities. This can be addressed on different scales, from neighbourhoods to cities.
- Socio-Technical System innovation level: here design approaches are focussing on promoting radical changes on how societal needs, such as nutrition and transport/mobility, are fulfilled, and thus on supporting transitions to new socio-technical systems. (p. 120)

However, DfS evolution has been barely explored in higher education in Brazil beyond the Learning Network on Sustainability (LeNS) efforts. The research carried out by Calegari and Oliveira (2015) on how design courses in the Brazilian Federal universities address sustainability in their programs exposed that mostly focus only on its environmental dimension through green design or eco-design strategies. Despite the environmental dimension relevance, such approach is out-dated, since it remarks to the concept DfS from the period of 1990 and the beginning of the 2000s, while the approaches that also address the socio-ethical dimension had emerged over ten years ago already. It is also limited as it has a lower impact on tackling urgent and complex issues as consumption patterns that we need to face to achieve a sustainable society. Moreover, by analysing the fashion design courses in Brazil, Lima (2018) also called attention to the need of developing a critical and active education, where teaching, learning and practising should be a transformative proposition.

Sharing is, potentially, better environmental, economic and social consumer practice than ownership. Product Service Systems for Sharing instead of the individual possession and usage of products can attend the strategies of life cycle optimisation and product use intensification, reducing its idle capacity (Manzini & Vezzoli, 2002). Furthermore, the reduction of products to be owned can lead to lower production and consequently less discarded products in the future (Turker, 2004). Social innovations (SI) promoting sharing on spaces, products and activities enhance social cohesion (Manzini, 2008). However, as argued Vezzoli, Ceschin, Diehl and Kohtala (2012) Sustainable Product-Service Systems (S-PSS) remain not widely implemented even they present environmental and economic benefits. Notwithstanding, little attention is given to the cultural dimension of PSS for Sharing (Vasques, 2015). Still, from the economic dimension, most studies are carried out focusing on the company's perspective, while users' motivation can be different (Böcker & Meelen, 2017). Thus, this paper addresses the following research question: how to teach DfS through designing products, services or systems for sharing beyond the environmental dimension of sustainability as an opportunity for developing solutions that are culturally desirable and economic viable?

The main goal of this paper is to present a toolkit and teaching strategies that was used for two years (2017-2018) in Design for Sustainability subjects of the Design course at the University of São Paulo, School of Architecture and Urbanism (FAUUSP) and the Federal University of Paraná State (UFPR) drawing upon Vasques' doctoral dissertation (2015). The toolkit and teaching strategies objective is to raise awareness and foster critical thinking on the relevance of cultural and economic aspects related to DfS. Therefore, students can be able to create solutions which, in addition to being environmentally appropriate, are economically viable and culturally desirable, aiming to promote changes in production and consumption patterns that support the transition to a sustainable society.

2. UNDERSTANDING MATERIALISM AND SHARING THROUGH CONSUMER CULTURE THEORY LENSES

Despite the growing offer of products and services for sharing, Mont and Plepys (2003) argue consumers generally try to prefer product ownership rather than a service substitution. And even when the service is accepted, the environmental impact will depend much more on consumer behavioural changes. Thus, to design systems that replace ownership, we need a deep understanding of aspects that may shape the acceptance of PSS offerings:

In order to change system design, it is necessary to understand how consumer acceptance of more sustainable solutions is formed, influenced or changed, what are the influencing factors and what are the leverage points for best results with the lowest costs. Understanding consumer perceptions and behaviour in this context is crucial. (Mont & Plepys, 2003, p. 3; our emphasis)

On the other hand, there are few studies with an emphasis on subjective aspects that are part of the socio-cultural dimension of sustainability (Ono, 2008). In the same sense, Mont (2004) draws attention to the need of understanding consumer practices from a sociocultural perspective and from the historical context in which they occur, as a way of comprehending how people assimilate both more eco-efficient consumption alternatives and shared systems. Piscicelli, Cooper and Fisher (2015) also recommend investigating the role sociocultural factors play in the

user's acceptance of PSSs, to scale-up these solutions.

Scholars from Marketing studies have been researching materialism and possessions since 1980. These studies have raised and developed a new research tradition called Consumer Culture Theory (CCT) through investigating consumption from sociocultural, experiential, symbolic, and ideological aspects, thus shedding light to the cultural dimensions of consumer practices (Arnould & Thompson, 2005).

Russell Belk, one of the leading scholars from CCT, summarised that “we are what we have” in his seminal paper on possessions and self-extension written over 30 years ago, stating the self as essential for understanding consumer behaviour. Moreover, possessions delimit and contribute to the construction of the individual identity (Belk, 1998).

Further studies on this research tradition remark the most important objects in people's life reflect their material values. Products embody the owner's value and communicate them to others; thus, influencing what kind of product is consumed and how such products become important (Richins, 1994). In this sense, Kleine, Keine and Allen (1995) pointed out that favourite and beloved possessions are those which help to describe a narrative of a person's life history (e.g. a ring or objects received from inheritance). Hence, more fragile attachment with products usually symbolise periods of life from which people want to detach themselves or that no longer represent their identity.

Still, Ahuvia (2005) agree with Belk (1988) concerning the relevance of the relation between consumption and identity. Nonetheless, he criticises Belk's concept of a central and extended-self as potentially confusing metaphors to define consumption and the appreciation of possessions. People have contact with a vast number of products and consumer activities, but only a few of them are meaningful and therefore loved. Thus, Ahuvia argues beloved products and consumer activities are central to understand consumer identity. However, he considers them as only a partial characteristic to comprehend the consumer's identity, since it is also formed by aspects that people do not like, which, in the same way, can be represented by objects.

Since 2006, Russel Belk has been researching sharing in the CCT tradition as one of the aspects of materialism and consumer behaviour. He calls attention to the fact that sharing was neglected in CCT studies, although comprehending this kind of consumption is critical not only to understand consumer behaviour in the face of new paradigms (as the phenomenon of sharing files, music, photos and videos provided by the Internet) but also as one of the oldest forms of consumption. Moreover, sharing relates directly to emergent issues of social justice, consumer welfare, materialism and sustainability (Belk, 2010). Therefore, we built our toolkit for the cultural dimension bringing the CCT knowledge on materialism and sharing to the DfS classes, using it to help students to understand consumer behaviour and practices, as recommended by Vasques (2015).

3. SHOULD SHARING BE PROFITABLE? QUESTIONING THE ECONOMIC DIMENSION

The economic dimension of Sustainability goes from a conservative perspective to the “green” economy (Vezzoli et al., 2018). Regarding the DfS, the Sustainability Design-Oriented (SDO) Toolkit presents a checklist¹ of considerations to be analysed and to set priorities. It might be useful for a company redesigning a system. However, it focuses on profitability and competitiveness. It also follows the traditional economic vision of scarcity (never will be enough things to satisfy the wanters), while the sharing economy has its foundations on the idea of abundance (resources, creativity and wealth are enough to everybody if well managed). Moreover, why should we follow the scarcity thinking that leads to greed and selfishness, especially when designing for new consumption patterns?

Sustainable Product-Service Systems (SPSS) guidelines² for economic sustainability are also vague when we try to apply them in the context of sharing. Furthermore, SPSS are thought to encompass business traditionally developed to “sell” something (in this case, a service) to users. On the other hand, SI as proposed by Manzini (2008) are bottom-up solutions, which do not fit in the business world. Still, the Sharing Economy embraces a wide range of products and services from spontaneous sharing practices among neighbours to successful endeavours as Airbnb.

Here it is essential to clarify the concept of sharing and if it should involve money or not. Belk (2014) argues services for sharing cannot include money, otherwise it is renting or pseudo-sharing. The discussion is vast and has been losing its meaning with the banalization of the concept of “sharing” in the virtual environment. Instead of entering this barren ground, we propose to focus on the usage of products, following Vasques (2015) definition of sharing: non-individual usage of a product, ranging from spontaneous practices to service-mediated, inside or outside the familiar circle, whether it involves money or not. Frenken and Schor's (2007, p. 4-5) definition of the sharing economy follows the same principle: “consumers granting each other temporary access to under-utilised physical assets (‘idle capacity’), possibly for money”. These definitions are useful and broader for design purposes since they are less limited to only spontaneous practices of sharing. Again: what if we have hybrid systems for sharing?

The relevance of these discussions emerges from studies (Vasques & Ono, 2016; Böcker & Meelen, 2017) that

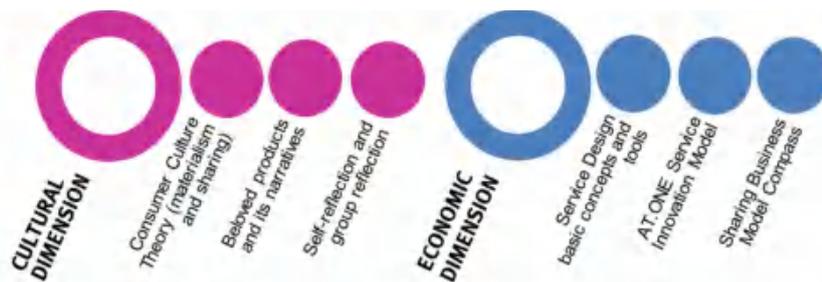
¹ SDO Guidelines for the economic sustainability: 1. Market position and competitiveness: Do you have a weak market position in the current system? 2. Profitability/added value for companies: Is the profitability of the current system low for your company and other external partners? 3. Added value for customers: Is the profitability/value low for customers/consumers? 4. Long term business development/risk: Are there any threats in the current system for your business in the longer term? 5. Partner cooperation: Is your market position in danger? 6. Macro-economic effect: Are there problems on a macro-economic level? E.g. disclosure of participants in economy, monopolistic structures, rebound effects? (<http://www.sdo-lens.polimi.it/>)

² To promote local economy; to strength and enhance local resources; to respect and enhance local culture, to promote network; to value waste reintegration.

have been showing users are more economically motivated to participate in the sharing economy than for social or environmental reasons. Böcker and Meelen (2017) highlight also the difference concerning motivations from users and providers, with most of the providers arguing the main reason to choose a shared service is for environmental awareness while users affirm to be more motivated by economic reasons, especially in different sectors of the sharing economy (i.e. sharing clothes, cars, tools, accommodation). Thus, designing with the standpoint of delivering a “unit of satisfaction”, a common driver for SPSS, seems to be failing. Everybody will need to travel from A to B sometime but offering only the most ecologic way to travel seems to be not enough. We need to understand also how the culture and self-identity blur the economic and environmental motivations and vice-versa.

4. TEACHING STRATEGIES AND TOOLKIT

The DfS subject held in USP and UFPR approached: 1. Sustainability and DfS history and concepts; 2. Green design and Ecodesign – concepts, tools and project focusing on the environmental dimension; 3. SPSS and Social Innovation – concepts, tools and project about sharing focusing on the cultural and economic dimensions (teaching tools and strategies described in this paper). To build our toolkit for teaching DfS embracing the cultural and



economic dimensions beyond the environmental one, we borrow research methods and techniques from “Local Wisdom” Project³, the AT.ONE Service Innovation Method (Clatworthy, 2010) and the Sharing Business Model Compass (Cohen, 2016; Muñoz & Cohen, 2018).

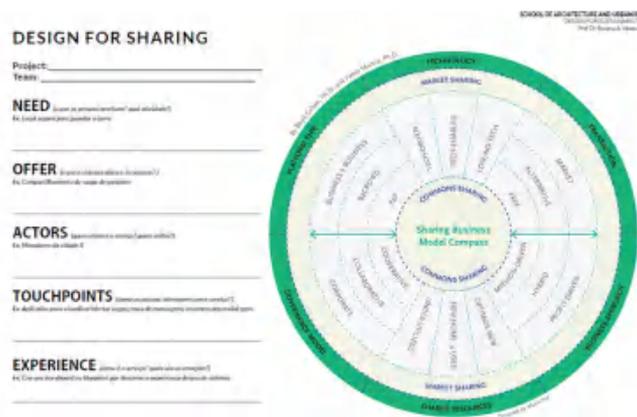
[Figure 1] Framework for teaching DfS beyond the environmental dimension

The “Local Wisdom” Project (a series of photographs and narratives about spontaneous fashion practices towards sustainability collected and documented by Dr Rachel Fletcher) inspired us to ask students to bring their beloved products and share the narrative about it, explaining why the product is essential for the students’ identity. After, the students were grouped in 5 and discussed within the group if they would share or not the beloved product with friends, family or strangers. The results brought awareness of materialism and altruism practices bonded in their culture and lifestyles. Self-reflection and group-reflection raised the urgency of understanding deeper consumers’ behaviour, identity and cultural habits that may influence or challenge the acceptance of services for sharing learnt through the knowledge from the CCT.

After understanding the cultural barrier or opportunity to develop a new service for sharing, we presented to students basic concepts of Service Design and an integration (Figure 2) of the “AT.ONE Service Innovation Method” (Clatworthy, 2010) with the “Sharing Business Model Compass” (Cohen, 2016; Muñoz & Cohen, 2018) aiming to give a comprehension of how to spot the new product, service or system for sharing from an economic perspective. By using the AT.ONE tool, students were requested to research and reflect on the anagram concept as described by Clatworthy (2010), starting with the needs previously identified with their reflection on materialism and sharing:

- A – Exploring new combinations of ACTORS who together can provide a new service for sharing;
- T – Designing the TOUCH-POINTS to offer innovative services to sharing (represented in a storyboard or blueprint)
- O - Developing new OFFERINGS aligned to both users and the company or community’s value;
- N - Understanding customer NEEDS and how the new service for sharing can satisfy them;
- E - Designing customer EXPERIENCES that delight users, making them prefer to share rather than own.

³ <http://localwisdom.info/>



[Figure 2] Integration of the AT.ONE Service Innovation Method and Sharing Business Model Compass

The Sharing Business Model Compass was used to demonstrate the variety of decisions needed to design a common shared resource to a sharing-based business or start-up, supporting and complementing decisions made with the AT.ONE tool. The Compass is also useful to present new possibilities and an overview of economic aspects concerning entrepreneurship and can be used in both SPSS and Social Innovation projects. It has the following structure that guides business decisions:

- **Shared Resources:** Is it based on an existing product(s) underutilised? Is it second-hand based? Is it optimising the life-cycle of a new product? What are the environmental impacts in which approach?
- **Transaction:** Is it for free? Is it build on alternative currencies (e.g. time banking)? Is it following the traditional market rules (i.e. money exchange)? What are the economic benefits and value perceived by users and providers?
- **Business Approach:** Is it mission-driven? Is it profit driven? Is it a hybrid (mixes profit and mission-driven)? How is it economically sustainable in the long-term?
- **Governance Model:** Does a cooperative manage it? Is it a collaborative service? Is it from a corporate? Who are the human resources?
- **Platform Type:** Is it P2P? Is it a B2C? Is it B2B? Who are the stakeholders/actors?
- **Technology:** Is it tech-driven? Is it tech-enabled? Is it low or no-tech? Which one has the best environmental and social impact? Which one is economically viable considering the transaction, governance model and business approach?

These questions guide student's reflection and decision making, following an iterative service design process focusing on its cultural desirability and economic viability. Finally, they must present a storyboard or service-blueprint and discuss the results with the other groups.

6. IMPACTS ON TEACHING DFS FOCUSING ON THE CULTURAL AND ECONOMIC DIMENSIONS

The emerging approach of Socio-Technical System calls for a radical change on how we teach and design. Sharing Economy has the potential to create a decentralised, equitable and sustainable economy, but it is also criticised for creating unregulated marketplaces, besides reinforcing the neoliberal paradigm (Martin, 2016). Thus, because of its inner ambivalent potential, teaching DfS through sharing is an opportunity to raise the students' awareness and critical thinking on the holistic perspective needed to cope with unsustainable lifestyles.

This paper describes a teaching experience of DfS conducted in 2 Brazilians public universities along 2 years (held in one semester per year). The experience is based on the following authors' questioning: How to develop students' skills to embrace the social and economic dimensions of sustainability in projects? How to improve students' autonomy and critical thinking to decide which DfS model (SPSS, SI etc.) is the best solution for the problem they found out?

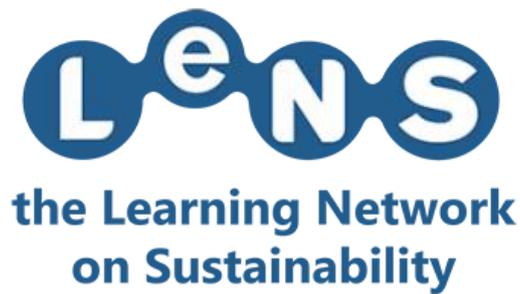
Teaching DfS through sharing focusing on the cultural and the economic dimension has been a challenging and meaningful experience for both, students and professors. From the professors' perspective, we had to fit the theory, design exercises and project presentation in twelve hours, in a total of thirty hours. Following the subject structure, it is essential first to present both the historical background of the concept and to practice tools addressing the environmental dimension of sustainability, before moving into the SPSS and Social Innovation concepts. From our experience, both the first phase (Sustainability and DfS history and concept) and the second (green and eco-design concepts and tools) of the discipline holds an average of eighteen hours. Hence, we recommend that a new subject could be created such as Design for Sustainability – level 2, which could address the Spatio-Social and the Socio-Technical System Innovation approach, and deeply discuss and explore the cultural and economic dimension with students, as well as the socio-ethic and philosophic dimensions in transitional systems.

From the student's perspective, many of them vocalised they have become more aware on the cultural dimension through practising the concepts of materialism and sharing from CCT since first they were motivated to reflect on their practices of sharing and ownership with their beloved objects before developing a solution that demands others to share. Nevertheless, we stand that CCT is not a panacea that can embrace the myriad of aspects concern-

ing to the cultural dimension for all DfS project, even it had proved to be quite useful on designing for sharing. Likewise, using the Sharing Business Model Compass and AT.ONE Service Innovation Method as tools have helped students to better comprehend the economic aspects of their solutions in this specific context, bonding the economic value to the users' needs. It is worth emphasising that our toolkit and strategies presented here are not a "one-way street" to address the cultural and economic dimensions for designing products, services and systems for sharing. Drawing upon Vasques (2015), the theory, toolkit and strategies were updated along the two years and in the two different universities. Now, we invite you to use them, contributing further from your own experience and context.

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ROLE OF DESIGN EDUCATION IN IMPARTING VALUES OF SUSTAINABILITY AS SOCIAL RESPONSIBILITY OF DESIGNERS

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ABSTRACT

Professional design has become a forceful, persuasive and omnipresent reality of contemporary world by influencing patterns of human consumption and aspirations. This influence is not limited to the clients or the consumers, but impacts the society and environment at large—local as well as global levels. A professional designer plays a pivotal role in creating the ‘world by design’, and, hence, shares the social responsibility of the larger consequences of the process/act of design. Therefore, it becomes important to examine the values imparted to design students, the future design professionals.

Design education programmes generally claim to impart values of sustainability as social responsibility of designers.

Does this intent get manifested in their course curriculums and actualised in the pedagogies? The paper addresses this question by examining the role of design education programmes and the challenges in imparting the values of sustainability as social responsibility of designers.

Key Words: Design Education, Curriculum and Pedagogy, Sustainable Design Values, Socially Responsible Design.

1. INTRODUCTION

In this paper, I examine the role of design education in imparting values of sustainability as a critical part of socially responsible design. The key areas of examination are: curriculum and pedagogies. This paper is divided into three sections. The first section provides a background to the growing need for imparting these values. In the second section, I examine the course curriculum and the pedagogy of design education programmes, by using quantitative and qualitative methods, to find out the actualisation process and challenges of imparting these values. The third section is the concluding part of the paper that discusses the findings. The primary field study and research used for this article was undertaken in India as a part of my doctoral research. Although the research base is location-specific, it brings forth insights valuable for multiple locations and parallel contexts.

2. BACKGROUND

In all possibilities, life on planet Earth will continue in some form or the other even if humans annihilate themselves. Global climate change and global warming have become key terms of reference and concern in discussions on sustainability of life on this planet, especially that of humans. United Nations Framework Convention on Climate Change (UNFCCC) acknowledged the factuality of climate change and significant human contribution to it. In 2016, the Paris Agreement on climate change and the 17 Sustainable Development Goals (SDGs) of the 2030 Agenda for Sustainable Development entered into force that not only points to the gravity of the situation but further emphasises the significance of sustainability in the human actions and development ('The Sustainable Development Agenda', n.d.). The Guardian reports that, according to an official expert group that presented the recommendation to the International Geological Congress in 2016, "Humanity's impact on the Earth is now so profound that a new geological epoch – the Anthropocene – needs to be declared" (Carrington, 2016).

More than ever before, in the past few decades, design has become an all-pervading reality of the human civilisation—shaping, serving and changing the world around us. A significant part of professional design today is involved in influencing the patterns of human consumption and aspirations, what Victor Papanek, way back in the 1970s, had described in his book *Design for the Real World*, "persuading people to buy things they don't need, with money they don't have, in order to impress others who don't care" (p. ix). The creators of such products, services and systems, share the responsibility of resulting environmental and social consequences of the acts of their design as a whole. In this context, it becomes significant to examine the roles and responsibilities of designers beyond the client and the consumer, towards the environment and society at large.

"The worldly actions that we have taken en masse to sustain ourselves in the short term have increasingly been at the expense of maintaining the long-term sustenance of ourselves and the world around us. The greater our numbers and our technological capacity to misappropriate planet Earth's resources become, the faster we defuture ourselves" (Fry, 2009, p. 110). Many researchers, from diverse disciplines, including designers and design thinkers, have raised concerns regarding the larger social and environmental impact of design. Though the sole responsibility of the current environmental status cannot be attributed to designers and their design actions, design, per se, has been a significant contributor to anthropogenic outcome, as expressed by Harold Nelson and Erik Stolterman (2003), in describing design as 'an act of world creation' and a designer as 'world creator' (2003, p. 239).

Donald A. Schön (1983) in his canonical book, *The Reflective Practitioner: how Professionals Think in Action*, describes the process of making positive contribution through a practitioner's 'conversation' with the situation and 'reflection-in-action' that influences, perspective, intentions, choice of explanations and arguments regarding the practice. Design students in their role of world creators, through a reflective process, should be able to perceive their practice as being beyond merely a source of livelihood. They should be prepared to consider the wider implications of their design action and its remotest consequences, on the environment and the society, in addition to the call of their direct normative professional behaviour or duties enforced by law. Design education has a significant role to play in this preparedness.

3. RESEARCH METHODS AND DATA ANALYSIS

In this section, I have examined the role of design education programmes and the challenges of imparting the values of sustainability as a critical part of socially responsible design. This section is divided in two parts. The first part deals with the research method used. The second part puts forth the analysis of findings relevant to this paper from the data collected through the research methods.

3.1. Research Methods

This paper employs quantitative and qualitative research methods to examine the course curriculum and the pedagogy of design education programmes, to find out the actualisation process and challenges of imparting values of sustainability as social responsibility of designers. In doing so, data was collected from 298 respondents (shown in table 3.1) through an online survey questionnaire and 20 expert interviews were conducted. All the respondents were involved with design education—as educators and/or as students—and represent a cross-section of over 100 design education programmes/institutions/departments from different parts of India. Of these respondents, 85%

were involved with professional design practice, which adds to the relevance of their responses. To further enrich the analysis, relevant institutional documents of five design education institutions from India, identified as top five institutions by the survey respondents, were examined. Though the study is India-centric, the relevance of its outcome holds valid in parallel contexts and other locations.

Categories of online survey respondents involved with design education in India	Respondent Count	Percentage
as current or past design educator (full-time faculty member or part-time visiting faculty member)	55	19%
As current or past design student	116	39%
both as design student in the past and, subsequently, as design educator – current or past, full-time or part-time	127	42%
Total	298	

[Table 3.1] Categories of Survey Respondents and Their Count

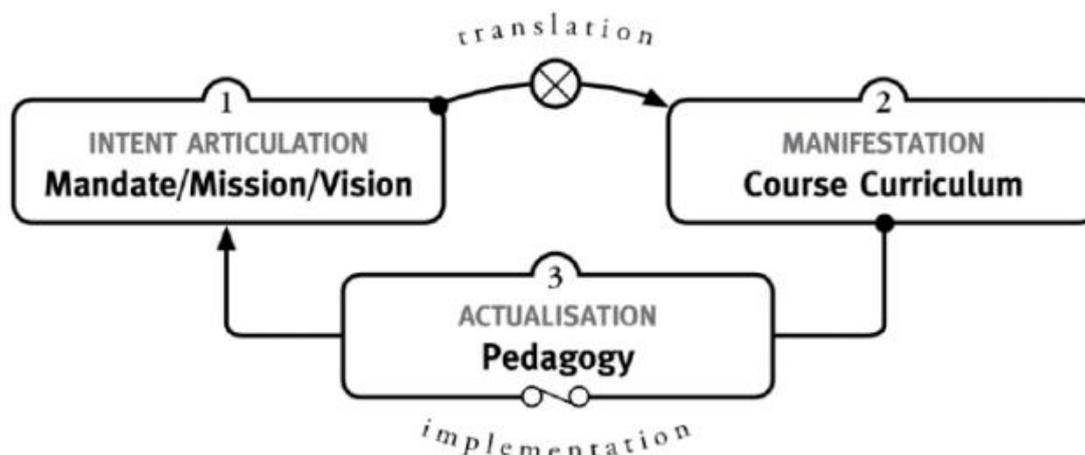
3.2. Data Analysis

A significantly large number of respondents are of the view that design has contributed to the growth of consumerism and related industrial expansion in India. Of the respondents, 67% saw design as a major contributor, and another 27% saw design as a minor contributor. Furthermore, regarding the response about the outcome and impact of design interventions, 86% of respondents indicated that design interventions also have unintended outcomes, beyond what is primarily intended by designers. Though design interventions may be primarily focused on the end-users/clients, there are larger social and environmental implications of such interventions.

Sustainability is critical for the future of the human society, thus foundational to social responsibility of designers. The survey respondents highlighted this significance in their responses. An overwhelming majority, 94%, of the respondents were of the opinion that application of socially responsible design values in design practice can contribute to a more sustainable future. Also, most of the respondents, 92%, were of the view that it is possible to integrate these values as an integral part of a design practice. With the growing significance of professional design and its implications on a sustainable future, it becomes imperative to examine whether or not design education programmes focus on sensitising students about the larger social and environmental issues related to design praxis.

In context of the need for imparting values of socially responsible design, through design education programmes in India, 89% of the respondents saw this need as critical and foundational, and were of the opinion that it would influence the larger social impact of design outcome of the design students. However, 15% of the respondents were of the view that these values are not imparted by the design courses. Another 14% saw that these values are imparted, whereas a significant 65% were of the view that these values are imparted only to some extent. These responses indicate that while imparting of socially responsible design values is not completely absent, since these values are seen to be imparted 'only to some extent', there is scope of improvement.

In response to the question regarding the most significant factor in imparting socially responsible design values among design students, 30% of the respondents saw 'institutional mandate oriented towards values of socially responsible design' as the most significant factor; 36% viewed 'syllabus and course components directed towards values of socially responsible design' as the most significant factor; and 31% perceive 'values and inclination of individual design educators towards values of socially responsible design' as the most significant factor. Since the differences in the number of responses vary marginally, it indicates that all the three factors are important. These three factors and their interrelation, as shown in figure 1, are discussed further based on the views of the survey respondents, expert interviews and document analysis. A few institutions were selected for a closer examination of institutional documents. These design institutions were rated as the top five in India by the online survey respondents. This examination of the mandates or mission/vision statements, curriculums, and pedagogies is not intended to compare the institutions but to analyse their overarching focus.



[Figure 1] Interrelation of three significant factor in imparting socially responsible design values

In exploring the first factor, the main query was whether the respondents came across references to values of socially responsible design in mandates or mission/vision documents publically shared by design education programmes/institutions. Of the respondents, 38% either did not come across such documents or were not aware of them. Because of the absence of such articulation in the institutional documents or a lack of their awareness itself can be one of the hindrances in imparting values of socially responsible design. However, 62% claimed that they have come across such publicly shared documents on websites or documents. The very fact that a large percentage of respondents were aware of the reference to values of socially responsible design in these institutional documents indicates the articulation of such institutional interest/commitment. Overall, the responses reveal that commitment to socially responsible design is articulated in institutional manifestos or mission/vision documents of contemporary design education programmes in India.

In analysing the second factor, the curricular focus directed towards values of socially responsible design, the survey respondents expressed a conflict between the need to impart values of socially responsible design and to prepare students as per commercial job market expectations. An analysis of their responses establishes a clear dominance of the percentage of courses focused on imparting skills oriented towards meeting the demands of the industry over the percentage of courses focused on imparting values of socially responsible design. Further study and analysis of curricular objectives/syllabus documents/semester flowcharts/course descriptions of the B.Des and M.Des programmes of the five design education institutions revealed a varying range of emphasis through their courses to impart socially responsible design values. The analyses of course credits indicate that such courses constitute less than 30% and, in some cases, were as low as 7% of the total course credits. Such courses are dominated by programme focus and courses that impart industry/specialisation-specific skill-sets, technical knowhow, presentation techniques, exposure/understanding of the industry, and professional projects and practices, aligned with industry demands for better employability in skill-based design roles.

It can well be argued that without a proper foundation of such skills design students cannot aspire to assume the role of employable design professionals in future. However, an array of skills without conceptual understanding of the wider interconnections and responsibilities of a powerful profession is akin to putting firearms into amateur hands. The interviewed experts held concurring views while responding to the query regarding curricular focus of design education programmes in India. They too highlighted a gap between the intent and actualisation of imparting socially responsible design values and larger public good. Most of them opined that there were few opportunities within the curriculum to address issues related to socially responsible design.

Shared below are views of interviewee A, a design practitioner with 33 years' experience, who has been associated with many design schools as a visiting academic or as a member of their advisory bodies for 23 years. He observes that most of the contemporary design education programmes are employability driven, training students in the "craft of design", i.e., supplying graduates who have strong software skills, are meticulous with getting the forms and the kerning right, can deliver sophisticated-looking, polished output, but who are not thinking individuals. He describes them as "Photoshop¹ donkeys" and explains: "Because they are good [with technical skills], they don't think. And design is essentially a thinking profession" that relies on soft skills—"on sensitivity, team work, being grounded, developing empathy". Such soft skills would be essential to deal with the complex social, cultural and sustainability issues and challenges that designers need to address.

The third factor, pedagogical role of design educators in imparting values of socially responsible design, is analysed in the context of the preparedness for understanding these values and imparting them. A design educator in the

¹Photoshop is a proprietary name of a software package for digital editing and manipulation of photographs and images. Photoshop, launched in the 1990s, has developed into an industry standard and allows complex work with images. The expected proficiency in handling the software and its usage have penetrated so deeply amongst industry professionals, design students and novice amateurs that photoshop is also commonly used as a verb now. The industry is known to have a continuous supply of highly proficient Photoshop buffs who do not seem to know what to do with their skills unless told what to do with the software or where to apply it.

role of a faculty member, project mentor/guide, an expert from the field, facilitator, advisor, motivator or academic evaluator is comparable to, yet quite different from, a teacher in the conventional sense. The difference is further magnified due to the absence of textbooks as source of explicit knowledge and significance of tacit knowledge of the design educator and the space for self-direction provided to them within the design curriculum and pedagogy. A study of pedagogical process of conducting courses, student projects and student evaluation has highlighted the central role of the design educator in the teaching-learning transaction within this field. This central role of design educators resonates with the views of survey respondents. The quantitative analysis of their views has established that appropriate restructuring of courses and syllabus, together with training and orientation of design educators, is necessary for a stronger thrust in imparting values of socially responsible design compared to only addressing one of the two. Such a response, while giving importance to restructuring course curriculum and pedagogical training, points to the critical role of the design educators in imparting the values.

A critical issue that impacts the imparting of socially responsible design values by design educators is their level of understanding of these values and adequacy of preparation in imparting them. A query regarding this was posed to both, design educators and design students. Only 7% of the total respondents were of the opinion that design educators were adequately prepared. The majority of the respondents, 53%, were of the view that only some of them were adequately prepared, while another substantial number, 36% of the respondents, were of the opinion that most of the design educators are not adequately prepared. The opinion of respondents about the adequacy/inadequacy of preparation regarding the understanding of socially responsible values is another impediment to the pedagogic process of imparting values of socially responsible design. It also points to the need to better prepare the design educators in understanding values of socially responsible design and imparting these values. In response to the query regarding the need for 'training of trainers', a significant majority, 79% of the respondents, were of the opinion that there is a great need, 19% point to some need, and none of the respondents think that there is no need for programmes focusing on training the design educators. Without the availability of such programmes and adequate training of the design educators, the onus of carrying these values forward would rest on the interest, inclination and preparedness of the design educators.

4. CONCLUSION

This paper refers to sustainability as critical for the future of the human society, thus foundational to social responsibility of designers and as values to be imparted to design students, the future design professionals. The paper primarily sought to find out the actualisation process and challenges of imparting these values. The analysis of quantitative data gathered from the online survey respondents and qualitative data from expert interviews of respondents involved with design—education and practice—in India, along with analysis of relevant institutional documents, contributed in finding out whether the institutional intent of imparting these values manifest in their course curriculums and actualised in the pedagogies. I examined three key components of design education institutions in India: mandates or mission/vision statements, course curriculums, and pedagogies.

First, the study points out that sustainability is not an isolated value; to be effective, it has to be an integral part of socially responsible design values. A majority of respondents acknowledge the references to socially responsible design in the institutional manifesto or vision/mission documents of the design education programmes. Analyses of mandates, mission/vision statements of design education institutions demonstrate that such documents, some more elaborate than the others, do articulate their commitment towards socially responsible design. However, these documents do not present further directions to actualise their intent and the process of assessing their progress in this direction.

Second, the examination of curriculums highlighted the manifestation of institutional intent of imparting the values of socially responsible design. The analyses of curriculums also showed varying percentage of courses across different programmes with scope of imparting these values. But the percentage of courses that have the scope of imparting such values is small. They are largely dominated by courses that focus on imparting industry specific skills and knowhow that may be only temporarily marketable and have little scope for imparting long-lasting values. The respondents too, expressed the lack of curricular emphasis on imparting the values of socially responsible design. Finally, another critical dimension of insufficient emphasis on socially responsible design emerged from the examination of the pedagogical role of design educators in this context. The curriculum is implemented through the pedagogic process that is highly dependent on the faculty members due to the nature of teaching-learning transactions in design education programmes. Competent faculty members are required even to actualise the scope of imparting socially responsible design values that are present in the small percentage of courses. The respondents were of the opinion that the design educators need to be adequately prepared in their understanding of socially responsible design values and better trained in transferring these values to the students. However, due to lack of adequate programmes to train design educators, the difficulty in imparting these values are magnified. Evidently, there is a gap between the articulated intent, its manifestation in the course curriculums and the pedagogic actualisation of the manifested intent. The examination of the three key components of design education is supported by quantitative and qualitative data. All these bring out that the commitment towards socially responsible design, as articulated in the institutional mandates or mission/vision statements, receives a small manifestation in the course curriculum and a proportionate



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SPREADING GOOD SUSTAINABILITY PRACTICES THROUGH TEMPORARY RETAIL SHOPS

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ABSTRACT

The paper presents a didactic experience aimed at increasing the design skills and the sensitivity of bachelor students on environmental issues. Future designers, who will be able to modify spaces and products we use, must have both a sound disciplinary competence and a sensibility that modifies their daily behavior and adds value to their professional competence. With these goals, the topic of the Design Studio that will lead to thesis work about 55 students, concerns the design of a temporary retail space, able to communicate the environmental culture of a multinational Company. The brief was built in strict collaboration with a famous brand (Company) of apparel and shoes, that since many years has been paying attention to sustainability both in the productive processes as well as concerning the impact of their products at different levels. The project brief deals with the communication of the culture of sustainability, devoted to spreading awareness in the consumers and also in our students.

Key Words: Brand communication, Retail, Sustainability, Water.

1. INTRODUCTION: PROJECT BRIEF

We proposed to our students to design a retail space for sport apparel, shoes and accessories. This space has to express at the highest level the Company philosophy concerning sustainability. The structures must be temporary, with the possibility of being transported, dismantled, reused, disposed or recovered. Moreover, they must be built using low impact materials and have low energy consumption. In short, they must respect the indications of research in terms of environmental compatibility. The students worked on the integration of environmentally conscious design solutions and technical principles. Thus, they have given great importance and consideration to understand how such structures can communicate a positive environmental message in order to induce higher levels of virtuous behaviors or modify harmful attitudes towards the environment (Vezzoli, et al., 2018). The theme of sustainability is seen as a positive value, linked to the joy of living, moving and doing sports in a healthy, beautiful and clean environment, as, of course, without a clean environment it is impossible to play sports. The main target is the generation Z, a generation of digital natives, attentive to technologies and environmental issues (Howe & Strauss, 1991), and the same to which our students belong.

Aim of this paper is to present the results of the aforementioned Design Studio, and its innovative didactic approach deriving from a didactic collaboration with a Company.

2. METHODOLOGY

During the first part of the Design Studio the students attended a cycle of lectures on circular economy, from the most general level, up to the planning and constructive themes. A series of testimonies have been brought on the topic of retail design and micro-architectures. Particular attention was paid to the issue of preventing the dispersion of plastics in the oceans, cleaning the seas and reusing plastics as a second raw material. To give a real location to the projects, and to underline the need for lightness, we asked that the structures could float on the waters of the Milanese Navigli. The brief was given by the Company, which for years has been working on reducing the impacts of producing and recycling certain materials, also in cooperation with NGOs dedicated to recovering plastic waste from the ocean. We consider the proposed topic extremely stimulating, because it is real and controversial at the same time: the students have to confront themselves with a Company that produces thousands of thousands of products, which manages factories in different countries, transporting and selling worldwide, which is putting in place a series of actions to reduce impacts, from the study of raw materials, till the end of the lifecycle of the products. An extremely complex system which still presents different unresolved knots, some of them very difficult to solve. In the first phases of the Studio we pushed the students to work through key words, inviting them to aggregate ideas with maximum



freedom. Later on we have logically arranged the words resulting from the general discussion into general clusters.

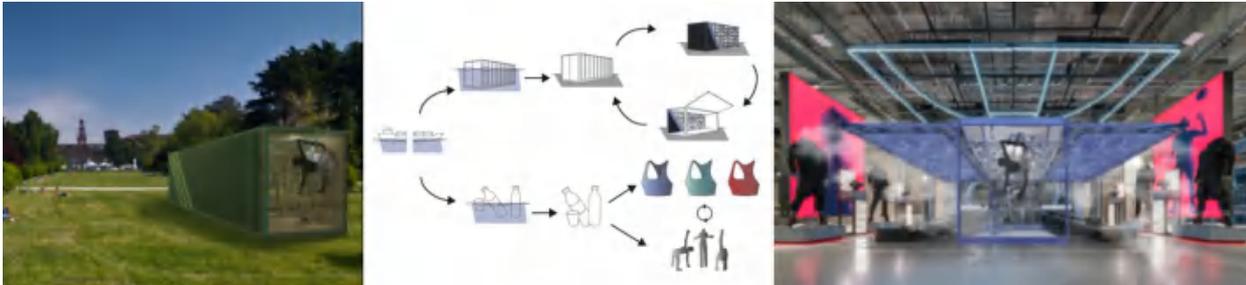
[Fig.1] Students working on keywords and their classification in clusters

The keywords have been elaborated in different ways by each working group. As a consequence, this initial analysis and elaboration has brought the projects in different directions. Keywords are, for example: sports, water, lightness, temporariness, mobility, energy, movement, community and others. Professors and tutors followed 19 projects, drawn up by groups of two, three or four students. Some projects are more focused on triggering virtuous behaviors in the costumers others are more interested in developing new exhibition solutions: in any case, both of them are present and closely connected in each project,. The main target users of the projects, generation Z, are very interested in the creation of communities based on the sharing of values. Values related to sustainability are conveyed through actions and emotions (Morin, 2015). The students declined the theme of sustainability in many different ways: the messages that are proposed are relative for instance to the fact that one small gesture can change the world, that taking care of things is a sustainable act, that the energy of the body teaches us to love the environment, that running alone is beautiful, but it is better together, that using digital and augmented reality (AR) lightens our footprint on the earth, that it's important to remove material, to lighten, to refine quality. Below some examples of the projects developed in the Design Studio.

3. PROJECTS

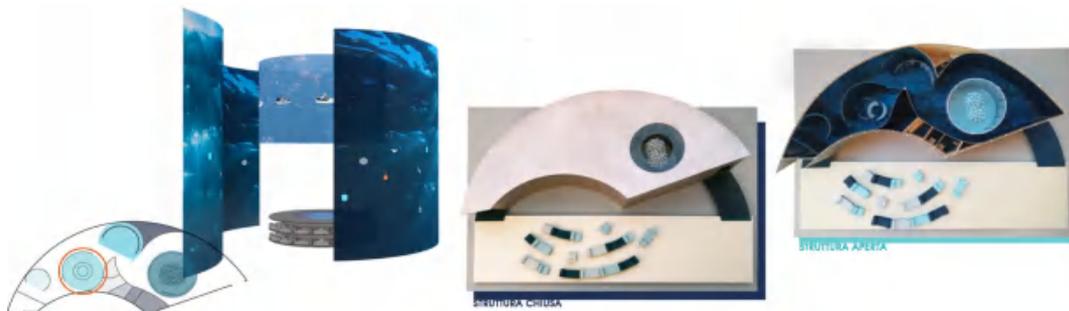
We are nature. The project has as its primary objective in the rediscovery of the potentiality of the binomial nature-body as a primary source of energy, in favour of the physical and mental well-being of the person. The concept of this project has raised from the idea of minimizing the environmental impact: reusing a container lost from a ship and recovered in the ocean. The recovered container becomes the testimony of an approach to reuse existing elements, contributing to the process of cleaning the sea. Inside it is set up an immersive space in different natural contexts: the ocean, the forest, the sunset. The container can be transported and reused in different places. Sustainability is generated by the symbiosis between individuals and the natural environment, which embodies the values of respect and care for oneself and for the planet.

Students: Cristina Pirovano, Martina Carozza, Nicole Bottazzini



[Fig.2] *We are nature project: concept and visualizations*

Immerse in future. The project consists of a light setting with reusable fabric and aluminum elements used for exhibition stands. It contains screens with immersive reality on environmental themes. The strong innovation of this project is the use of augmented reality in the shopping process. This choice arises from the need to address new generations in a simple and instant way, being at the same time sustainable since in a virtual world nothing can be created nor destroyed physically. Inside, the environment is initially dark and evocative and illuminated almost only by large panels that surmount circular structures, such as micro capsules, and in which suggestive images of the water world are projected. By framing the user's foot with the shoe worn, the various colors and textures can be chosen, given that in this shop all shoes are white solely as prototypes to be tried. Thus, the space from dark becomes full of light and coloured. Even in the purchase phase, users are involved: they can customize their product by choosing a certain date, so that the delivered product will be made with plastics collected on that specific day. Then, through



the App, it will be possible to see how many people have chosen the same product and date, the idea is to connect people from all parts of the world with a common goal.

Students: Michele Corna, Veronika Merlin, Baoshan Xue

[Fig.3] *Immerse in future project: concept and visualizations*

Laundry. The project deepens the theme of sustainability through a real 'shoe clinic' that sensitizes the consumers to the topic and offers an innovative service. The pop up space is set up during the Design Week and remains there for the following three months. The entrance welcomes the user in the sales area, where it is possible to see the shoe and apparel collection and buy it online. At the same time it is possible to enjoy the view of the whole environment. The "laundry" is located in the heart of the structure and becomes the pulsating center of the space. Through the transparent walls it is fully visible from every corner of the whole environment. This space offers a laundry service and small repairs. Every customer can directly follow the process of washing their shoes, as the whole mecha-



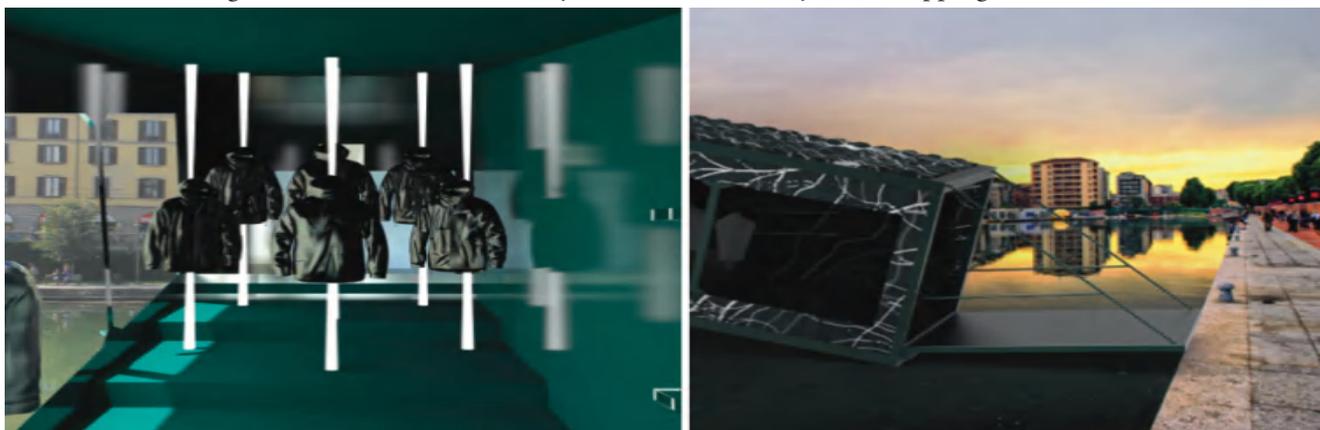
nism is visible. In the end a the conveyor belts make the shoes float on the ceiling. A gradient allows the descent to a

softer and clearer space, in connection with the water; in fact it is possible to access it only by removing the shoes.

Students: Marika Caputo, Chiara Di Fonzo, Alessandra Vigani

[Fig.4] Laundry project: concept and visualizations

Synapsis. The name Synapsis refers to the sinapsis of the brain and also means “connection” in Greek. In the project the sinapsis take the form of containers that are the central contact spots of the community. Inside the structure the user finds himself in an immersive space, surrounded by screens and sounds showing several montages of videos from different places. Each video is dedicated to a different sport and shows a representative athlete of the specific discipline sharing his/her sport experience and how environmental issues influence it. They act as brand ambassadors to spread the sustainability that the Company aims to give. Furthermore, a window is opened on the floor to walk on and create a visible contact with the undergoing water. The outer walls of the containers are covered with a special fabric that contains dimming lights creating the effect of a neural net that has the purpose of visualizing the connections with lights and colors. The main layout is constituted by three shipping containers, that can be indi-

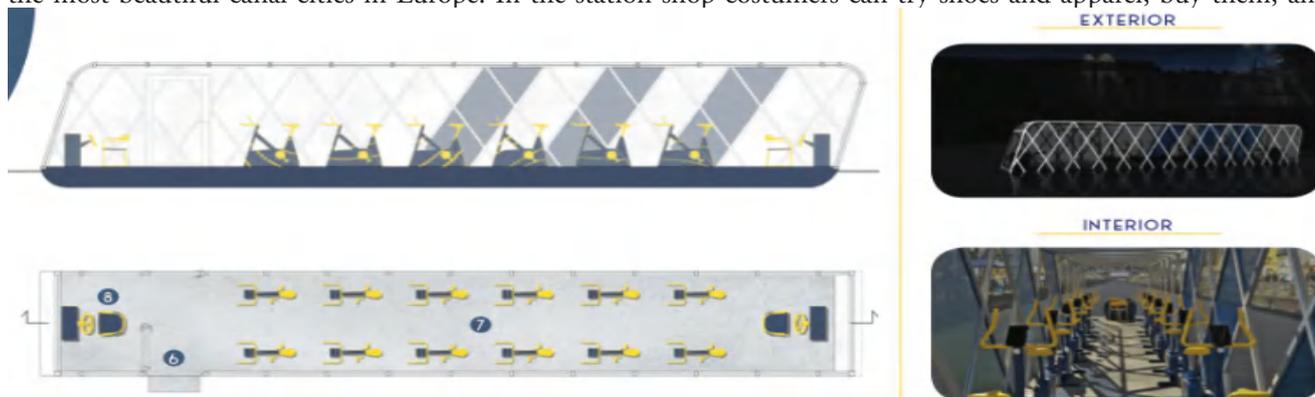


vidually disassembled and moved to different locations. It presents one container with the immersive experience, one container with all the technical parts and a storage area.

Students: Miona Aleksic, Gaganjot Kaur, Libero Padula, Luca Parravicini

[Fig.5] Synapsis project location and interiors

Moven: Floating Cycling Gym moved by green power. The project structure is self-standing thanks to the use of LSC panels, from which it collects energy. The project comprises two structures: a station shop, placed on the canal border and fixed; a Cycling Gym, with exercise bikes inside. A small group of people can make the Gym move by cycling for a long time; a person alone can produce a certain amount of power, that it is multiplied when produced by a group, which also serves in creating a sense of community. While cycling people can enjoy the view of some of the most beautiful canal cities in Europe. In the station shop costumers can try shoes and apparel, buy them, and



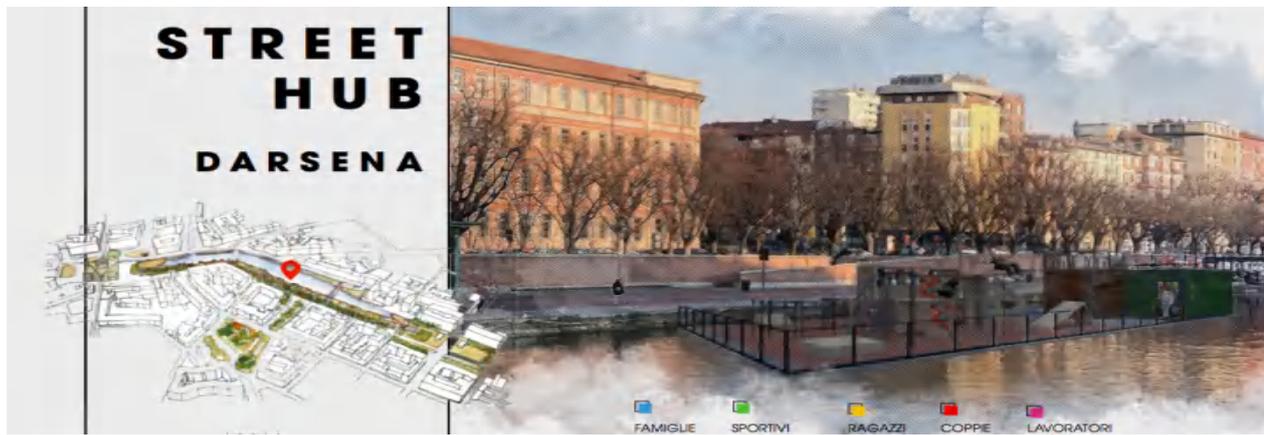
wait for the gym to arrive. A bridge allows them to enter the Gym, and start the experience.

Students: Ivanka Yordanova Dicheva, Kate Natalie Rova, Maroussia Lindsay P de Gheldere

[Fig.6] Moven Cycling Gym technical drawings and interiors

Street Hub. The Street Hub project is a floating platform in the suggestive Milanese Darsena, aimed at offering the city a unique place to practice Parkour, one of the most prominent sports of recent times, together with a store selling sports shoes and apparel and a space for related events. Overlooking the north side of the Darsena, the space opens up to all the traceurs, sportsmen or simple passersby who are there, providing an open-air gym and a place for meeting and exchange. From an eco-sustainable point of view, only recycled materials were used. Old scaffolding tubes and chipboard form the gym to practice Parkour, three dismantled containers host the store that is furnished with 100% recycled steel elements; and finally, the external anti-trauma flooring was created with crushed tires, ideal for ensuring greater safety, reducing injuries.

Students: Stefania Caruso, Michele Mortula, Sergio Petrolò



[Fig.7] Street Hub project visualization

4. CONCLUSIONS

Spreading good practices through the design of retail stores seemed a difficult challenge. Thus, the experience has shown how complex and interesting is this specific topic. Furthermore, communicating the culture of sustainability through the development of retail design projects requires to face different levels of complexity, from the definition of communication strategies, to the ways in which such strategies are transformed into actions and concrete objects. The choices therefore concern:

- a reflection on the target, made up of active, aware and digital born consumers, attentive to the environment and to sociality;
- the range of activities promoted in the space: the so-called shop is no longer the traditional store, but it tends to accommodate different functions and to cross activities not directly related to the actions of selling and buying (Vaudetti, et al., 2014).
- Specific choices related to constructive criteria: the focus is on the temporality of the intervention, taking into consideration reused or reusable structures, dry assembly, the use of certified materials throughout their life cycle (Bengisu & Ferrara, 2018; Thackara, 2015);
- the increasingly intense use of interactive digital technologies, destined to profoundly modify design discipline for the coming years. The relationship between real and virtual affects design projects and emphasizes a possible dematerialization of part of the retail experience, in line with the desire to “touch the earth with lightness” (Piardi, 2004).

The experience described in this paper has also brought about the following results:

- to the mutual enrichment between the university context and the entrepreneurial context: we have learned from each other in a relationship of trust and continuous exchange of skills and experiences; the different points of view has generated interesting tensions;
- to the increased environmental awareness of the students, as they immersed themselves in complex constructive and design themes, their environmental competence grew. This expertise will hopefully affect all their future projects;
- to reinforce the belief that design projects, in order to modify the present, must act in a harmonious way in all its phases, from the concept, to the activation, to the executive development, to the construction and its disposal.

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FASHION DESIGN-RELATED DOCTORAL STUDIES IN SELECTED KENYAN UNIVERSITIES: ADVANCING APPLIED RESEARCH IN SUSTAINABILITY AND HUMAN-CENTRED APPROACHES (SUB-THEME: DESIGN EDUCATION FOR SUSTAINABILITY)

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ABSTRACT

Globally, PhD training has received particular currency in higher education policy circles. Universities are challenged to conduct research that demonstrates measurable positive impact to stakeholders. Notably, all fashion design doctoral theses in Kenyan universities adopted pure/basic research bearing limited scope within the practical-oriented discipline. This paper explores how thesis content occasioned skewedness toward basic research and limited sustainability discourse through mixed-method research design. Fashion design-related doctoral research focused on fashion marketing (34%), fashion design training (22%), textile science (22%), sustainable fashion (11%), and consumer behaviour (11%). Fashion stakeholders' increasingly complex conundrums persist for lack of practical solutions notwithstanding that research outcomes in design-related disciplines need designing. This paper strongly recommends taught-doctorate programmes incorporating practical-oriented units and alignment of research to national and international development goals and research agendas. Consequently, fashion design doctoral candidates should competently engage in emerging discipline-specific issues especially trans-disciplinary applied research in sustainability as well as human-centred approaches.

Keywords: applied research; fashion design; human-centred approaches; sustainability

1. INTRODUCTION

Globally universities are challenged to conduct research that demonstrates measurable context-responsive social impact by positively contributing to the realization of diverse national development plans and visions (M'Rithaa & Jamie, 2017) and international development goals namely United Nations Sustainable Development Goals (SDGs). The development of higher education (HE) systems is particularly critical in Africa given the potential of research to drive scientific output and innovation in order to address dynamic significant challenges (British Council [BC] and German Academic Exchange Service [DAAD], (2018) experienced by stakeholders: academia, end-user, solution economy, industry and community. For instance, unemployment among the youth (15-24 years old) in Kenya stands at 39%, the highest in eastern Africa (BC, n.d). Currently, there is a 'shared optimism' in sub-Saharan Africa (SSA) on the value of building PhD capacity, as exemplified in the Kigali Communiqué (2014) and the Dakar Declaration (2015) (BC & DAAD, 2018). The outcome of a doctoral study in problem-solving disciplines (inter alia fashion design) can be the production of consumer products' prototypes, curriculum development or a design practice tool (Evans, 2009) as well as a fashion collection, training module, marketing tool, theory, textile decoration technique or a policy brief emanating from applied research in sustainability (ARS) and human-centred approaches (HCAs). In Kenya, doctoral research must constitute not less than two thirds of the entire PhD programme structures (Commission for University Education [CUE], 2014) preferably strategically aligned with Kenya Vision 2030, African Union (AU) Agenda 2063: The Africa We Want and UN SDGs. Lecturers with fashion design PhDs in Kenya account for 30.4% of the total number who deliver all degree programmes (Njeru, 2016) posing a significant strain on the human resource. Kenyatta and Maseno Universities in Kenya have been offering fashion design doctoral degree programmes for almost 20 years. A reconnaissance survey of fashion design-related PhD theses submitted in the two universities between 2007 and 2014 reveals that 100% adopted pure/basic research – these advance knowledge at the expense of applied research which solve a current problem relevant to society and HCAs. Consequently, there is a dearth of robust concrete and impactful interventions to fashion design conundrums despite the discipline being problem-solving and practical-oriented.

2. CONTENT OF DOCTORATE THESIS

A thesis is the final embodiment of an advanced independent study conducted by a doctoral candidate. The research should strictly employ the principles and practice of research methodology (Evans, 2009). There is a marked disconnect between PhD research topics/output and the national research agenda, which calls for an evaluative framework at national level for judging the quality and relevance of research output, including PhD output (BC & DAAD, 2018). All sections of research include literature. thus a good literature review must be exhaustive, fair in its treatment of authors, topical, from varied sources and well organized (Mouton, 2001). Theory and research are inextricably linked and therefore complimentary in nature. Both qualitative and quantitative research methods may be employed and be robustly defended in design-based PhDs (Evans, 2009). Problem-solving disciplines, such as fashion design should embrace trans-disciplinary (TD), human-centred and participatory qualitative tools for more creative and innovative solutions in the development projects in Afrika¹ (M'Rithaa & Jamie, 2017) and to significantly deepen the range of human problems Home Economics (comprising clothing and textiles among others) the discipline would consider (McGregor, 2016). Evans (2009) argues for the use of researcher-practice as a data collection method in creative disciplines whereby the role of practice becomes 'data translation'. Technique triangulation is highly recommended in doctorate research in order to provide the whole picture about the phenomenon. Three factors motivate researchers to engage in practice, specifically industrial designers: research outcomes need designing; designers enjoy designing and; students need tutors that can design (Evans, 2009).

3. SUSTAINABLE FASHION

The contribution to Africa's "creative economy" and society by the creative industry/solution economy that comprises fashion design among others, over many years has been relatively small despite its huge potential (Nzohabonimana, 2016). Fashion design is the art of application of design and aesthetics to apparel, fashion accessories and textile products influenced by arts, aesthetics, technology, culture, architecture, science and politics and varies over time and place (Campos & Rech, 2010). Fashion design research focus areas include sustainable fashion, socio-cultural, economic and psychological aspects, technology, product development, historic textiles and costumes, costume conservation, textile science and curriculum. Sustainability encompasses materials, energy, products, product-service systems, distributed economies, social innovation, circular economy, business models, indigenous practices, informal economies, policies and education. Fashion production and consumption are unsustainable. Sustainability frowns on wasteful consumption (Dissanayake

¹ Afrika (as spelt with a 'k') reflects the emerging narrative of the continent as viewed from the 'inside-out' - in contrast with Africa (the traditional 'outside-in' perspective).

& Sinha, 2012).

Unsustainable fashion consumption is occasioned by fast changing fashion trends, affordable prices and mass production systems (Niinimäki, 2012) and limited lifespan of sustainable fashion products (Armstrong et al., 2016) which lead to disposal of waste products. Co-creation, a design approach where many stakeholders are actively involved in the design process (Prahalad & Ramaswamy, 2000) could be the panacea to unsustainable consumption and to meet the needs of a growing population of environmentally (and socially) conscious consumers willing to pay a premium for sustainable products (Republic of Kenya, 2015) especially Gen Y which is one of the most informed age groups about environmental issues, with enormous influence and buying power (Brosdahl & Carpenter, 2010) as well as special-needs end-users. In Kenya the manufacture of textile and apparel, and dyeing and leather is categorized as moderate and high energy-intensive respectively (Ecocare, 2013). The solution to unsustainable fashion production is green manufacturing/cleaner production: the manufacturing of green products and the greening of manufacturing (Republic of Kenya, 2015) and packaging, thus safe and healthy for workers, communities, and consumers. Green/sustainable products are durable, repairable, easily bio-degradable, recycled, reversible, multi-styled, unisex, allow for growth of end-users, adaptive, made from natural fibres and decorated with natural dyes. At the end of the products' life they can be sold in fleas markets instead of disposing in landfills. The dynamic sustainability conundrums demand doctoral candidates to innovatively employ ARS and HCAs in order to address them without off-setting economic benefits.

4. STATEMENT OF THE PROBLEM

The authors collectively by virtue of serving for extended periods in schools' Postgraduate Studies Committee as well as supervising and examining doctoral theses have observed some trends in the fashion design-related doctorate theses: 100% of the research outcome is pure/basic research at the expense of ARS and HCAs; devoid of diverse current design methodological applications and; limited scope in terms of appreciating emerging global trends especially sustainability in the disciplinary domain. Consequently, doctoral researches conducted did not provide practical solutions to societal problems thus have limited relevance/impact. This trend is contrary to the imperative for PhD candidates to conduct meaningful authentic research that substantially demonstrates positive measurable social, economic, cultural and environmental impact whilst strictly employing emerging principles and practice of design-related research methodology. No attempt has been made to systematically analyse fashion design-related doctorate research in Kenya in terms of contribution to sustainability and research output. Thus, the specific objective of the study was to analyse fashion design-related doctoral thesis content that drives the skewedness toward pure research output and lack of sustainability concepts.

5. RESEARCH METHODOLOGY

The research design adopted was mixed-method: literature reviews and descriptive survey. The study was conducted in Kenyatta and Maseno Universities in Kenya. These universities combined have offered fashion design doctorate degree programmes since 2000. The study population comprised nine fashion design-related doctorate theses. The theses and six doctorate graduates were selected via census and convenience sampling respectively. Data collection entailed analytically reading the theses guided by an observation checklist as well as a semi-structured questionnaire administered to the graduates via electronic mail. Quantitative and qualitative content analyses as well as descriptive statistics (frequencies and percentages) and thematic analysis were employed in the study. Both technique and data triangulation helped enhance reliability and verification of the study. In terms of ethical consideration the researchers and academic supervisors remain anonymous.

6. FINDINGS

6.1 Gender and graduate degree

Survey findings reveal that 100% of the respondents were female. The result is probably because women are perceived as the predominant and "traditional" purchasing agents of apparel for themselves and family members (Visser & du Preez, 2001).

The respondents pursued PhD in fashion design in Kenyatta University and Maseno University at 80% and 20% respectively. The most common structure of the programme was by doctorate-by-research model (83%) with a minority (17%) by course work/examination/thesis. The finding resonates with BC and DAAD (2018) that the structure of PhD in all the countries typically is doctorate-by-research model culminating in an oral defence of the thesis. Accordingly, the dearth of preparatory coursework and seminars denied the doctoral candidates exposure to and engagement with emerging fashion design-related research methodologies and global discourse on sustainable fashion. The candidates could have been ignorant of BC and DAAD (2018) assertion that researchers especially PhD candidates are essential in driving scientific output and innovation thus contribute to the overall development

of a country. Hence, the limitations perhaps led to skewedness toward basic research at the expense of ARS and HCAs thereby the stakeholders do not benefit from the research.

Years	Respondents	
	N	%
2-3	2	33
4-5	3	50
5-7	1	17
Total	6	100

Mean years = 4.5

From the survey, Table 1 reports half (50%) of the respondents took 4-5 years to complete their studies. The period was ample to conduct ARS and HCAs.

Table 1: Respondents by duration of studies

6.2 Doctorate thesis content

The study analysed thesis content that drives the skewedness toward pure/basic research output and lack of ARS and HCAs on fashion design doctoral research. The theses titles are broadly categorized as fashion marketing (34%),

Source of research problem	Respondents	
	*N	%
Academic supervisor	0	0
Theses	0	0
Scientific journal manuscripts on fashion design	3	50
Observation	4	67
Personal experience	3	50
Newspaper	1	17
My Masters thesis	1	17

*Multiple responses were allowed

fashion design training (22%), textile science (22%), sustainable fashion (11%) and consumer behaviour (11%). The limited doctorate study conducted on sustainable fashion occurred against a background of unsustainable fashion production and consumption even in Kenya, and solutions to the fashion conundrums require ARS and HCAs.

6.2.1 Source of research problem

Table 2: Respondents by source of research problem

Survey outcome (Table 2) reveals major source of the research problem was observation (67%). However, observation may be subjective and affirms BC and DAAD (2018) that there is disconnect between PhD research topics/output and national research agenda. The reliance on observation contributed to skewedness toward basic research outputs at the expense of ARS and HCAs for fashion design conundrums. Sericulture development in Kenya has been constrained due to lack of sufficient technological expertise in cocoon processing requirements and silk production process (P1). Despite the government's effort to support the use of information communication technology (ICT) by micro and small enterprises (MSEs), garment-making micro-enterprises (GMEs) in Kenya face marketing challenges (P9). There is threat of cultural extinction, specifically, the ethnic dress of the Mau Ogiek of Kenya (P3). Little of practical use has been published on the art of draping beyond introduction of the basics (P7). The adoption of the Kenya National Dress (KND) was unexpectedly low among the Kenyan public, despite bearing significant cultural and economic implications in Kenya for fashion designers, manufacturers and traders (P6).

6.2.2 Objectives of the study

An equal number of theses had four, five and six objectives. Verbs employed in the objectives include determine (25%), establish (22%), evaluate (9%), identify (9%), describe (7%), analyze (7%), verify, examine and assess (4%), and investigate, discuss and develop (3%). The results depict verbs of low level complexity in Bloom's taxonomy. The verbs contributed to skewedness toward basic research outputs rather than ARS and HCAs that would have innovatively solved real-life fashion design conundrums for diverse fashion stakeholders. P8 sought to determine the effect of soil properties and climate conditions in A. Americana "Marginata" fibre properties. P2 aimed to establish various marketing strategies undertaken by GMEs. P4 sought to identify range of products sold by textile-based handicraft traders. Noteworthy is that P6 aimed to develop a decision-making model for enhancing adoption of new local apparel designs. P6 resonates with Claudio et al. (2016) whose objective was to develop new forms of recycling synthetic textile waste containing PA66 (supplex) that could be applied in the development of new materials, products and business models.

6.2.3 Significance/justification of the study

Results reveal the words significance and justification were used interchangeably in the theses. The theses analysed argue that benefactors of the studies include fashion and textile industry, farmers, body of knowledge/research, universities/education, culture, government and enterprises. The industry was said to benefit from improved marketing of existing and potential micro-enterprises by using best e-marketing tools

(P9); Farmers were found to benefit from development of a concept to commercialize the A. Americana "Marginata" fibre (P8). Addition to the body of knowledge and research was textile handicraft trade in Africa (P4). The universities/education were reported to gain from improved UUGFAD training to address industry manpower needs (P5). The significance to culture was to conserve ethnic dress, add to the scarce collection in the Nairobi National Museum (NNM) and provide cross-cultural point of view in adapting theories and practices of dress to an African ethnic group (P3). Thesis P3 championed the implementation of the Kenya Constitution 2010 and achievement of Kenya Vision 2030 but omitted UN MDGs. Finding contradicts Ogot (2017) stresses that the significance of a project or research for PhD candidates must clearly describe the novelty, uniqueness and innovativeness of the idea as well as its impact. Though theses P2 and P6 allude to the development of manuals and P9 the design of appropriate tools and framework, these outcomes were not presented in the theses. Thereby, denying potential benefactors of valuable resources to address fashion design-related conundrums.

6.2.4 Theoretical or conceptual framework

The theses adopted conceptual frameworks (78%), theoretical framework (11%) and both theoretical and conceptual frameworks (11%). The use of both conceptual and theoretical frameworks could possibly be a misunderstanding of the difference between the two frameworks. Theories employed in the theses include Contextual (P3), Systems (P5), Entrepreneurial Orientation (P2), Contingency (P9) and Activity (P7) while models adopted were

Source of literature	Respondents	
	*N	%
Fashion design-related manuscripts in scientific journals	6	100
Theses	5	83
Textbooks	6	100
Newsletter	2	33
Magazine	4	67
Brochure	1	17
Trade publication	3	50
Government report	4	67

*Multiple responses were allowed

Entrepreneurship (P4) and Momentum of fashion industry (P6). It is crucial for fashion design doctoral candidates to develop home-grown theories and models of fashion.

6.2.5 Literature review/review of existing scholarship

Table 3: Respondents by source of literature

The survey outcome in Table 3 demonstrates that all the respondents (100%) obtained literature from fashion design-related manuscripts in scientific journals and textbooks probably because they are readily available in the university libraries and Internet. A further 83% sourced for literature in theses, which provided the local perspective of the phenomenon being probed. The finding resonates with Mouton (2001) that the bulk of scholarship is still published in standard scientific journals and textbooks, which should be the first stop for graduate candidates. Conversely, textbooks may be out-dated thus do not address contemporary phenomena. Government reports (though very detailed and current with a methodology section) would have essentially provided in-depth insight on diverse fashion design-related phenomena (for example industry competitiveness), but were partially (67%) sourced. The respondents were thus unable to grasp the magnitude of the problem under review, its impact on national development and potential for research, hence failed to provide practical interventions to the conundrums.

6.2.6 Research methodology

Theses content analysis explored the role of research methodology toward skewedness toward basic rather than ARS and HCAs notwithstanding that fashion design is a problem-solving discipline and that fashion is experiential.

6.2.6.1 Research design, study population and sampling techniques

Research designs adopted included survey design (56%), experimental (22%), ex-post facto (11%) and ethnography (11%). Notably, no study adopted mixed-method design. The outcome contradicts McGregor (2016) that stresses on Home Economics (which includes fashion design) research to adopt trans-disciplinary approach in order to design practical interventions. Textile science studies' population included silkworm strains (P1) and Agave Americana plants (P8). A significant majority (78%) of the study populations were stakeholders comprising GMEs (P2), textile handicraft traders (P4), fashion enterprises (P9), ethnic group (P3), staff and students of universities and technical training institutes (P5, P7) and consumers (P6). The human subjects provided opportunities for HCA applications and practical solutions to their challenges, but it was not exploited. Probability (78%) and non-probability (22%) sampling techniques were adopted. The former, influenced by the majorly quantitative research designs adopted led to skewedness toward basic research output rather than ARS and HCAs that is more amenable to fashion design.

6.2.6.2 Data collection methods and analysis

Generally, the studies employed 1, 2, 3 and 4 research instruments respectively at 45%, 22%, 22 and 11%.

The former negates the requirement for technique triangulation especially doctoral research which provides a basis for checking and rechecking interpretations and reveals “the whole picture” of the phenomenon (Kaiser, 1997; Gobo, 2008). Among the data collection instruments used were interview guide (27%), observation checklist (11%), fieldwork photography (11%), laboratory equipment (11%), semi-structured questionnaire (6%), focus group discussion guide (6%), and document analysis (6%). The evidence is inconsistent with M'Rithaa and Jamie (2017)

Data analysis techniques	Thesis	
	*N	%
Frequencies	7	78
T-test	2	22
ANOVA	3	33
Factor analysis	1	11
Multiple regression	2	22
Co-efficient of determination	1	11
Pearson product-moment correlation	1	11
Chi-square test of association	3	33
Thematic analysis	3	33
Qualitative content analysis	1	11

*Multiple techniques were employed

who stress that problem-solving disciplines, inter alia fashion design should embrace participatory qualitative tools for more creative and innovative solutions.

Table 4: Doctoral thesis by data analysis

Predominant employment of quantitative statistical techniques (Table 4) skewed the studies toward basic research. The candidates did not design, contradicting Evans (2009) who underscores that research outcomes need designing.

7. CONCLUSION AND RECOMMENDATIONS

A small pool of fashion design doctoral candidates solved diverse problems in textile science, sustainable fashion, fashion marketing, fashion design training and consumer behaviour through basic research. Notably, the studies were not aligned to Kenya's Vision 2030, AU's Agenda 2063 and UN's MDGs and SDGs thus failed to contribute to the goals' achievement. The skewedness toward basic research in the thesis content is attributed to the dominance of quantitative research at the expense of qualitative research designs and their accompanying tools. Hence, the fashion stakeholders' conundrums persist unabated because the studies did not provide concrete solutions despite fashion design being a practical-oriented discipline and research outcomes need to be designed.

In order to guide and enhance fashion design doctorate research in Kenya that promotes better quality of life for all, the following recommendations are made:

i) The development of new and revision of existing fashion design doctoral programmes to taught-doctorate per CUE guidelines. Units offered in the coursework to include fashion design for sustainability, seminars to engage with contemporary issues, practical-oriented to solve real-life problems, practicum for linkage with stakeholders, design-related research methodologies that promote robust impactful solutions to stakeholders' conundrums through innovation of products, curriculum, services, systems, tools and experience;

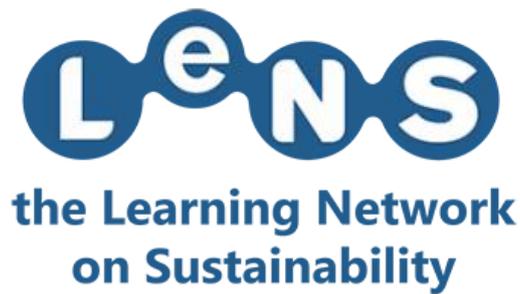
ii) Candidates should align research to national, regional and international research developmental agendas. Specifically Kenya's Big Four Agenda refers. In so doing, the candidates shall address existing national challenges and priorities especially unsustainable fashion production and consumption using ARS and HCAs; and

iii) Capacity building be actualized to address the dire shortage of fashion design PhD holders who are potential academic supervisors of graduate candidates. These graduates should be well-equipped to practically engage in design concerns, especially ARS and HCAs.

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TRANSDISCIPLINARY FUTURES: WHERE DO EMBODIMENT, ETHICS AND EDUCATION MEET FOR SUSTAINABILITY LEADERSHIP?

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ABSTRACT

Artists, designers and educators of today and the future have the particular challenge to create for a fragile world where politics, economics and ecosystems are placed at the tipping point of culture, ethics and the tradition of the artisan. The sustainability crisis is not merely one of the biophysical environment and its extreme degradation but also a severe crisis of the social, cultural and individual environment. These crises are not just outcomes of global demands in technology, production and volume but rather complex behavioural issues and the paradigms that sustain them. With all these existential and philosophical issues at stake today, Universities offering Design education programmes have the challenge of creating programs that embrace sustainability through transdisciplinary viewpoints. In this paper, we are offering two transdisciplinary units - 'Sustainable Institute' and 'All of a sudden!- Time as paradox' as case studies to exemplify Sustainability curriculum design and its outcomes.

Key Words: Embodied Learning, Transdisciplinarity, Gardening, Sustainable Institute

INTRODUCTION

Curriculum designers in today's Design schools envision the people who will navigate their programs and emerge with unique capacities to interact with the world in diverse ways and design meaningfully under global duress and transition. "Until recently, sustainable design methods seldom engaged with more fundamental questions such as the meaning and place of products in our lives and the contribution of material goods to what might be broadly termed the human endeavor" (Chapman, J. *Design for (Emotional) Durability Design Issues* vol 25 number 4 2009 pg 29-35). With all these existential and philosophical issues of the human condition at stake today, Universities offering Design education programs are forced to reconsider what they train their students to excel in, as well as create newer programs that embrace multiple viewpoints through transdisciplinarity and/or consider transition as a key navigation scheme. (School of Design at Carnegie Mellon University. (2012). *Transition Design*. Retrieved from <https://transitiondesign.net/>). Two key approaches today are looked at as Nicoliescuan and Zurich schools of thought in transdisciplinarity. "Nicoliescu's writing led to a new way of thinking about knowledge and inquiry that has included writing from ethical, metaphysical, and even mystical perspectives (see Nicoliescu, 2008, de Mello, 2008, Voss, 2008), while the Zurich school has led to work aimed at designing and implementing tangible solutions to "real world" problems (Segalàs & Tejedor, 2013)." (As cited in Bernstein, 2015).

Transdisciplinarity challenges knowledge fragmentation and emphasizes production of knowledge in a reflexive non-linear format ready to respond to uncertainty and the local character. It enables inter-subjective and context-specific transaction of knowledge frameworks. Transdisciplinary research combines the individual's access and relationships within the social network to the constraints enmeshed within the social, natural and material contexts thereby requiring close collaboration during all phases of a research project. It is especially needed for theoretical analyses and interpretation of complex issues that interconnect the individual with the environment, economics, society, science. Much of the traditional paradigms of Asian and Far eastern approaches and traditions rest on transdisciplinarity as well and there is a potential to reflect and adapt many of these paradigms into current approaches and conversations. The notion of creativity is key to culture, education, design production, development and consumerism. The need to unpack the notion of creativity through the framework of the arts in Asia is crucial to reframing and redefining alternative perspectives to Making, Development, Sustainability and Education. Education defines the politics of how we think, make and act in society (Vatsyayan 2010, 2013; Balaram, 2011; Subramanyan, 2007).

In 2015, when Srishti Institute of Art, Design and Technology expanded its vision, B.Des and M.Des Information Arts and Information Design Practices as well as M.Des Earth Education and Communication were three new courses that were started as transdisciplinary courses. They problematize the fields of art and design within socio-cultural, ecological and ethical frameworks. Further, their focus emerges from and lies in the crucial space of education, problematizing the nature and politics of knowledge in the emergent transdisciplinary frameworks of the two courses. Srishti has developed its positioning of the two courses within the School of Law, Environment and Planning (SLEP) and through the Centre for Educational, Research, Training and Development (CERTAD). Our unique stance and approach to these emergent frameworks evolve from the intersection of the philosophy and praxis of both SLEP and CERTAD. My particular challenge as the principal curriculum designer¹, Course Leader (2015-current) and Associate Dean for SLEP, (2018-) therefore is to design and develop these two key courses as programs that would dissolve discipline-based perceptions, notions and definitions of information and data to engage with real life in its nuanced stories, allowing for new discourses to emerge. The units within the courses were developed with the aim to adapt and evolve modes and acts of research, making, collaboration, storytelling, exchange, communication, coexistence, intelligence, negotiation and leadership, enabling transdisciplinary and embodied engagement in the field. The courses are positioned within the School of Law, Environment and Planning (SLEP) and through the Centre for Educational, Research, Training and Development (CERTAD). The unique stance and approach to these emergent frameworks evolve from the intersection of the philosophy and praxis of both SLEP and CERTAD. Within the framework of Srishti, the core values of the institution lie in transforming consciousness through its pedagogical approaches (Narayanan, 2010). The transformation of consciousness through embodied practices, community engagement, contemplative reflection on the self, rediscovering interdependence and coexistence and the processes of learning and teaching lie at the heart of both IAIDP and EEC. My focus for both IAIDP and EEC curriculums is the aim to enable the student to be a discerning designer, one who is liberated from a 'cosmology restricted to the marketplace' and a 'sense of time limited to cycles of fashion and technological innovations' (Findeli, 2001). A discerned practitioner emerges from investigating, researching and creating in place and time, keeping all these complexities; the natural world; cultural histories; human notions of creativity and being across time.

The challenges of operationalizing any curriculum lie in translating the vision of the course through diverse units, documentation, assessment, training faculty and in evolving models of mentorship. Ensuring different aspects

¹ Special acknowledgements to Kavita Arvind as one of the architects of the IAIDP program and course leader from 2015-2018 April. Special thanks to Catalina Alzate and Sharath Chandra for critical inputs for IAIDP program development and to Anupama Arun and Padmini Nagaraja for the initial framework of the EEC course. Operational support of Murali Krishna Menon 2017-18 (IAIDP) and K.V.Gururaja 2017-18 June (EEC) are also acknowledged. (These courses acknowledge the inputs, support, directions and feedback of all faculty and students who have been involved in the B.Des, M.Des and the Post Graduate Diploma Program)

of the curriculum run cohesively and coherently across the different years of the program both undergraduate and postgraduate are key to the development and sustained evolution of the program. The design of units, supportive mentoring in the classes, primary and secondary research that both faculty and students immerse in to develop key ideas of a unit, extending the unit to develop new ways of being and making that are resonant with the curricular vision and emerging both critical reflections and directions for engagement in the field are essential components of translating the vision of the curriculum and the capabilities that we seek to develop in students. The educational/pedagogical question here is - how do we translate the vision of a curriculum in its individual unit level components and how does it address the capabilities framework of the program. Emotion, embodied practice, interdependence, creativity, reflection, community engagement and leadership are guiding principles of the pedagogy. The translation of these through unit design, mentorship, tools and methods used for teaching and learning, administrative support, research, and reflection are key goals to understand how the teaching of sustainable thinking can be evolved in the framework of the program.

Two of the units that I created for IAIDP and EEC M.Des students were co-taught with Sandhiya Kalyanasundaram from Aug -Nov 2018. We are offering these two transdisciplinary units - 'Sustainable Institute' and 'All of a sudden! - Time as paradox' as case studies to exemplify the curriculum design and its outcomes. The goals for these units were to support students in emerging an individual quest for developing an ethical and ecological consciousness as well as a keen interest in sustainability leadership.

THEORETICAL BACKGROUND:

Ecological, social, cultural and economic issues dynamically intertwine in the complex interplay of sustainability issues in India and sustainable design must be evolved keeping in mind India's position in the world marketplace. It is within this complexity that our contemporary practice as artists and designers arises. It is impossible to separate the politics of self, culture, ecology and making from our own personal practice. Reflective Practice, Ethics, Values, Being, Intelligence, Consciousness and Creativity -create the basic texture in which these programs are rooted. The key questions that fuel both these programs are: What does it take to be human? What are the ethics of engaging with life? What is the responsibility of creativity? What is the epistemology of good art and design practices?

The predominant pedagogical goal of environmental sustainability management education has focused on helping students increase their cognitive understanding of environmental sustainability in managerial practices and decision-making (Shephard, 2008). Yet, recent studies call for a significant shift in this paradigm (e.g., Audebrand, 2010; Shrivastava, 2010; Starik et al., 2010). For example, Shrivastava (2010) explains that teaching environmental sustainability management requires a more holistic pedagogy, that is, a pedagogy that integrates cognitive learning with emotional, spiritual, and physical learning. Christopher Uhl writes in his chapter on Process and Practice: Creating the Sustainable University, "Nine students expressed an interest in the project and we met to hatch a plan for measuring sustainability. I was candid with the students telling them that although I knew how to measure the dissolved oxygen concentration of a lake and the acidity of soil, I didn't know how to measure sustainability. Indeed, there is no equipment manufacturer that sells a "sustainability meter" (Barlett, Peggy F, and Geoffrey W. Chase(Ed.), 2004). We asked ourselves similar questions alongside the question of how we can find an internal meter for sustainable practices. Uhl and Stuchul articulate that the industrial and cartesian worldviews, alongside education and modern technologies have left us with a 'separation consciousness' (Uhl and Stuchul 2011, 4). They suggest a closer observation of life to emerge a 'relational consciousness' and turning inward to ask questions about how we can change ourselves to deal with the paradigms of both sustainability and ecological crisis (Uhl and Stuchul 2011, 5).

METHODS

Sustainable Institute Initiative is on the agenda of every major educational Institution across the world and across disciplines. Creating the community garden and the Mati eco-club were the first steps to this vision. Pedagogy, as well as assessment frameworks were carefully planned to create transdisciplinary engagements, contexts as well as methods that allowed students to take on large goals that enable them to engage with openness, question their own notions of disciplinarity as well as residues of cartesian and industrial worldviews. Embodied practice and contemplative reflective making were two key principles that we decided to adopt as our core methods for the two units. Cognition is viewed as embodied action by Varela, Thompson and Rosch in *The Embodied Mind* (1991). Merleau-Ponty also postulates an 'Embodiment Theory of Art' where he proposes that ideas of art have their origin in embodiment. (Haworth, 1997). Indian aesthetic thought perceives aesthetic emotive states as reflective and embodied states of performance stemming from a state of equilibrium arrived at through lived experience and meditative transformations. "It is the unreflected which is understood and conquered by the reflective. Left to itself perception forgets itself and is ignorant of its own accomplishments" (Merleau-Ponty 1964a: 19 as cited in Haworth, 1997).

A triangular patch area of 500 sq. ft. was chosen for regeneration in a red soil area where erosion has occurred for several years. The entire area was being used by the nearby communities as a dumping site for garbage, construc-

tion waste and other wastes. The aim was to regenerate the land and

- Create a community resource garden with social, ecological, ethical and learning design principles
- Reflect on interdependence and co-existence
- Strategically work with emergent systems and chaos
- Develop a body of creative work based on the embodied experience of creating a garden
- The broad approach to learning design included:
- Studying the soil quality, drainage rate of water
- Digging the garden. Understanding body and mind in relation to the simple act of digging and understanding varied layers of soil, trash. Reflecting consciously on the body.
- Consulting with experts, faculty in Srishti and other experts that include gardeners, Specialists in Traditional medicinal plants, composting, fencing, and others to build primary research and understanding of how to work in the garden.
- Developing a rain garden; Creating an onsite compost pit.
- Visiting FRLHT, TDU and GKVK campuses to get a list of medicinal plants and also visit the nursery. Selecting Plants, planning butterfly and medicinal garden.
- Understand relationship between elements and principles of art and design in visual works as applied in gardens and how to design for a garden keeping seasonal parameters in mind.
- Preparing the land, working with labourers, improving soil quality with vermicompost and additional layer of topsoil. Creating pits, contour bunds, planting grasses and embedding porous tiles along edges to stop soil wash-off
- Document work, reflections, online blog development, social media; Develop charter

The second year students transitioned their work to first year students. First year students worked on the garden for five weeks as part of their class and for two weeks as a self-designed inquiry. First year students build the rain garden and furthered the work with the community leading to a community event. Both batches worked on some aspects together post the SDI to develop systems design for expanding their work further both with community and strategizing plans for the eco-club.

TEACHING PEDAGOGY

- 1). Ways of thinking: We scaffolded the students at all steps in order to enable several ways of thinking about Sustainability as a whole and land regeneration in particular - Critical thinking; Holistic thinking by understanding indigenous methods of land regeneration, Systems thinking; Futuristic thinking; Strategic thinking for community involvement and land ownership issues.
- 2). Working styles and Inspiring awareness methods: The tasks were set in stages so that students could brainstorm and work in teams as well as independently reflect on their work while offering well thought out critical peer reviews. With the community engagement component the students were tasked with ways of enabling and motivating others to participate, come up with immersive workshops and act as community catalysts for change. In the process they realised that building alliances with the community members was key to conflict resolutions. Above all deepening listening as an act of embodied cognition and reflective compassion emerged as the core of new design and art.
- 3). Personal transformative processes: Empathy for self, human and non-human; Dealing with complexity and uncertainty; Dealing with personal grief and environmental grief; Self-reflect and group reflect; Commitment and self-responsibility towards their own learning; Moving from a place of paralysis regarding the ecological crisis to action through a reflective self; Overcoming tacit assumptions were varied processes that students experienced as evident in their reflection papers.
- 4). Experiential learning/embodied learning: Translating embodied acts in the garden into creative practice and process consciously.
- 5). Understanding that sustainability is an act of self-transformation: Working the land, preparing it, understanding, observing and becoming more aware of our immediate surroundings and our relationship with non-human/ more-than-human world; Observations and documentation of changes in the land; Observations and documentation of how one's own mind-body awareness has shifted.
- 6). Understanding that sustainability is as much a social and behavioral change movement: Working with communities in Srishti and around N4 to build a relationship with the land and evolving strategies for a long term upkeep and maintenance of the land were key tasks.
- 7). Understanding that sustainability is a reflective and responsible creative practice: Engaging with the question of time through personal artistic/design practice
- 8). Results and Analysis

Both the batches of Year I and year II students learnt to persevere and persist under emergent problems and put in very long hours to overcome internal resistance clear the land and create the rain garden. They also performed exhaustive research on the plant list and traditional/organic land reclamation method. As four of the second

year students started working in the land, each stage posed emergent challenges that they had to overcome to create the garden space. The students first discovered that it had been used as a rubbish dump and they had to stop all other work and focus on removing trash including trash that was buried under layers of soil. They also discovered that the land had huge rocks and also had lots of small rocks that made it difficult to dig or start planting immediately. They eventually had to buy new red soil as well as vermi compost to create about 3 inches of new earth in which they could finally start planting. All the 4 students worked rigorously to buy fence materials and make the fence around their designated space to keep out cows and animals. Besides actually working on the land, the 4 students also worked on creating the vision for Mati eco-club with the goal of involving the larger Srishti community. They specifically brainstormed and came up with a plan for varied aspects to ensure continuation of their work to reclaim the land and create a garden space by transitioning to the M.Des first year students. As the eight first year students started working in the remaining area of the land, each stage posed emergent challenges that they had to overcome to create the garden space. The students first discovered that it had been used as a rubbish dump and they had to stop all other work and focus on removing trash including trash that was buried under layers of soil. They also discovered that the land they wanted to work on first needed to be cleared of all the construction waste that their seniors had excavated from the nearby space. They had bought coco peat and vermi-compost to create a rain garden in which they could finally start planting. All the 8 students worked rigorously to buy fence materials and expand the fence around their designated space to keep out cows and animals.

Besides actually working on the land, the eight students also worked on creating the Mati eco-club with the goal of involving the larger Srishti community. Each of them underwent a personal transformation as they reflected on the trash, the paradoxical nature of time, self-referentiality, transdisciplinary link-making, awareness of self and discovering a chosen media of self-expression.

For Year 1 students, as it was a fifteen day class and a lot has been accomplished. However, we felt more could have been accomplished and extended the exercise to another ten days of Self-directed inquiry(SDI).The students initially felt a lot of resistance because they were unsure about the future of the land as the land belonged to Karnataka Housing Board corporation (KHB). There were other land ownership issues by neighbouring farms that tried to stake their claims on the land that also took away time from actual work on the land. Students needed assurance that their work would not go to waste even if the land belonged to KHB. The extension of the project into a ten-day Self designed inquiry, allowed students to engage with community and set up a framework for community engagement starting with a community event at the end of seven weeks of engagement with the land.

IMPACTS ON SUSTAINABILITY

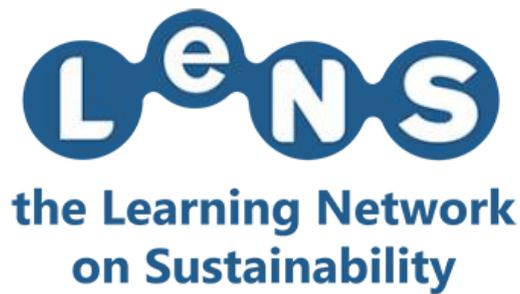
Upon reflection, the students acquired a great sense of ownership and joy, responsibility, teamwork, initiative and leadership combined with a love for working the land. They also reflected about time and learnt how time is at once cyclical, geological, linear, non-linear, personal, psychological, emotional, expansive and contracting. They also understood that time was not just anthropomorphic, time belonged to and was possibly different for different creatures. While resolving land ownership issues that arose during their project time, they worked on their leadership and diplomacy skills while ensuring they were able to continue their work. In creating their posts for Mati, they have learned to write about their work and in their attempts to engage the larger student community, they have also learnt and applied the principles of information design and social media marketing. The engaged work in a short span of ten weeks has allowed us to emerge important educational outcomes as well as pedagogical principles that align with the capabilities of the two courses. Developing ecological consciousness through embodied practices of land reclamation and regeneration, community gardening, as well as creative making and linking these processes through community engagement and deep personal reflection have shown us ways in which we can encounter internal parameters for sustainability. These units are ongoing projects that we continue to work with students on for a long term evolution of key ideas and to further develop an institution led eco-club that takes on sustainability as a social change movement. We hope to emerge a model that can raise critical issues and challenges along with creating tools, strategies and possibilities.

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DESIGN: A REFLEXIVE, REFLECTIVE AND PEDAGOGICAL INQUIRY INTO SUSTAINABILITY

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ABSTRACT

Can design be used as a pedagogical approach: as tools of observation, conversation, analysis, reflection, interpretation and storytelling, in order to foster and strengthen a critical understanding of sustainability? This paper explores critical questions around the relationship between processes in design education and a contextual holistic examination of 'sustainability' using narratives. This is done by inquiring and reflecting upon case-studies of students of design, through a pedagogical lens. Mediated by orality, the design of learning in these cases, delved into the socio-cultural-historical-ecological dimensions of a context. How did one question one's own ways of seeing a place and its people, while unpacking multiple forms and structures of narratives to understand aspects of sustainability? How did they learn how to connect the practices of communities with personal and collective histories, identify the many relationships and interactions that bind lives together in a place and therefore understand the changing role and state of communities and their practices in order to create a regenerative culture? This paper argues on how a critical understanding and examination of the notion of 'sustainability' can be achieved, through almost any course in 'design' irrespective of whether the objectives consciously articulate sustainability as a desired outcome or not.

Key Words: oral narratives, pedagogy, design, sustainability

KEY QUESTIONS:

Can design education be used as a reflexive and reflective tool of inquiry? Can design research be source of narratives that constitute the heritage of a landscape? Can narratives be treated as an essential component in understanding, interpreting, and looking after the heritage with the knowledge of the heritage, from an insider's point of view and memory? Especially when the heritage can also be ecological or socio-cultural heritage, which are integral aspects of sustainable development? Can design be used as a pedagogical tool to foster a critical understanding of what sustainability might mean from a local or traditional perspective? Considering that contextual inquiry-based learning forms an important basis of design education, what relationship do memory and narration have, in understanding and de-constructing a context, which helps in avoiding the 'standardisation' of 'sustainability' which can lead to systemic problems? These were some of the questions I intended to explore through my own practices in designing learning experience.

SETTING THE CONTEXT:

I have noticed in my experience of being a design educator that many a time, almost like an unintended consequence (although well-desired from a wider point of view), many explorations, engagement, experimentations in the process of learning aspects of design, led to deep and critical inquiries around notions of sustainability, something that I would not anticipate consciously as I designed the courses. These inquiries, when sustained, followed and connected through a process, led to very interesting findings and insights. When these were inter-woven, the relationships among the new found perspectives of the micro and the systemic knowledge of the macro created a deep contextual wisdom of the inquirer's position, dilemmas or role, in the larger framework of the transitioning world. Often this became a transformational experience for the learner and me, as an educator as well. I therefore wanted to dive deep into my experience as an educator, without taking any process or hypothesis for granted. Even if there are theories backing or challenging the role of a particular process, which in my finding, was important, my rationale behind talking about it, comes from an experiential perspective and not textual knowledge.

In this paper I would like to share some of those insights and perspectives around sustainability that came out as by-products of the research where, as mentioned earlier, the purpose of the research might not have been to understand sustainability nor critically examine some of the sustainable development goals. However, the meta-learning from the courses allowed for critical understanding of notions of 'sustainability'. For example: through a course where students were looking at food as a lens to understand the history of a city, they ended up also understanding various issues of sustainability with respect to socio-economic practices that existed in the city. A course which was designed to understand the textile industry and its evolution in a place, led to critical understanding on the relationship between vanishing traditions, geo-political realities, socio-economic factors behind consumer choices and so on. A course which was about teaching students using camera as a lens to inquire, allowed them to understand many practices and beliefs that made them question their assumptions around what sustainable development was and ask 'whose development is it anyway'? A course which was about learning research methodologies and mapping, led to the discovery of the horrors of vanishing lakes in a city in the name of 'development'. In order to design walks for others, one ended up questioning how accessible is a city or who decides territories for humans and other lives in a city or noticed that the duration of walking inside a shopping mall often beats the duration of actual walks within a city.

In order to unpack the many questions I framed at the beginning of the paper and make sense of some of the examples I cited above, I looked closely into my work. I delved into my course plans, my intention for each course, the desired 'enduring understanding' (core ideas and processes central to learning with a lasting value beyond the classroom), the chosen focus areas, the essential questions that would guide the 'backward design' that went into the course design. I also mapped the outcomes of these courses, both intended and unplanned, the processes that were followed along with the reflections and documentation of the students along with my own anecdotal narrative reflections and documentation of those processes. I also looked closely into the visual facilitation that I engage in, while having structured conversations with students: in the form of opening and closing circles, Socratic seminars, café conversations or conversation roundtables, to name a few processes. The visual generative scribing or sketch-noting that I facilitate became a treasure-trove for many a powerful insight, that mere analysis of an outcome would not be able to generate.

UNDERSTANDING A PLACE AS A COMPLEX ADAPTIVE SYSTEM

Most courses taught in design education quite obviously are situated in a context, consciously or unintentionally. More often than not, there is a locational or spatial dimension to this context. As a part of designing a course therefore one needs to think, how one creates engagement with a place and interaction with the people who inhabit the place, in order to gain a deeper understanding of the context. Explorations that a design educator facilitates may not be just about the geographical, biological, geological features, but the social, cultural, economic, political or ecological features of the landscape as well. Fleming noted that 'people play an active role in conceiving, making, using and thinking about the landscape in which they live'. Considering that as a design educator it seems important to enable

the learners to unravel the behaviour and thought embedded in a landscape through multiple perspectives.

The many methodologies that I bring into my classes, in order to teach research for design, combine design research, oral history, ethnography, participatory rural appraisal and narrative based inquiries, to name a few. Interestingly the idea of a 'thick' description used in ethnography also involves understanding and absorbing the context of a situation or behaviour. It also ascribes intentionality to one's behaviour. The intentionality is both present and future. So understanding a person seems deeply connected to the ability to interpret a person's behaviour within the context in which the observation of the person happens. As one learns how to do rich and thick descriptions of the context under which interpretations are made, the interpretive characteristic of the description often becomes stronger and more useful as one starts using tools to 'record the circumstances, meanings, intentions, strategies, motivations and so on'. There are confusions about what exactly is 'thick' description and how exactly is it different from a 'thin' description. Since meaning is one of the aspects that differentiate between rich thick description and superficial thin description, I have realised that bringing in the idea of narratives make it easier and relatable. Also because the idea of using methodologies borrowed from diverse and yet inter-related disciplines like oral history and ethnography in design research, is more than doing mere theoretical arguments but experimenting with what helps in the process of sense making, the process of design synthesis in a practical way. This in my experience becomes more useful when one starts observing, locating, collecting, connecting and interpreting narratives found in and around the context. Narratives act as missing pieces helping one to connect the dots. More importantly, the intention of 'understanding' has the potential to shift one's focus even through an ethnographic process from only humans to other forms of lives.

A bigger value of 'looking' at the context closely and yet in a systemic way, helps one move towards, the 'realisation of our own self as a relational reflection of the larger community of life', called 'our ecological self' and seeing in it the basis for responsible action out of enlightened self-interest', in the words of the philosopher Arne Naess. This process therefore not just remains at the level of reflection of 'what we see', but also brings in an aspect of self-reflexivity where we become more aware of our frames of references. We question why 'we see what we see'.

In my years of working on designing of these learning experiences I have realised it is through these processes that one can deepen the understanding of both the 'self' and the 'world as an extension of one's self'. Using 'Backward Design' in constructing pedagogical processes to unravel places as a 'complex adaptive systems', in my experience, allows this kind of deeper understanding. Tools can be used to unpack the intricate, inter-twining of elements within a system or between a system and its environment. This also can help in understanding the complexity which arises from inter-relationships, inter-actions and inter-connectivity of elements within the system or between the system and its environment. Realising the fact that dynamic systems are able to adapt in and evolve with changing environments leads to the idea of 'co-evolution'. It is this realisation that can be constructed through a careful pedagogical design where one learns to see the in-between, the hidden, the invisible, the unknown and starts re-imagining, re-claiming, re-generation and re-design.

WALKING AS A TOOL TO READ A PLACE AS A TEXT

Walking can be an extremely powerful tool in design. Walks can lead to many discoveries and help in forming many perspectives of an experience. One can locate narratives as a binding force among place, people, other lives and time. Through deep immersion, observation, conversation, interpretation, inter-connections, reflection and finally communication of one's own synthesis through walks can allow one to move from data to information, information to knowledge and further from knowledge to wisdom. Through walks one can walk into the past in order to walk towards the future, one can walk as someone to gain empathy and understand aspects of inclusion in a very embodied way.

From curated walks where the lens is guided by someone else or participants end up consuming information, interpretation and experiences crafted by someone else, walks can be designed by a design educator as a way to reconnect with and learn from land, place, different forms of lives and non-humans as well, in order to engage in and thereby catalyse 'localisation' in a deeper way. Walking can be used to experience ways of being, knowing, doing and relating with the unknown and through the learning with hands, stories, senses, hearts, along with the heads, a form of 'de-colonisation' happens within, as one's inquiry becomes deeper and more authentic. Designing walks can also be given as a task to students as a way of inquiring and finding their own perspectives. The room for slowing down or pausing, in the process of walking enables one to notice and wait, virtues which are rare in a fast-paced world. In my experience this really has a transformational potential.

In this context, the idea of 'walkability as a measure of sustainability' also plays a major role in understanding how a place, especially a city is constructed. Apart from health, environmental and individual benefits, social and recreational importance, the idea of a walkable city as connected, convivial, conspicuous, comfortable and convenient, also brings forth the ideas of identity of a built environment and a sense of belonging.

Designing walks as a pedagogical tool can be very powerfully connected with facilitating mapping as a process. Here walks can be treated as a meaningful process of wayfinding, including 'social wayfinding', which helps in re-imagining the process of cartography.

MAPPING AS A WAY OF SENSE-MAKING AND VISUALISATION OF ONE'S JOURNEY

Pedagogical discourses usually mentions about the need and power of observation and conversation in processes of art and design. The ability to see, listen, talk and interact are crucial to not just any form of research but also framing problems, understanding systems, thinking design, attempting to solve wicked problems, gaining empathy and even user-testing. Mapping, both literally and figuratively, is one of the most essential parts in this meaning-making process. Through my many discussions with students, especially as a part of visually facilitated closing circles post different activities, I have been able to gather very powerful insights about various aspects of teaching-learning as explained earlier in this paper. Students have shared that one of the ways in which a non-linear, holistic and systemic understanding about a landscape became possible was through the diverse and creative processes of mapping that were facilitated in the class. Maps are visual representations of a landscape in layers. They help one navigate, locate and find directions, help in exploration and give information. Many a time the information gathered in research is in the form of oral narratives or visuals of what is found or seen in a context, rather than concrete data in text or numbers. The information in the process of mapping become visible, connected, complex yet clear, multi-layered yet organised and the process of 'reading' the maps requires a lens to see and perspectives through which different kinds of sense-making occur. This allowed many of them to have a critical and creative engagement with the recorded data and in some cases with the process of recording itself, which led to the construction of a very unique, personalised and yet universal understanding. Students shared that they were being able to differentiate between 'thinking' and 'thoughts', 'looking' and 'seeing' and 'listening' and 'hearing' through this process. Mapping 'what is there', and mapping 'what was there', through the collective memory and oral narratives of people enable one to predict what might be there in future through the cartographic processes of visualisations of thoughts and insights. This ability to be intuitive about the future, which is otherwise volatile, uncertain, complex and ambiguous, is certainly a desired 21st century skill.

In a fast changing world, ways of making sense of the world cannot be static. I propose that it is not just absolute frameworks, tools and templates that one uses in design education that can make learning more meaningful but the evolution, transformation and adaptation of learning methodologies that need re-defining, re-looking, re-designing and often that starts from a process of unlearning by the educator herself/himself. Hence regeneration of older learning methodologies is required too. I am nowhere suggesting that one needs to discard the old or only invent 'new' tools and techniques for the sake of bringing something new but one need to bring in a fresh pair of eyes to re-view, re-interpret and re-imagine the old. This leads to effective re-purposing or adaptive re-use of old methods and techniques as well.

We no longer can ignore bigger questions around the 'finiteness' of our planet, facing ever-growing uncertainty and complexity. Along the philosophy of many like Daniel Christian Wahl, in order to guide us through this transition, one needs to successfully co-create a story with sufficient meaning. And in order to co-create this story one needs to ask deeper questions on 'why should we be sustained' before asking 'how to make ourselves sustainable'. This initiation with the 'why', followed by 'what if', many believe, is the only way to inspire people to change their behaviour and co-create what is called diverse 'regenerative cultures' adapted to the unique biocultural conditions of a place. In order to 'live' our way rather than 'know' our way into future, there is a need of a 'collective narrative' about 'who' we are and 'why' we are worth sustaining. This shared story is believed to be powerful enough to keep everyone innovative, creative and collaborative as we journey towards a more sustainable, regenerative and thriving future.

FRAMING POWERFUL AND GENUINE QUESTIONS

In a culture of quick-fix solutions and instant answers, as design educators teaching design, it becomes very important to establish the need for questions, more than answers as pathways to collective wisdom. This can be followed by instilling the idea of living those questions in order to unleash the power of transformative social and technological innovation in the transition towards regenerative cultures. In this endeavour, conversations around framing powerful questions becomes a meaningful step towards the intention of designing through a nuanced understanding of the emerging 'forever new' and 'forever old' cultural narrative of 'inter-being'. Learning to frame powerful and meaningful questions not only is a step to deeper understanding of multiple perspectives but also a step towards moving away from the limitations of duality. When the intention behind the questions is a genuine intention to learn more the in-betweens open up as 'authentic' and 'fresh' questions are being framed by re-framing old queries.

The situation and architecture of questions can be a very significant learning for any student. Understanding the construction, matching the scope of the question with the needs and looking into both implicit and explicit assumptions within a question can certainly make one ask relevant, purposeful, recognisable, fresh, evocative and more importantly genuine questions that lead to possibilities and invites fresh perspectives. As educators a significant time spent on empowering students to 'frame' questions can lead to miraculous findings.

LOOKING INTO THE PAST TO LOOK TOWARDS THE FUTURE: DOCUMENTING ONE'S JOURNEY

As a design educator, in alignment with Jon Kolko's idea of design as a process of abductive sense-making, docu-

mentation becomes a very crucial part of design. Teaching documentation and reflection are two inter-related and inter-dependent process which immensely help in sense-making. Documentation mostly is considered as a “task” that is perceived as a “chore” which students somewhere want to either avoid or somehow want to be done with. Encouraging students to document is one of the first and crucial steps towards building understanding. In a context often it becomes overwhelming for learners as to what to record and once they understand the bias that is inherent in observing and interpreting, that can become a hindrance in recording as well. One does not know whether to choose a lens and record with that lens or try to be objective and ‘fair’. But how much to record, what to select and what to let go, what to eliminate and how to locate one’s own position while recording? Having critical conversations around these along with introduction of appropriate tools, bring in a shift where documentation stops being a list, mere ‘recalling’ or accumulation of data. Instead it becomes a reflective, layered, assimilated meta-narrative of experiences, thoughts, ideas, emotions, conscious position, informed opinions formed by personal and collective viewpoints, evaluation along with facts, questions and inter-connections, analysis followed by synthesis, agreements and confusions, judgments and struggles in the process of deep immersion.

Creative and reflective documentation helps one map processes, find structures and patterns, locate something in relationship with its surroundings. Rather than being static and frozen, it is evolving, insightful, it is both a reference for the past and a window to the future, being a creative record of the outside and the inside, the concrete and the abstract, facts and imagination. Interestingly documentation is a way of mapping one’s journey figuratively, and mapping can be ways to document one’s journey literally.

HELPING LEARNERS CONNECT THE DOTS

One of the most important aspects of facilitation is to guide the learners towards a process of synthesis in a non-intrusive non-preachy way. This can be done by facilitating learners to make their own connections, inter-connections, help them find patterns and relationships and develop and strengthen perspectives around any idea or issue. This process enables one to move from mere accumulation of information to assimilation of knowledge which has the power of transformation with wisdom generated. I often consciously intersperse various socio-cultural thinking tools along with visual thinking tools while delving into a context. These tools help in developing skills that help design students understand relationships, context and perspectives about and around a place. They enable one to think deeply, reflectively, critically and visually. Some of these tools help one see, listen, talk, connect and collect stories, memory and history in a given setting. Participatory and research methodologies help one interpret culture and its narratives. In order to understand the system as a whole, parts are explored and inter-woven. From an educator’s viewpoint, these are not just abstract and vague aspects of development which cannot be evaluated. The evaluation includes assessment criteria that recognise the holistic development of capabilities that can be measured. Mapping what one wants to see as a part of learning, with appropriate assessment criteria that can be used in a tangible or intangible evidence of that learning, for a facilitator, becomes very crucial.

CONCLUSION

Design involves abductive thinking, ways of sense making and synthesis. Design also uses empathy where the idea is to attempt to be in the other’s shoes. The current realities of our life no longer can afford only an anthropocentric world view and solving complex problems instantly to walk towards sustainable development goals in isolated ways. It is important to question a lot of notions that have been taken for granted for far too long. It is crucial to examine what ‘design’ means in a vision to walk towards the creation of a regenerative culture through collaboration and co-creation. Empathy for the ‘other’ should start with questioning who the ‘other’ is but a ‘reflection of our larger self’. This would not just foster a deeper understanding about other lives but also create self-awareness which the designers for tomorrow need. The ‘why’ about ‘sustainability’ not just can guide the ‘what’ and the ‘how’, but also the development of a layered understanding of the ‘self’. In this context the design educator can facilitate processes that create shifts from being ‘ego-centric’ to ‘socio-centric’ to ‘species-centric’ to ‘bio-centric’ to ‘cosmos-centric’ perspectives of the self. This can be made possible by paying attention to the micro and the meta narratives and their meaning, recognising wisdom beyond text-books and beginning to inter-connect the parts to create the whole through every process of sense-making. In this process of meta-learning, along with skills, knowledge and character can be inter-woven by re-design of teaching-learning methodologies. The meta-learning which is essential in a four-dimensional education, can be a deeper understanding of both the self and the extension of the self in a larger ecological context. This paper argues on how a critical understanding and examination of the notion of ‘sustainability’ can be achieved, through almost any course in ‘design’ irrespective of whether the objectives consciously articulate sustainability as a desired outcome or not. In this proposition, the meta-design possibility a design educator has: the design of design education, acts as a reflective and reflexive lens to have an authentic inquiry into what sustainability is. Eventually this affects the choices one makes as a designer, at a later stage in life.

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URBAN MINE REDESIGN COURSE: RESEARCH AND TEACHING PRACTICE

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ABSTRACT

Garbage is a misplaced resource. With economic development, underground mineral resources are running out while enormous precious resources (minerals) have been turned into facilities and supplies in our daily life, which become the so-called “Urban Mine”. This paper will introduce the core idea, teaching method and student works with regard to the course Urban Mine Redesign offered by Academy of Arts & Design, Tsinghua University, explain how to guide students to incorporate social and environmental issues into design and explore solutions to future sustainable cities through design thinking.

Key Words: Urban Mine, Circular Economy, Sustainable Design, Course Research

1. BACKGROUND

With rapid economic growth and prevailing consumerism in recent years, urban garbage is experiencing a surge. Particularly, owing to the penetration of e-commerce, people depend increasingly on online shopping, bringing about an unprecedentedly prosperous express industry and causing disposable packaging waste to spawn. According to relevant data, the world produced 490 million tons of garbage in 1999, of which that from Chinese cities amounted to 130 million tons¹; in 2016, 214 large and medium-sized cities in China generated approximately 188 million tons of domestic garbage (Ministry of Environmental Protection of China, 2017). China is the world's largest domestic garbage producer. As China lags far behind in municipal waste classification, plenty of valuable waste is burnt or buried, not only posing a huge pressure on environment, but also constituting a serious waste of valuable natural resources.

Futurist Toffler once forecast in his book *The Third Wave* that “another wave influencing the survival and development of human beings, following the agricultural, industrial and computer revolutions, will be the garbage revolution to appear at the turn of the century.” In fact, mineral resources upon which industrialization depends have gradually been transferred from the natural world to the unnatural one. After 300 years of plunderous mining during the industrial revolution, over 80% of mineral resources available for industrialization in the world have been rendered aboveground and piled up around us in the form of “garbage”, which totaled hundreds of billions of tons and increased at the rate of 10 billion tons a year (Qu, 2010)². How to find treasure from the enormous urban garbage heap and turn waste into minerals has become an important issue attracting the attention of experts in various fields all over the world. This necessarily has posed a new challenge to the design discipline which makes it its mission to solve problems.

In this context, the course encourages students to consider design issues from the perspective of ecosystem, so as to turn urban garbage into mineral resources, probes into the collection, disposal and reuse of urban waste at present with design thinking and finally puts forward innovative solutions based on user needs. Learning of the principle, strategies and evaluation criteria of sustainable design will entail the course, from identifying problem to research and then to putting forward a design proposal, which means that design issues will be considered environmentally, socially and economically. The course aims at arousing students' environmental awareness and sense of social responsibility, so that they can participate in the process of social innovation to explore sustainable solutions.

2. CONTENT, PHILOSOPHY AND METHODOLOGY

2.1. Urban Mine

The concept of “Urban Mine” can be dated back to the 1980s in Japan, which initially described the recycling of rare metallic materials in waste home appliances. In 1988, Michio NANJO, a Japanese scholar, first gave a definition from the perspective of recycling of metal resources: industrial product resources piled up above the ground can be considered as renewable resources and called “Urban Mine”³. The concept did not widely spread in China until China's National Development and Reform Commission and Ministry of Finance issued the Notice on the Construction of Urban Mine Demonstration Bases in 2010. “Urban Mine” is a neat metaphor for scale development of waste resources recycling and specifically covers recyclable resources generated in the process of industrialization and urbanization and contained in waste mechanical and electric equipment, cables and cords, communication tools, cars, home appliances, electronics, metals, plastic packages and waste materials, such as steel, nonferrous metals, rare and precious metals, plastics and rubber.⁴ Later, the extension of “Urban Mine” has been further expanded to gradually include all discarded but recyclable materials and energy resources in production and life.⁵

2.2. Teaching philosophy and methodology

That waste can be turned into minerals is a result of a combination of design strategies, technological means and organizational management in the principle of circular economy; otherwise waste is just waste and is either burnt or buried. By borrowing the Circular Economy System Diagram proposed by Ellen MacArthur Foundation and Cradle to Cradle, Figure 1 simply classifies the waste in our life into biological and technical nutrients from the perspective of “minerals”. Most of the supplies of daily use are sold to us following raw materials mining and production. Once discarded, both technical and biological garbage can be re-mined and return to the chain of circular economy, so as to minimize incineration and landfill. Technical nutrients can be recy-

¹ TheMeetingMinutesoftheFirstSymposiumontheSituationofChina'sMunicipalSolidWasteandtheCountermeasures(2000),JournalofNaturalResources, 15(1).

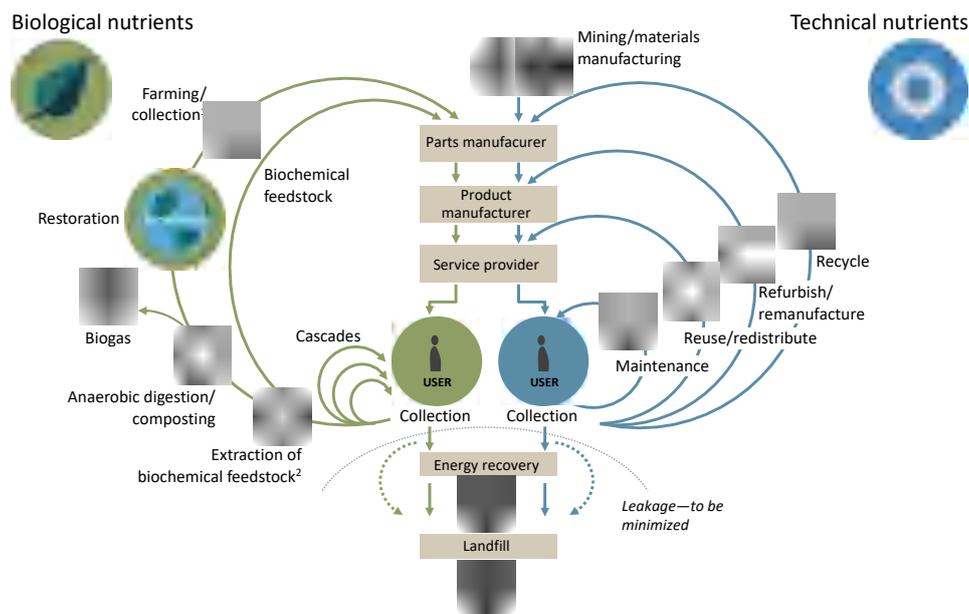
² Qu Y X (2010). Interpretation of the “Urban Mine”, *China Nonferrous Metals*, 24, P30-31.

³ Wang C, Xu J & Yao H L (2017). A Systematic Review of Urban Mining Theory, *Resources Science*, 08.

⁴ National Development and Reform Commission, Ministry of Finance, Notice on the Construction of Urban Mine Demonstration Bases, retrieved from http://www.ahpc.gov.cn/upload/xxnr/100232012_2287780.pdf, 201005.

⁵ Brunner P H (2011). Urban mining: A contribution to reindustrializing the city. *Journal of Industrial Ecology*, 15(3): 339-341.

cluded through classification, maintenance, reuse/redistribution, remanufacturing/refurbishment and recycling; and biological nutrients can be recycled through classification, biomass extraction, fermentation/composting, preparation of biofuel, soil remediation and production of feed stuff.



[Figure 1] Circular Economy System Diagram, Source: Ellen MacArthur Foundation

In terms of garbage disposal, as the waste incineration technology becomes increasingly mature, harmful gas emissions have dramatically decreased in the disposal and the incineration efficiency has been greatly raised. Incineration is becoming a mainstream technique to dispose municipal waste worldwide and is expected to occupy a larger share in future. The share of garbage incineration in China is estimated to exceed 50% in 2020 (Liu, 2016). Despite a lot of controversies, garbage incineration, as an effective approach to energy recovery, is apparently advantageous over landfill.

However, in the lifecycle of garbage generation, the tremendous resources wasted in links including production, use, storage and transportation of products cannot be offset by incineration. As a result, from the perspective of circular economy, we must minimize the generation of garbage and promote garbage classification and recycling as far as possible, whereby the goal of completing a sustainable society can be achieved. This exactly is the basic idea and viewpoint of the course.

The course is an elective course for undergraduates from different majors and often carries out design research and practice through lectures, seminars, field research, concept design and prototype test. It is mainly offered through interdisciplinary research and in-depth communication and discussions between teachers and students. The course will contain a systematic introduction to concepts, theoretical development, core idea and evaluation criteria with regard to sustainable design; and invite experts in various fields to give lectures and have discussions with the theme of “Urban Mine”, which will cover the theory of circular economy, the status quo of the environmental sanitation industry, policies and measures, design philosophy, environmental public services and commercial practices; later, students will conduct an intensive survey into the categories, disposal techniques and the possibility of recycling of waste resources, be inspired through case collection, sorting and analysis to reflect profoundly about the status quo and look forward to the design exploration about to begin. Finally, students will be required to put forward innovative product or service system solutions and evaluate the sustainability of their own solutions.

3. INTRODUCTION TO PRACTICE PROGRAMS

Over the past three years, the course has been taken by undergraduate students from different majors at Academy of Arts & Design, Tsinghua University, including Industrial Design, Fashion Design, Visual Communication Design, Ceramic Design, Animation Design and Environmental Art Design. The student research and redesign Urban Mine in combination with their design expertise and sustainable design criteria, which involves the application of multiple strategies, including design for reuse and recycle, product life cycle design, product-service system design, etc. The course design works will be described below.

3.1. Plastic bottle cap redesign

Students in this group studied common plastic bottle caps and made some interesting attempts given their features such as high material strength, orderliness and rich colors, and gave them a second life before there were smashed. After repeated experiments, students finally produced three arc grooves on each of the bottle caps through laser cutting and turned these colorful caps into splicing blocks for children, which were equipped with supporting maps to be “Lego”-like educational toys. Whilst meeting the entertainment needs of children (especially those with mental

retardation), they can also exercise the ability to create and the capability of 2D-3D thinking shift. Such a splicing mode offers a variety of possibilities for further toy development. More importantly, it makes a small contribution to garbage classification and recycling and popularization of knowledge of materials to prolong the service life of plastic bottle caps and guide users to actively separate bottle caps from bottle bodies.



[Figure 2] Plastic Bottle Cap Redesign: Shen Ruotong and Cai Miaoting

3.2. Textile upcycling design

According to the data from China Association of Resources Comprehensive Utilization (currently China Association of Circular Economy, CACE), China sees approximately 2,600 tons of clothes thrown into garbage cans every year, of which most are not recycled or safely disposed. Therefore, this group studied how to upcycle old or worn clothes and finally created a mysterious and staid material by mixing old or worn clothes with resin, and designed and produced a number of simple and fashionable household products with the material. Natural texture of textiles presents a unique and fantastic sense of beauty while the new material is hard and smooth and can be easily processed. With a customized service system, such design can not only meet individualized household needs, but also reduce waste and create new commercial value.



[Figure 3] Textile Upcycling: Zou Dianshe and Yan Zeteng

3.3. Shared Refrigerator

Two students majoring Visual Communication proposed a “food sharing”-based product-service system design against the waste of food near the end of shelf life by combining ideas such as charity, environmental protection and sharing. The system targets hardworking and busy couriers and low-income groups in cities. Equipped with technologies such as identity verification and magnetic stripe scanning, it guarantees the convenience, safety and efficiency for both merchants and users. The system encourages enterprise donations by means of public-benefit publicity and brand planning, and safeguards food safety, thus ultimately achieving the practical and public value of “Shared Refrigerator”. Apart from designing the products and interface of Shared Refrigerator, students also designed a complete brand image and service procedures.



[Figure 4] Shared Refrigerator – Zhang Qingxi and Liu Shuhao

3.4. CRH fast food box reuse system design

Fast food waste occupies an increasing share in urban waste year after year, which also has an astonishing yield on CRH. As Chinese food contains much oil and sauce, classification and recycling of fast food boxes cost high and are

therefore often neglected. Targeting China's high-speed railway system, the student attempted to realize the reuse of fast food boxes within a controllable range and designed a viable service system. The student had catering facilities at CRH stations offer standard catering services, set up old box recycling devices and cleaning service sites along different lines and designed dedicated in-train transfer trolleys.



[Figure 5] CRH Fast Food Box Reuse System Design: Hu Kaizhou

3.5. Bio-toilet design

The bio-toilet design based on human waste recycling is a part of the reflection about Urban Mine. The student carried out basic research on technologies such as humanized toilet facilities, rain water collection and biogas system, with toilet design not only meeting functional needs, but also presenting a unique and simple style; more excitingly, the student built the toilet with waste plastic bottles through modularization & parametrization, guaranteeing effective lighting and shelter needs and creating an elegant and distinct building form whilst advocating waste recycling and environmental protection. Design for Urban Mine must and ought to be a part of our beautiful life.



[Figure 6] System Design and Reuse Device Design: Zhou Rui

4. CONCLUSION

Mass production, consumption and abandonment represent the basic development mode of an industrialized society, which are followed by exhausted underground mineral resources. These precious resources are turned into facilities and supplies in our daily life and ultimately into massive urban waste. With garbage siege, design is playing active role while change in concepts lies at the core of design. From a new perspective, a city is a mine with infinite possibilities and urban garbage becomes valuable mineral resources.

Urban mine redesign is a systematic issue involving reflections on garbage production, classification, collection, storage, transportation, recycling or disposal and stakeholder relations. A systematic view is the essential ideological basis for design research. Redesign or beautification of single waste might be shallow and will often fall into the vicious cycle of turning a kind of garbage into another.

Additionally, single product design can hardly be an effective solution, but product-service system (PSS) design can facilitate the formation of a sustainable business model and may stimulate and guide community residents to perceive and participate in circular economy and green lifestyles, so it is an effective way to explore system solutions.

Designers' understanding and application of technologies are vital. However, they should not worship technologies and even be deceived by the same. Although specific technological breakthroughs are of great significance, whether such breakthroughs in any subsequent links will weaken our previous thinking and attention is worth discussing from the perspective of full product life cycle. No mines are inexhaustible.

Rather than garbage disposal alone, at the core of the garbage problem is to reduce garbage from the source, which on a deeper level concerns human's consumption views and values. If we remain advocating luxury, unrealistic comparison and unrestrained spending, any solution might be a daydream or idealistic words. Therefore, designers—quite influential in consumption despite no power—have to assume the heavy responsibility of leading social changes and pioneer a sus-

tainable lifestyle in their own capacity. Definitely, first of all we have to change our own concepts.⁶

The course effectively translates social and environmental issues into design issues, which are open-ended and require constant exploration and experiment. These design works are far from perfect, but the students have realized the problems and began to seek solutions with design thinking. The course is also open to the public: seminars and oral defenses gathered participators in different fields and the course had thousands of views on WeChat. Apparently, explorations into Urban Mine design and sustainable lifestyles are not confined to campus, but are increasingly concerned by the public.

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TRANSFORMING FOOD SYSTEMS IN CHINA: THE ROLES OF FOOD LITERACY EDUCATION IN ALTERNATIVE FOOD MOVEMENTS

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ABSTRACT

Food is part of daily life and central to public health, economy, social relationships and well-being, therefore the sustainable food systems are fundamental to the stability of society. However, there are growing concerns in current food systems toward food security, environmental degradation and other food related problems. In response, food literacy education paves the way for broad participation in alternative food movements addressing unsustainability. Focusing upon food literacy education, this paper attempts to discuss the roles of it in alternative food movements which potentially have the educative value that transform individuals' environmental concerns, pursue fair food and reshape market relationship, and motivate the reconnection in alternative food networks. Evidence for the research comes from participant observation and document analysis in China.

Key Words: food literacy; alternative food movements.

1. INTRODUCTION

The majority of people consume about three meals throughout the course of a day, and food may be one of the most ubiquitous cultural presence in the whole world. There is no doubt about that food is as important as everybody says it is. Among the 17 Sustainable Development Goals (SDGs) of the 2030 Agenda for Sustainable Development, which are published by 193 Member States of the United Nations on 25 September 2015 (United Nations, 2015), nearly each goal could be connected with agriculture and food from stopping poverty and hunger to reacting to climate change and sustaining natural resources (FAO, 2018).

However, nowadays developing countries and developed countries are all facing with different food related problems. According to the data from Food and Agriculture Organization of the United Nations (FAO, 2017), yet 815 million people go hungry in 2017 and more than 600 million people in 2014 were suffered from a growing obesity epidemic, which is expressed in rising rates of certain non-communicable diseases such as diabetes and cardiovascular diseases. On the other hand, with the increase of population, the demands for food is boosting. The higher and higher food consumption would add pressure on natural resources, and it is critical for everyone to re-think the food systems and meet current and future challenges.

Meanwhile, a large amount of food initiatives, co-operatives, organisations and communities spark a new food-related revolution all over the world (Yu, 2014), and the similar changes are happening in China, including Community Supported Agriculture, farmers' market, Slow Food Movement, and school-based programs, etc.

This paper is organised as follows. Beginning with the framework for alternative food systems education in China, and then conceptualising food literacy, this paper concludes with a discussion of the potential role of food literacy education in alternative food movements to transform food systems in China by using the participant observation and document analysis methods, as well as limitations and considerations for future research.

2. THE FRAMEWORK FOR ALTERNATIVE FOOD SYSTEMS EDUCATION

How would we change ideas to the concept of ethical eating? What can be done to transform current food systems toward healthier and more sustainable food systems? These questions contributed us to focusing on alternative food systems addressing unsustainability. Based on ongoing participant observation on food issues in China, we outline the alternative food systems education into six components.



[Figure 1] The framework for alternative food systems education

2.1. Changing structure of food consumption through critical consumer education

With a myriad of food scandals leading to a general lack of trust among the consumers, the emergence of Little Donkey Farm in 2008 is a sign of the rise of Community Supported Agriculture in China, which is a model of food production and distribution that emphasis on sharing the risks of farming and partnership between consumers and producers (Henderson, 2007), trying to change the structure of food consumption and rebuild trust between consumers and producers. Not only as a marketing strategy, Community Supported Agriculture but also provides consumers an education opportunity for people who are removed from agriculture and food production to track the production progress back to see how, where and from what the food is made and who grows the food in alternative food systems.

2.2. Organising food producers to embrace sustainability transition

Jan Douwe van der Ploeg affirms that “a world with peasants is definitely a better place than one without them” and has characterized world agriculture in three component constellations what are peasant agriculture, entrepreneurial

agriculture and large-scale corporate farming (Ploeg, 2018). In contrast, there is distinctive difference of scale and many other differences between the three constellations, but the essence of the differences is “the different ways in which they mould their social and material resources and their interrelations with others” (Ploeg, 2018). In the era of empire and globalization, although more and more peasants in China have to leave their land to earn their bread and “peasant” is the name of “poverty”, there are still some peasants likely to have strong self-exploitation on sustainable livelihoods and they can get support from the organisations such as foundations and social enterprises. For instance, the Sustainable Agro-ecology Centre below division of Nurture Land, a social enterprise connects consumers and smallholder farmers through e-commerce platform, provides sustainable agricultural techniques training courses and communication opportunities for young peasants.

2.3. School-based programs contributing to food education for the future

Currently, school lunches scandals are common in China due to the lack of honesty and responsibility in food industry, unguaranteed transparency and ineffective regulation. Daystar Academy is one of the few schools in China which would like to buy locally grown fresh food to offer meals for students (Daystar Academy, 2019). The food writer and the founder and president of the International Slow Food Movement, Carlo Petrini, considers that younger teens are viewed as tomorrow’s adult consumers and it is determined in the early years of life for them to build the relationship to food (Petrini, 2004). School-based programs like farm-to-school program in Daystar Academy contribute to increasing knowledge about how food reach the plate, forming a positive eating habits and making healthier food choices for students.

2.4. Community-based exploration to a highly participatory in food systems

Beijing Farmers’ Market has established three community shops in different places, which are full of fresh products and other goods mostly from smallholder farmers, to support for consumers and producers besides the farmers market at weekend. In addition, Beijing Farmers’ Market often gathers producers and consumers to hold various food related events, sharing meetings and workshops. We could define them as a type of community food systems, which integrate food production, processing, distribution, consumption and disposal to enhance the environmental, economic, social and nutritional health of particular places, are considered as a small, local, open and connected alternative to the mainstream global food systems (Eames-Sheavly, etc., 2011; Garrett and Feenstra, 1999; Manzini, 2010).

2.5. Approaches to find visions of an ancient wisdom

Permaculture, an ecological design system and a natural system design approach originally started in Australia, is popular in China now and rooted in mimicking natural ecosystems and combining with many other different knowledges such as ecology, architecture, anthropology, agronomy and botany (Holmgren and Mollison, 1978). Permaculture has spread via publications, online education, educational workshops and training courses, primarily through Permaculture Design Courses (PDC) which has been taught thousands of people globally. Permaculture provides practitioners not only down to earth skills such as the ability of growing food, but also a sustainable attitude towards life to improve self-sufficiency in an ecological way.

2.6. Activist-based food systems education arising in grassroots initiatives

Meek and Tarlau believe that what a central goal of any food system education program or theoretical approach is the food justice which pays attention to class and race dynamics and the concept of food sovereignty which is progressively recognised as the powerful corrective strength for food systems education by some researchers (Meek and Tarlau, 2015). The food activists in Beijing Farmers’ Market uphold the right of smallholder farmers to define their own food systems and focus on class and gender inequalities issues in alternative food systems.

3. FOOD LITERACY: A CONCEPTUAL REVIEW

Within the changes, food literacy in alternative food movements actually functions as a mechanism conducting to the transformation in food systems. While alternative food movements have gone from a trickle to a sweeping current in recent years, there is growing interest and concern about food literacy and related food education “go beyond ‘health promotion’ and ‘lifestyle education’ to encompass holistic and sustainable food knowledge, including ‘traditional’ food and cultural food pedagogies taught through theoretical, critical and applied methods” (Colatruglio and Slater, 2014).

Food Literacy, emerged as a new term having been used in the context of nutrition and health, agriculture and environment, culture and tradition, education, connectedness, life skills, social development and equity (Colatruglio and Slater, 2014; Bellotti, 2010; Vidgen and Gallegos, 2014), is a multi-faceted concept concentrated into four main domains:

3.1. Food and cooking skills education

In a society where is full of ready-made food and lack of the knowledge of where food comes from and what is in it, why teach people how to cook? Tull explores this question in the book entitled “Food and Cook Skills Education” and assumes that the notion of food literacy in a universal set of competencies is appropriate for Food and Cooking Skills Education (Tull, 2018).

3.2. Health and nutrition knowledge

Some researchers define food literacy as the capacity to obtain nutrition information and the competence to use it to health enhancing (Kolasa, et al., 2001). Although nutrition knowledge and healthy eating have an impact on disease prevention and transformation in the way people take their nourishment, some critics argue that the focus on nutrients removed from other settings of understanding food while real foods are disappearing and replaced by processed nutritional food (Colatruglio and Slater, 2014)".

3.3. Local environmental context

Michael Pollan, with Alice Waters and Wendell Berry, are best-selling writers as locavores who improve general public ecological awareness about food and have a critical thinking about food production (McWilliams, 2009). Through food-related books about local and global food systems issues, it has captured popular attention to ecological and environmental knowledge and practices. Food is more than just food, and also associating with carbon footprints and food miles. They make people start to think the key question as Bellotti asked: "what is the impact of my food choices on the environment (Bellotti, 2010)?"

3.4. Social justice, equity and development

Quality food developed by Slow Food is based on three interconnected principles: good, clean and fair, corresponded with high quality food, sustainable environment and fair food systems, which refer to pursue social justice, equity and respect the right of consumers and producers (Petrini, 2004). Since every food choice and policy would affect the whole long food supply chains and have influence upon social development, researchers consider food justice and food sovereignty in food systems as part of food literacy. Food justice is a grassroots movement recognising food systems as racial and class projects (Meek and Tarlau, 2015), while La Via Campesina describes food sovereignty as the movement of reclaiming the rights of people who produce, distribute and consume food rather than multinational corporations and market institutions to control over the way food produce, distribute and consume (Meek and Tarlau, 2015; Patel, 2009).

4. RESEARCH METHODS

As we have been working in alternative agriculture and food areas since 2012, this paper is based on our long-term participant observation and document analysis in a range of alternative food initiatives, including farms, farmers' markets and food co-operatives in China, in which people there promote and practice food literacy education.

5. DISCUSSION AND CONCLUSIONS

This paper offers the framework for alternative food systems education in China and the review of food literacy education. To this end, this paper aims to analysis that how food literacy education in alternative food movements play a potential role in transforming food systems in China. For this purpose, Beijing Farmers' Market is used as a case for discussion as it provides different ways for food literacy education.

5.1. Educative value for environmental concerns

All the practices in alternative food movements advocate for improving public awareness of ecological and environmental issues. To be sustainable is the ultimate aim for alternative agriculture, not just for food safety, nutrient and flavour. Beijing Farmers' Market has announced a plastic ban in recent years, stipulating that the stallholders could not provide single use plastic bags for consumers. Besides plastic ban, Beijing Farmers' Market also calls on the consumers to donate bags in good condition for second use and rewards people who donate bags over a certain amount. The donated bags are used for people like some new consumers, who do not know the rules or forget to bring their bags. At first, some consumers thought it with inconvenient and incomprehension, and even some smallholder farmers appear not to understand why they should take more care in explaining the reasons, but Beijing Farmers' Market continued doing so and holding it to account for that the ban was essential in order to protect the environment and it will benefit later generations. Eventually more and more people join the movement and it enables people to rethink deeply on how their behaviour have impact on the environment. According to the statistics from Beijing Farmers' Market, it could reduce plastic bags use by a hundred thousand a year (Beijing Farmers' Market, 2016).

5.2. Consumer education for fair food and reshaping market relationship

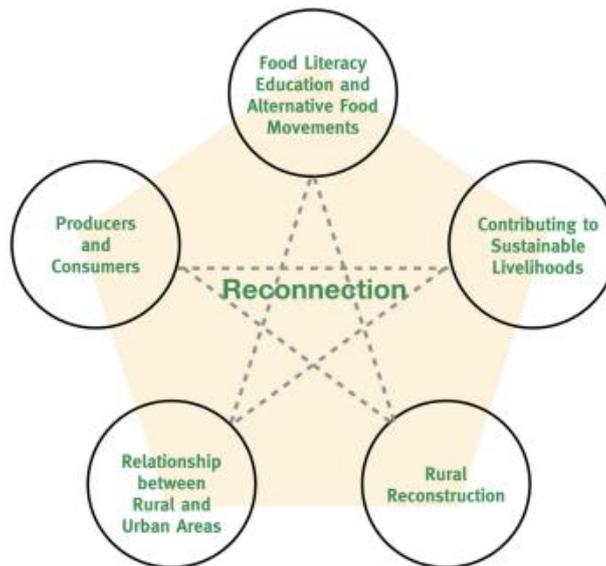
How to build trust mechanism among consumers and producers? Beijing Farmers' Market is establishing their own Participatory Guarantee Systems (PGS) to answer this question. Participatory Guarantee Systems (PGS) are quality assurance systems focused locally and through multi-participation to third-party certification proposed and promoted based on a large number of organic practices by the International Federation of Organic Agriculture Movements (IFOAM, 2019). To ensure better quality, build trust and encourage communication and collaboration, Beijing Farmers' Market recruit consumers to pay a visit to the farms. This is a process of creating a trust and sustainability nexus in food literacy education. Food is no longer the cold products in the supermarket but warm food which consumers know who grows it and they probably have participated in growing or harvest. Furthermore, this kind of consumer education has the potential to enforce consumers to support for fair trade and

reshape market relationship.

5.3. Reconnection in alternative food networks

Most of the organisations in alternative food systems design the internship program that create a pipeline for people who would like to learn sustainable agriculture in China. It has the potential to bring new blood into rural areas through training qualified individuals in sustainable agriculture and food field.

Yao Huifeng, one of the smallholder farmers shared his story at Beijing Farmers' Market, was an internship of Nurture Land and decided to start sustainable agriculture in his hometown. After Yao overcoming enormous difficulties and generating good sales, which is not about success for him but means a lot for a small village, some villagers were keen to join Yao to transform to organically grown rice from conventionally grown rice. Therefore, Yao set up an agricultural cooperative in the village and cooperated with 12 farmers in 2013. Yao also concentrates on changing local culture by reason that left-behind children has been a serious social problem and the prevailing of gambling and



frequent quarrels and fights are the huge challenges in rural areas. In response to this situation, Yao invited volunteers to teach for the left-behind children and established the rural children's library and women's dance crew.

[Figure 2] The reconnection in alternative food networks

In this case, we could see a nexus of urban-rural relationship, possibility of sustainable livelihoods and rural revival in present China starting with people having access to food literacy education. Ezio Manzini described the distributed and resilient systems have appeared and spread as four waves of innovation, and one of the gradually converging innovation waves are distributed food networks which concern food and agriculture (Manzini, 2015). Represented by Transition Town Movements and Slow Food Movements, both of the two innovations work on solutions to build a connection between agriculture production and food consumption (Manzini, 2015). It would form a new sustainable and resilient culture grounded on alternative food movements in distributed systems, create the new concept of globalisation as "a distributed globalisation where, for each process of production, distribution, and consumption, much of the decision making, know-how, and economic value remains in the hands, minds, and pockets of the local community" and redefine the notion of work, the meaning of relationship and time based on the small scale and interconnectedness of social organisations (Manzini, 2015).

Notwithstanding as with the majority of studies there are several limitations to this paper that we analysis inadequate sample information as individuals do not represent the total and we are unable to interview consumers who are associated closely with the food systems, we could perfect them in continuing research as part of contribution to a new possible sustainable world.

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SUSTAINABILITY AND CREATIVE EDUCATION: DEVELOPING A SUSTAINABILITY CULTURE OF HIGHER EDUCATION IN CHINA

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ABSTRACT

Sustainable development and creative thinking have become central aspects of Higher Education in today's multi-disciplinary world. By considering the balance between learning and teaching priorities, the Design Academy, Sichuan Fine Arts Institute and School of Design, Jiangnan University incorporate the author's newly evolved teaching methodology — 3A: 'Acknowledgement, Action and Accountability' model of sustainable development and creativity — into its taught programs at all levels. The 3A model is a formative learning method for building capability of individuals to create changes toward sustainable development. This paper first defines the 3A design teaching process in the context of sustainability and sustainable development. Acknowledgment is the appreciation and recognition of the importance and quality of sustainability in the face of global challenges, with a particular focus on team effort, co-design and sharing findings and practices. Action is the establishment of design strategic and action plans that consider not only the importance of intents, goals, affordable and reachable resources, but also a clear roadmap for achieving maximum efficiency when tackling the most challenging tasks. Accountability deals with the growing understanding of the benefits of working together to tackle global challenges such as Corporate Social Responsibility (CSR) practices. Based on evidences from the feedback and evaluations of action research, the research team plans to further refine the 3A design teaching methodology and create a model that can be implemented and scaled effectively with collaborative partners from community, business and local government.

Key Words: sustainable development, design methodology, creative thinking, higher education

1. INTRODUCTION - THE ROLE OF UNIVERSITIES

Issues of creativity and sustainable development have been dissociated since the Industrial Revolution in the West over two hundred years ago. While many designers were preoccupied by creating marketable products rather than saving the planet in the past, an increasing number has begun to argue that sustainable development cannot be avoided any longer. Thus, a sustainable future for the planet is something that will only happen by design (To Last, Signed magazine, HKDI launch issue p42). Nowadays, to be or not to be sustainable is not an option but is one of the imperative goals to foster sustainable development in this global world. Education in design is prominent in providing responsive training for students who are going to engage the creative industries. Countries may vary in how they support design or creative learning with immersion programmes in sustainable development. In 2009, one of the researchers who was designated Head of the Department of Foundation Studies, at Hong Kong Design Institute (HKDI) has identified a need to question the role of higher education in promoting and educating about sustainable development.

Accordingly, the Reform of Design Education Foundation forum, hosted by HKDI to explore how higher diploma programmes can incorporate sustainability in their learning approach. Since 2017, the Design Academy, University of Sichuan Fine Arts Institute set out an aspirational goal of sustainable development learning and teaching for its design major programme for both undergraduates and post-graduates. The goal is to 'Provide a vision and missions to design learners on a sustainable development pathway to meet and enhance the needs of the present and to propel the greatest opportunity for improving a sustainable life for future generations.' To follow up on the mission, we asked: "where should we start?", "what needs to be reinvented?", and "what are the appropriate learning and teaching approaches? "

In this paper, we established an interaction learning environment that lead to better understanding and more appreciation of sustainable development contexts, especially the connectedness and impacts of the 17 Sustainable Development Goals (SDGs). Aiming to end poverty, promote prosperity and people's well-being by 2030. To greater empowerment of students' engagement, we invited students deep-heartedly involved, collaborated with community more directly, and facilitated activities for open discussion and ideas exchange. The Sustainable Development Goals are to be achieved and mindfully monitored. It is regarded that achieving the SDGs would transform the status of human development (The 2015 Human Development Report, A Future the Planet Can Accommodate, Syke Policy Brief, 2018).

To reach these ambitious goals, in 2018, a new design methodology, namely, the 3A: Acknowledgment, Action and Accountability was put in place, comprehending the process of sustainable development in line with their local objectives and projects. By reinventing higher education toward Sustainable Development and establishing a sustainable learning culture for students aged 17 to 23 years in Hong Kong and China, we want to enable all members of society to access the benefits of sustainable development of a globalizing world (UNESCO Bangkok, 2008).

2. WHAT ARE THE SUSTAINABLE DEVELOPMENT GOALS?

In 2012, the Sustainable Development Goals (SDGs), also known as the Global Goals, were born at the United Nations Conference on Sustainable Development in Rio de Janeiro , built on the success of the Millennium Development Goals (MDGs) which started a global effort in 2000 to tackle the indignity of poverty. The SDGs is a universal call to action to end poverty, to protect the planet and to ensure that all people enjoy peace and prosperity according to the new sustainable development agenda while protecting the environment by 2030. The objective is to produce a set of universal goals that meet the urgent environmental, political and economic challenges facing our world. Yet, the questions of how designers with sustainability capacity can be nurtured and what the challenges of designers in the 21st Century and future are - require immediate responses from design education disciplines.

There is an urgent need for people with an interdisciplinary, multidisciplinary and problem-solving capability because learning for sustainability involves how to make decisions that consider the long-term future of the economy, ecology and equity of all communities (Glasser, 2004, Y. Y. Lam et al, 2012). All of these issues have a major bearing on curricula and the processes of learning in tertiary and higher education. Learning for this purpose is rather than a traditional, and often over- specialised, scientific or technical competence (UNESCO, 2002). To achieve these goals, concerted efforts are required; it is not limited to students but also for all teachers, administrators, and educational planners, as well as educators in other sectors (UNSD, Agenda 21, 1992; Jay, 2004).

The SDGs encompassing a broad range of issues, are bold commitments to tackle some of the more pressing challenges facing the world today (UNESCO Bangkok, 2008) . All 17 Goals are interconnected, meaning success in one area affects success in other areas. Dealing with the threat of climate change impacts how we manage our fragile natural resources; achieving gender equality or better health can help eradicate poverty, while fostering peace and inclusive societies could reduce inequalities and help economies prosper.

3. THE 3A TEACHING METHODOLOGY ON DESIGN WITH ACKNOWLEDGMENT, ACTION & ACCOUNTABILITY FOR ‘SUSTAINABLE DEVELOPMENT GOALS’ PROJECTS



[Figure 1] The 3A Design Methodology

A new design methodology, namely, the 3A: Acknowledgment, Action and Accountability was put in place since 2018. Goals for sustainable development is at the heart of the 3A design methodology, a commitment to transform the sustainable development learning culture and to improve the living conditions and providing opportunities for every individual in line with their local objectives and contexts. Moreover, the 3A design methodology intends to enhance and extend students’ thinking capability in identifying and promoting inclusive sustainable solutions on a sustainable development pathway, while acknowledging risk and resilience, and taking actions to advance prosperity and well-being, as well as addressing issues of accountability and social responsibility.

Acknowledgment, Action and Accountability are the central paradigms of the 3A design methodology. These paradigms have been developed in an interconnected manner to help trainers and trainees prepare projects of sustainable development and measure their impacts.

Acknowledgment: defined as the expression or display of the appreciation for an individual, team or leader. It is confirmed by a Globoforce research study in 2013 which indicates that 89 percent of people is more motivated when being told what they are doing right rather than being told that they are doing wrong, and nearly 80 percent of people looks for this recognition to be given at the time of a desirable activity. Taking a broader view, acknowledgments of others’ feelings may have an important role to play in the resolution of conflicts in work; all of which contribute to the richness of human lives.

Action: taking action is to encourage the formulation of action plans, agendas and roadmap to monitor timelines and progress on every task. Without specific timeframes and deadlines, work can potentially expand to fill the time allotted, and some tasks may never get completed in the worst case. Educating with a new approach of time management will enhance students’ competence in distribution of duties, coordination with co-creating tasks and development of targeted actions.

Accountability: our research argues that students can make a lot of progress just by creating a design that makes people think about sustainability and accountability. As Bob Proctor remarks ‘Accountability is the glue that ties commitment to the result’. Accountability will enable establishment of actionable goals for long-term development and investments in sustainability. It also creates sustainable mentality, an effective and efficient method that forces us to shift our mentality. We are accountable to consider the impact of trends in the changing world of creative education development (Y. Y. Lam, in DESIS Conference 2016).



Design Team: Helen & LenLen (Master degree in Product Design)

[Figure 2] Selected Student Project illustrates the implementation of 3A design methodology approach : Sustainable Design Workshop, Design Academy, Sichuan Fine Arts Institute

4. RESEARCH METHOD

This paper presents the teaching approach and learning process through a teaching case. The case involves a group of students designing a product or a service for a group of real people in a real or simulated situation with a commitment to design for sustainability and social innovation. Action research is the central method used in this research. The data were drawn from feedback, face-to-face interviews, project review meetings and focus group discussions of direct stakeholders (learners, trainers, users and policy makers). A lesser extent from websites, conferences, and presentations, because the common nature of these methods can elicit rich, detailed material and firsthand information (Stewart et al. 1990; Lofland, 1995; Frechtling et al. 1997). And these methods are also the centralisation of human interaction for knowledge production (Kvale, 1996). Data analysis was grounded in theory with reference to current literature on sustainability, sustainable development and government policy.

5. CONCLUSION

The research major findings demonstrated that capabilities to take good practice of the '3A' design methodology with sustainability concern are the followings:

- 1). Study mindfully and better understanding the importance of sustainable development through the acknowledgment of the 17 Sustainable Development Goals not limited to its contents but also its contexts of case studies from different countries.
- 2). Design for sustainability is the international trend. It is found that most young participants is the consumers' purchasing and spending patterns which could be an important point of leverage based on the positive impact of Millennials' lifestyle trends. (The Positive Impact of Millennials' Lifestyle Trends 2018)
- 3). Major opportunities and challenges were identified from the research components of the project. For instance, we observed from our feedbacks that the perceived urgency of adopting a more sustainable lifestyle was low even among learners in higher education level. Our analysis also showed that understanding the diverse needs and interests of various stakeholders could assist us to devise appropriate communication strategies accordingly.
- 4). Participants were inspired by learning and creating in a new way. Designers should use their abilities to the utmost for creating design to help acknowledge, appreciate and propel sustainable learning culture, societies and industries.
- 5). Learners were encouraged to create designs with the lowest possible environmental impacts by minimizing resource and energy consumption throughout the life cycle of products, structures, services and systems. Equally important is the selection of local materials.
- 6). A visionary education approach for sustainability education, by its nature learning design is exciting, powerful and joyful while we could use capability building to manage challenges, pressing issues of sustainability.
- 7). Establish excellent networks and partnerships with a broader range of sectors to gain legitimacy and project an image of accountability regarding as a new knowledge of this design methodology.
- 8). 3A design methodology strengthens students' commitment and enthusiasm for creation. Students are eagerly to learn new things, meet new people and create new design to stimulate people interest in sustainability.
- 9). Co-creating culture has been well transformed. Students are genuinely to take up the social and cultural responsibility with a wider perspective starting from the society to the community, designers to users and design to production.

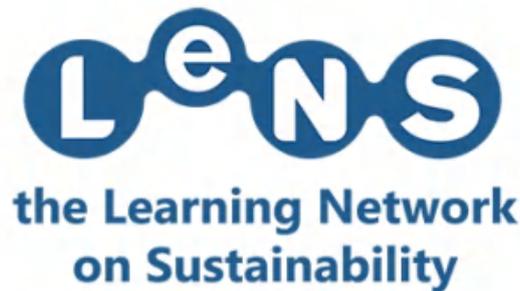
3A design methodology incorporates with divergent and convergent thinking can instill a positive energy in design education to encourage learners involved to acknowledge, action and be accountable of the beauty of our mother earth (Y. Y. Lam et al. 2015). Toward the end, both involved parties become transformed into local issues as appropriate.

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ORGANIZATION AND TEACHING OF INNOVATIVE PRACTICAL TEACHING COURSE BASED ON SUSTAINABLE CONCEPT COMMUNICATION: THE CASE OF THE TEACHING OF KNOWLEDGE OF PREFABRICATED BUILDINGS FOR JUNIOR IN THE DEPARTMENT OF ARCHITECTURE, HEBEI UNIVERSITY OF TECHNOLOGY, CHINA¹

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ABSTRACT

This article introduces the innovative practical teaching course on prefabricated buildings of the third-grade undergraduates in the Department of Architecture, School of Architecture and Art Design, Hebei University of Technology, China. Based on BIM technology, a variety of teaching modes and methods are conducted in the course with the purpose to achieve the teaching targets and carry out teaching reflections.

The development and implementation of the prefabricated buildings and BIM information technology is clearly defined in the State's documents- "Opinions on Promoting the Sustainable and Healthy Development of the Construction Industry" (2017) and "Guiding Opinions on the Development of Prefabricated Buildings" (2016). Accordingly, the Chinese construction industry will usher in new development opportunities. With the vigorous development and implementation of prefabricated buildings, a large number of information-based and industrialized talents are required in the construction industry, which will pose the greatest challenges for universities and enterprises as to training qualified new-era architectural talents. The innovative practice course of the third-grade undergraduates is an exploration and trial with the purpose to build college students' awareness of sustainable development, to improve students' professional knowledge, to be familiar with technology of Assembled Architecture and to enhance students' employment competitiveness.

Key Words: prefabricated buildings, innovative practical teaching course, School-enterprise cooperation

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1. INTRODUCTION

Between 1999 and 2010, as the amount of construction increased, the urban land in China became more and more tense, and the height of the residence increased again and again. In order to further improve the integrity of buildings, the cast-in-place concrete technical system has been fully applied. However, the shortcomings of the technology system have gradually emerged. For example, the labour-intensive of traditional manual formwork, time-consuming maintenance, the serious pollution at construction site and the prevalence of quality defects. In recent years, with the shortage of labour, this traditional construction method is not sustainable, thus the development of fabricated buildings has attracted attention.

The development and implementation of the prefabricated buildings and BIM² information technology are clearly defined in the State's documents- "Opinions on Promoting the Sustainable and Healthy Development of the Construction Industry" (2017) and "Guiding Opinions on the Development of Prefabricated Buildings" (2016). Accordingly, the Chinese construction industry will usher in new development opportunities. The innovative practice course of the junior is an exploration and trial with the purpose to build college students' awareness of sustainable development, to improve students' professional knowledge, to be familiar with technology of prefabricated buildings and to enhance students' employment competitiveness.

2. BACKGROUND

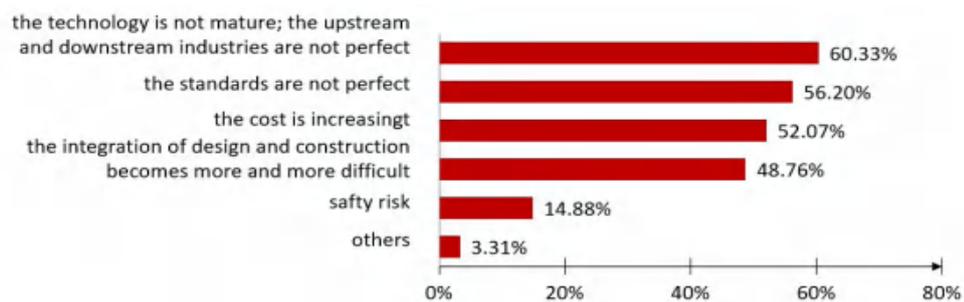
2.1 Policy level

From 2011 to 2018, China issued a series of policies to encourage the development of prefabricated buildings, and strive to create a good atmosphere for the progress. For instance, In 2016, "Several Opinions on Further Strengthening the Management of Urban Planning and Construction" (State Council document) proposed that the proportion of prefabricated buildings to new buildings should reach 30% in about 10 years. In February, 2017, "Opinions on Promoting the Sustainable and Healthy Development of the Construction Industry" and "Guiding Opinions on the Development of Prefabricated Buildings" (State Council document) clearly defined the development of prefabricated building and the implementation of BIM information technology. At the same time, local governments also consider from the aspect of the economic and social development of the region, introduce local policies and standards successively to promote the development.

2.2 the industry problem

According to statistics from the network data platform, the current problems in the development of fabricated buildings from the perspective of developers are as follows:

2.2.1 The resistance for the development of prefabricated building: the technology is not mature; the upstream and downstream industries are not perfect; the standards are not perfect yet; the cost is increasing, and the integration of design and construction becomes more and more difficult.



[Figure 1]

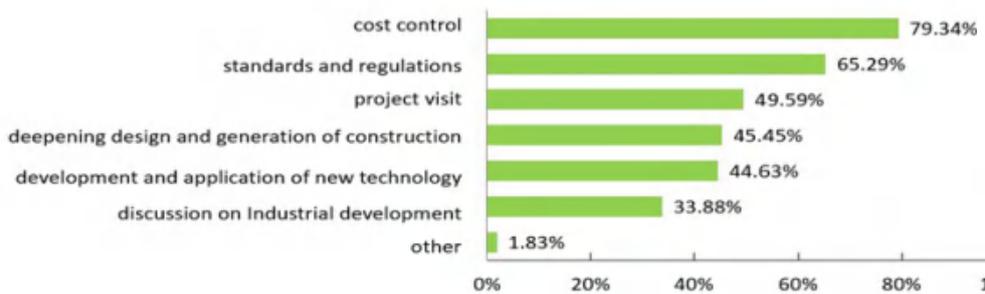
2.2.2 Difficulties in prefabricated building construction: high input capital costs in prefabricated building; the appearance of prefabricated buildings is relatively simple and lacks of diversity; lack of quality standards for prefabricated building structure.

² Building Information Modeling. The key of BIM is to build a virtual three-dimensional model of building engineering, Using digital technology, the model can be provided with a complete and consistent information base of construction engineering.



[Figure 2]

2.2.3 The aspects of concern over the prefabricated building: the capital cost control; the structural standards and specifications; the project case study and construction deepening design and generation, etc.



[Figure 3]

[Figure 3]

To sum up, nowadays in China, for the prefabricated construction industry, its design, construction, project delivery and operation have changed greatly from the traditional project management. The traditional project managers, researchers and designers have no systematic knowledge and recognition to the design, production and the construction process so as to limit the further development of prefabricated building. Therefore, the pressing urgency is to cultivate the high-level technical workers, quality management personnel and compound talents which will help to create a team with excellent quality, comprehensive technology and strong management ability.

2.3 Teaching background

Innovation practice course is a professional course established by faculty of architecture and art design in Hebei university of industry with purposes of practicing teaching and learning, and it is arranged in spring semester for architecture majors. This course is set in order to provide students with relevant directions and enlightenment with the hopes of provoking students and teachers' innovation awareness by helping students understand practical development in this field, academic innovation theories, rules and methods. Course subjects are small, micro-structures training oriented. Students are able to recognize the significance of material, structures, and constructions and are able to be enlightened with innovation designing ability through theory teaching and learning and practical teaching and learning stages. In 2017, based on purposes of fostering students sustainable developing ideas, enhancing professional knowledge and being familiar with techniques of assembling style, BIM techniques and assembling techniques were designed as teaching and learning outcomes and lecturing content and plans were organized by lecturers and relevant experts in enterprises.

3. TEACHING PRACTICE

3.1 Basic idea

The idea of organizing the teaching is to pass the concept of sustainable development to students and design small structures under the guidance of the designing idea of prefabricated buildings. In guiding students to the practical course, we simplify the complexity of the prefabricated building in all aspects, the structure of a building is seen as a major equipment and materials are parts of the equipment, in order to reflect “standardization” and “industrialization”, with the connection between architectural component designing and construction of components as one of the main research aspects of architectural designing

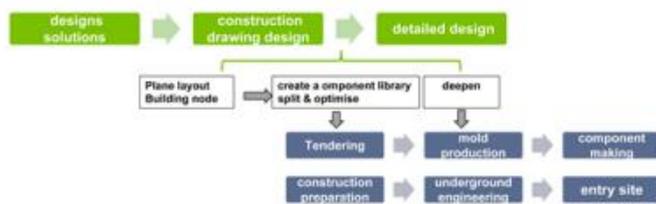
(1)The task formulation is based on the actual project, the training topic is introduced by real subgrades and social needs, Information is obtained based on the field observation and visit, and the theme is set and carried out according to the demands. Materials and novel construction methods are chosen. After connections between components are designed, information and blue prints which can be used for machining are formed; finally, the cost is estimated. The knowledge of sustainable development and prefabricated building is explained and integrated with the practical operation of small and micro structure design and construction in practicing as learning.

(2)In the teaching mode, the basic knowledge of assembly is introduced through “group discussion + explanation + one-to-one communication” in the two-week innovation practice course. In the process of designing practice, experts from member enterprises of prefabricated building alliance are invited to explain the construction process and to guide students to adjust their design ideas. Component dismantling and standardized design are thought about through BIM tool, and the component customization and ordering to understand the cost estimation; through the assembling stage, students can understand the close relationship between the component design and the actual assembly process. The design effect and teaching results are evaluated by department heads and experts in enterprises.

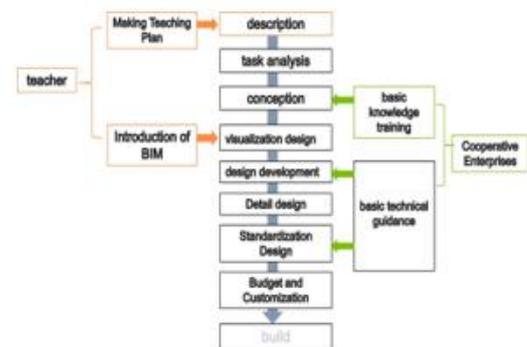
3.2 Method

3.2.1 Teaching process

Aims are set by university lecturers and lecturing contents and plan are organized by collaborative efforts of lecturers and experts in enterprises with reference of prefabricated architecture design process.



[Figure 4] Prefabricated architecture design process



[Figure 5] Teaching process

Integration of different teaching environment such as round-table conference, mini-salon, discussion and multimedia classroom are adopted, which is leading teaching direction and is beneficial for students to bring about questions, to speak their minds, to communicate with lecturer. In the scheme stage, according to the teaching situation in the previous stage, teachers and students conduct case selection and scheme comparison, and teachers put forward constructive suggestions to guide the scheme. Teachers make teaching adjustments according to students’ feedback and needs which promotes curriculum development step by step. At the end of the course, teachers in charge of the department are invited to evaluate the effect and summarize the experience and shortcomings, so as to make further improvement.

3.2.2 Interaction in Teaching

The content of the innovation practice course is set up by the teachers according to their own research direction to set up a number of workshops selecting topics; Students volunteer to join the teachers’ workshop and complete the topics they are interested in. Therefore, teachers need to have a group discussion with students before teaching. Teachers introduce and explain their own subjects and topics, and students put forward questions and needs. During the course, program discussions were organized on a regular basis, where lecturers in charge of the department, enterprise experts, and students have discussions and interactions on the theme of “assembly” based

on the specific program, and evaluate the results of the program process and put forward constructive suggestions. In order to pay attention to students' learning progress, in addition to discussions and exchanges at school, teachers establish working groups through the Internet, so that students' questions and teachers' interviews are not restrained by time and space.

With the help of cooperation with enterprises, VR³ technologies are used to assist teaching and design, so as to cultivate students' practical operational ability and innovative ideas. Ultimately, students' interest in learning can be stimulated in the process of practical training, and the design can be extended to collision design analysis and architectural science separation. In the future, students will be organized to go on field trip in the factory with the convenient help of enterprise, so that students fully understand the process of the whole modernized industrial chain in construction industry, which changes the students' way of study from virtuality to reality and greatly improves the teaching.

4. Results and analysis

Compared to traditional lectures, teaching this course in addition to the increasement in the content of the plan also encountered unpredictable changes.

In terms of teaching preparation, in addition to designing teaching procedures based on the architectural design curriculum, teachers must rely more on their own efforts to enrich their knowledge in order that students can accept new content. At the same time, teachers and business experts have conducted many exchanges and discussions to obtain more comprehensive information about fabricated buildings, including the technical knowledge currently being used.

In the process of teaching, what is taken is continuous "companion" and "follow-up". In the program stage, teachers and students may discuss and research around the program every day, especially in the component standardization and node design section, because these two links are not deeply involved in other courses, and need to consider more weight bearing and fixed, we even have to balance the factors of materials, size, safety and price in the cost stage.

In order to avoid the subjectivity of the assessment results, multiple assessment sessions are set up during the teaching process. In the evaluation of the design stage, except the instructors, there are also teaching leaders of the department, and the evaluation is based on the requirements of the task book. During the standardization process, enterprise experts will participate, mainly to evaluate the operational aspects of reality.

To establish a good feedback link, the student counselors and teaching supervisors of the department participate in the course from time to time, listening to the teaching feedback of teachers and students, so as to timely discover and correct all the tendencies that deviate from the normal mastery process. This allows the course to proceed smoothly without deviating from the teaching objectives.

The specific contents of this practice class are two topics: a campus public space "a pavilion" design; B. design of a shelter at campus bus station, during which, students experience the stages of case analysis and base research, scheme design, BIM model building, VR simulation, node design and cost estimation. The scheme has two tendencies: the standardized design of components and the construction of components customization and on-site assembly, and the combination of nonlinear design and concrete printing.

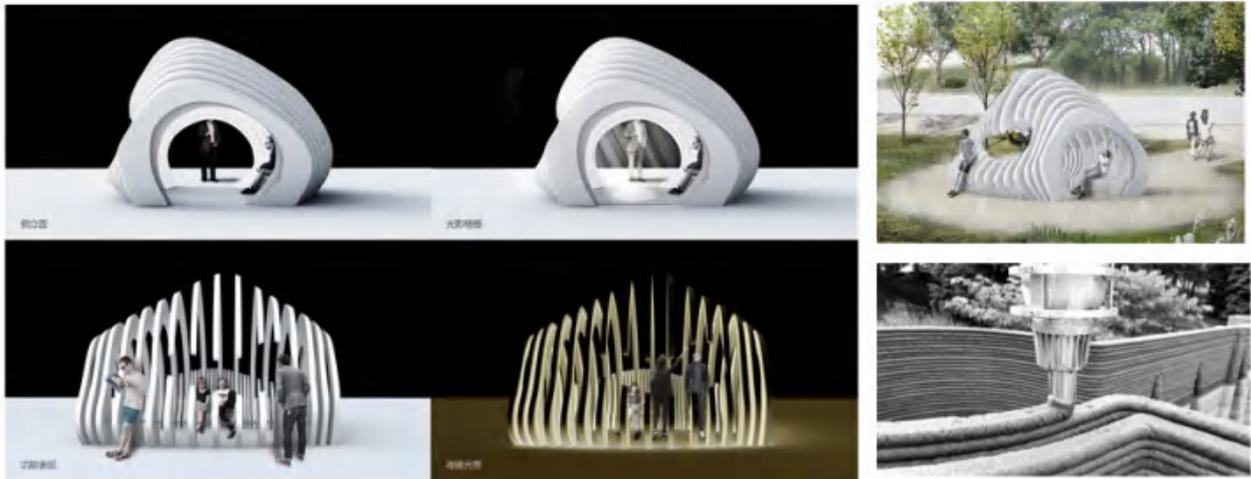
Category 1: side used standardized design of building components and the connection between building components. This kind of achievement fully embodies the teaching idea of architectural design -- scientific separation -- component design "standardization" -- budget. BIM tools play an important role in such achievement.



[Figure 6] Category 1

³ Virtual Reality The most important feature of VR is to use computer simulation to generate a three-dimensional virtual scene.. This virtual scene provides users with visual, auditory, tactile and other sensory simulation, so that users can be as immersed as they are.

Category 2: combination between side used component fabrication and nonlinear design with concrete printing. For this kind of achievement, nonlinear design method is adopted. For this project, we consider a variety of solutions from the perspectives of material selection, processing method and the balance between construction member. Finally, the new technology of 3D concrete printing was selected. This is also the serendipity of this class.



[Figure 7] Category 2

The prefabricated construction design course, is carried out with the idea that “education is not the filling of a pail, but the lighting of a fire,” and the idea of sustainable design is adopted into specific topics, more attention from the task is set to students’ interest stimulation in learning from subjects selection to tutoring, students reflect they have deeper understanding of sustainable design. At the same time, students are able to quickly change thinking mode that architectures are detachable industrial products, but also can customize the components according to different designs, and design the components of connections so that it can be realized to build buildings on site like playing “building blocks”.

As for limitations: firstly, students are limited to a very small field on materials, 85% of students choose the materials of load-bearing members as wood and light steel, and 15% use concrete materials. Due to the monotonous selection of materials, there is a lack of innovation in the connection of components. Second, due to the limitation of funds, it is not able to achieve the final construction.

5. CONCLUSION

Reviewing the course process, we can see that the concept of sustainable design has been deeply understood. The uni-enterprise cooperation enriches the teaching content, which produces a stronger bond between classroom teaching and practice in this industry and stimulates students’ interests. The application of BIM, VR simulation and other tools enables students to think more deeply on projects. Meanwhile, we also find that there are some control deficiencies in teaching. Therefore, in the future teaching, we will increase the number of visits to the prefabricated construction site and invite the leading enterprise experts in this industry to give lectures. According to the situation of funds and facilities, we will make 1:1 physical production of the connection part of the components.

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