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Editorial

Open Debate

Stories

Designrama

Forum and Reviews

Editorial

This issue focuses attention on circularity and sustainability in the design process. It does so by casting light on the Packaging system that we have taken as a paradigm for the system of contemporary commodities because it is the sum total of everything that is designed around the commercial commodity in order to unleash its potential exploitable value.

The contemporary designer knows too little about this complex and intricate System, while the number of scientific specialisms involved and their depth is very advanced.

We have all overestimated the short-term economic dimension and the relative consequences of this System in terms of business, while many other dimensions of the problem lie in wait: we will try to account for them through the eyes of the designer who engages in dialogue and integrates knowledge and who seeks to play an active role in many of these production chains.

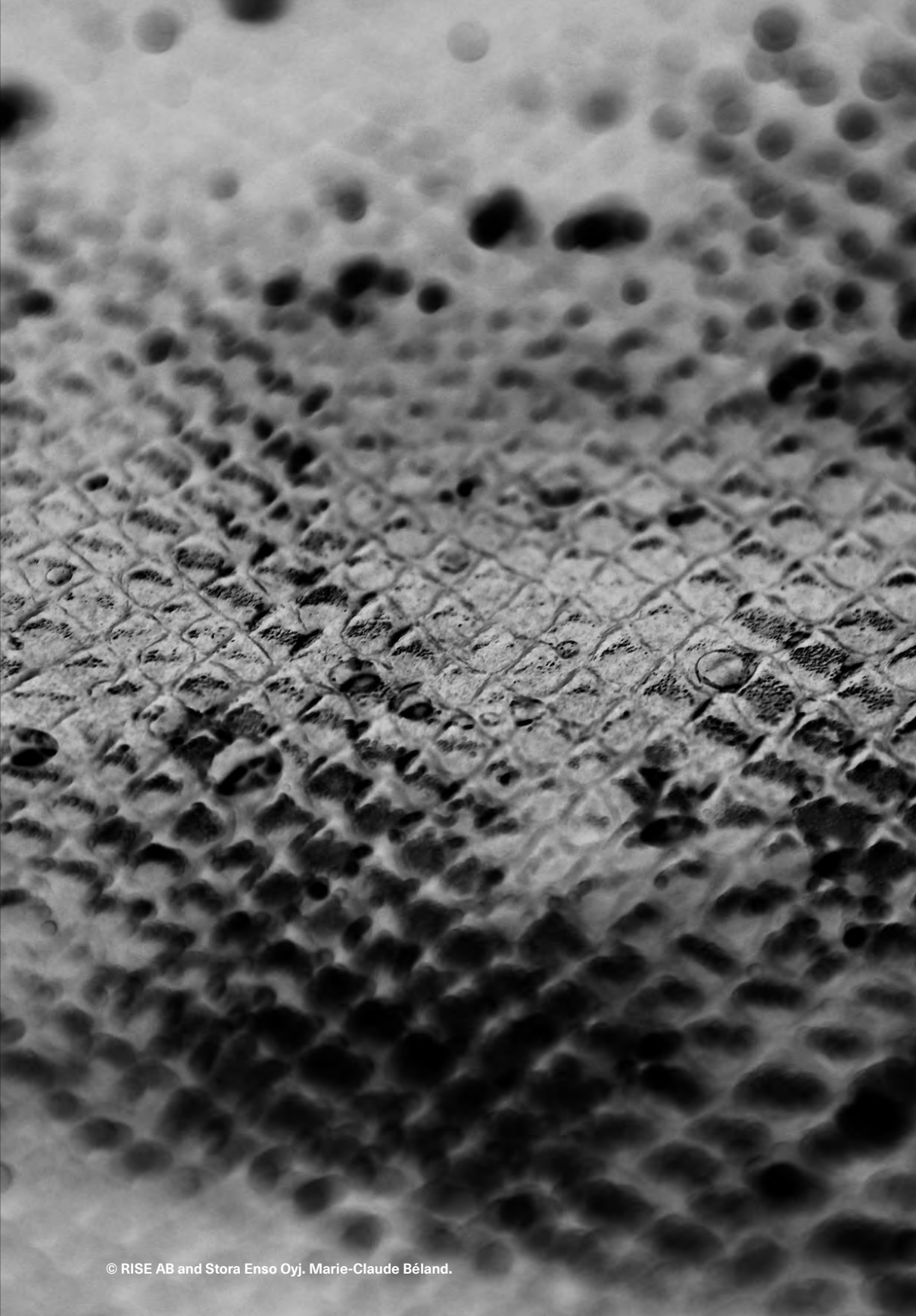
Tatjana Karpenja and Clara Giardina, who bring with them different backgrounds and sensibilities, accompany us through this journey with vertical investigations, highlighting the state of research at the various international, European and Italian national scales, where an alliance is being formed between all the most prestigious universities that have invested in these themes.

Diid's journey of evolution continues, expanding the number of colleagues who from around the world support us in our Scientific Board, seeking to grow together and to cultivate the scientific conscience of our contemporary design cultures.

Flaviano Celaschi
Editor-in-chief

Open Debate

The complexity of the contemporary context is the background for an articulated and multiform Packaging industry, driven by different actors whose roles are rapidly changing. This Open Debate section addresses some of the key aspects in the evolution of this sector, from process assessment methods to material issues, from aspects of logistics optimisation to the consumer perspective, while mapping the network of international organisations involved and highlighting the intangible aspects of the System, as well as the crucial role of Research. The perspective to be maintained is holistic, with a Life-Centred approach and driven by Design, understood as a discipline capable of organising this plurality and guiding the sector through a sustainable and circular transition, in order to achieve harmonic well-being for all creatures and ecosystems.



Life-Centred Design of a Packaging Value Cycle

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Abstract
Packaging is omnipresent and has evolved through times reflecting the changes in society and in our lifestyles. The modern packaging industry gradually shifted its focus from a product-centred to a human-centred approach and is now starting to embrace a new era in which packaging is considered from a broader perspective — a so-called life-centred design perspective. The reasons behind the constant change are many, from market demands, rapid technological development, rapid population growth, to political steering due to resource and other societal constraints. A life-centred design of packaging value cycles is one that will take into account the well-being of and interaction between all ecosystems. Answers will be discovered through an inclusive exploratory journey of how it should be done.

Keywords
Packaging value cycle
Life-centred design
Sustainability
Resilience
Circular economy

Change is the only constant in life
— Heraclitus, Greek philosopher

Introduction

Packaging has been present in our lives since ancient times, reflecting and adapting to changes in society in general and in our lifestyles in particular. It fulfils multiple functions, takes different shapes, utilises various raw materials and is increasingly tailor-made to specific uses. In modern times, packaging is still constantly evolving but at a faster pace due to enablers such as globalisation and digitalization. At the same time, societal challenges such as climate change, resource efficiency, littering and resilient society are becoming acute, being ever more regulated on international and national levels. These challenges influence the development of packaging production and consumption.

If we take food as an example, consumers now have the choice between drive-through, home delivery, take-out, cooking at home, and eating out. The model of traditional meals, eaten together, is fading — to be replaced by meals or snacks eaten alone, with each member of the household watching their screen of choice. Today, many teens eat in their bedrooms, often lying on their beds. This highlights the trend of a permanent evolution in lifestyles and consumption (Dairou, Lageat & Delarue, J., 2022). In the political arena, EU legislation such as the Single Use Plastics Directive (EC, 2019), Packaging and Packaging Waste Directive (EC, 2018), regulations on product safety for packaging materials intended for food contact and many more, are becoming more stringent in their requirements for sustainability and circularity of packaging in relation to the environment and the human.

From Product-Centred to Human-Centred Packaging Design

Lockhart (1997) proposed three main criteria for packaging functions, namely a) protection, b) utility, and c) communication. As summarised by Grundey (2010), protection means that a product is shielded from environmental effects during transport and storage. Utility means the packaging gives the consumer an experience of functionality, like spouts on milk cartons or holes in the snap-on shaker inside a spice jar. Finally, the function of communication is about communicating important information to the consumer as well as brand identification, and in some cases advertising and promotion. Extensive research allows us to understand and clarify packaging functions (Brennan et al., 1990; Copley, 2004; Blythe, 2005). Historically, the focus in packaging development was solely on the functional performance of the packaging material with respect to the product packed, i.e. *product-centred design approach*.

In our everyday life, we can observe examples of failure in packaging design for broader value cycles. For instance, one of the reasons why much of plastic packaging is not recyclable today is the industry's previous sole focus on packaging functions and

diid No. 79 — 2023
Doi: 10.30682/diid7923a

making the packaging attractive to the consumer while ignoring material recyclability (KfS, 2018). Here, separation of different types of collected plastics is very difficult, making recycling practically impossible. Furthermore, many materials that are both functional and recyclable are not yet commercially available. This applies, for example, to cheese packaging — for the quality of the cheese to be maintained during its shelf life, the packaging must "breathe", which means that several different types of plastic must be used in one and the same packaging to ensure this packaging property (KfS, 2018).

Meanwhile, packaging design is becoming an important intersection between the product and the user by assisting the latter with information about product use and the benefits the user can expect. A so-called *human-centred design approach* is believed to have been born out of the Stanford University design program in 1958 — when Professor John E. Arnold suggested that engineering design should be human-centred and focus on positive and long-lasting change. The concept has since expanded into numerous fields beyond engineering — including psychology and anthropology — and continues to provide a creative problem-solving solution to help push innovation forward in a practical manner that is grounded in human well-being and user satisfaction (Fast Company, 2022).

In the packaging area, considering the user experience (human-centred design approach) is becoming a key issue for packaging developers. This experience results from the use of the packaging and the product's contents, which together create a complete experience for the user. The experience produced by both must therefore be consistent. The product and its packaging exist together and need to interact if they are to best serve the user. This may seem an obvious aim, but it is often not achieved because many companies have tight deadlines, organisational constraints, and economic pressures to deal with (Dairou, Lageat & Delarue, J., 2022).

One example of human-centred packaging design failure that we can learn from is a packaging-innovation project carried out by Danone, which combined the perspectives of user experience and lowering environmental impact. An innovative and completely recyclable yogurt cup was designed, with lighter packaging material weight. To achieve this goal, the new cup had to be made of both plastic and paper-based components. The packaging developers made it easy for the consumers to tear the two components apart so that each could be discarded in the appropriate recycling bin. The consumer survey results showed that, despite the labels and clear instructions on the packaging, 80% of consumers did not behave in the way that the developers thought they would and later discarded their cups in the wrong bins (Dairou, Lageat & Delarue, J., 2022).

Packaging Dilemmas

We are faced today with a number of dilemmas in packaging value cycles. The value cycles are the opposite conception of "linear economy value chains" where resources are used to "take-make-dispose" of products without further value circulation in terms of variety of value reuse and recycling paths. Dilemmas occur partially due to the complexity of cycles and partially due to focusing only on one

aspect at a time when attempting to solve a problem. This can lead to sub-optimization elsewhere in the value cycle:

- The demand for 100% recyclable food packaging is not compatible with the lack of commercially available functional materials. The risk this creates is to jeopardize food safety, protection, and shelf life. All the while, the environmental impact of food and food waste remains higher than the environmental impact of the packaging it comes in.
- Generally, the consumer is logical and tends to sort waste according to the waste material type such as plastic, paper, metal waste etc. However, in the EU, packaging waste collection under the scope of the Extended Producer Responsibility (EPR) scheme is based on materials application. Separate collection and sorting schemes exist for packaging, electronics, tires etc, rather than for different material types such as paper, plastic, metals. This leads to incorrect sorting of, for example, plastic-based toothbrushes, children's toys, etc., as plastic packaging waste.
- The Packaging and Packaging Waste Directive (PPWD) counteracts value cycle thinking by encouraging packaging recovery by the means of material recycling, incineration or composting. This can be interpreted as considering incineration to be a circular approach, which in practice contradicts the development towards circular material principles. Additionally, the EPR scheme is implemented but lacks control of compliance.
- Designing unnecessary packaging for enhanced user experience.
- Transition to packaging design for reuse offers substantial packaging material savings though it may imply an increase in the costs of logistics and in water usage (during cleaning processes for packaging reconditioning). The net sustainability effect of the transition is still unclear and remains to be realised and measured.

Feber, Lingqvist and Nordigården (2022) describe three disruptive eras in the global and dynamic packaging industry. The era of 2000 – 2009, where the change in substrate (packaging material) occurs in favour of plastic packaging for convenience and low cost. The era of 2009 — 2020, defined by a continued shift in the choice of substrates, expansion into emerging markets and increasingly environmentally-conscious consumers. Finally, the era of sustainability and digitalization starting in 2020 and currently ongoing, with its stricter political measures to foster sustainability and a circular economy. In the EU, this era also includes increased e-commerce and capital allocations based on the sustainability performance of businesses.

Towards Life-Centred Design of Packaging

In the past few years, the design community has begun to question this explicit prioritisation of people and their needs and desires. We can no longer afford the damage wreaked upon the global systems essential to human well-being. Scholars argue that it is necessary to shift to a new design paradigm, creating products with an

diid No. 79 — 2023
Doi: 10.30682/diid7923a

increased focus on human-centred design, that explicitly consider global well-being within the design process (Nardi, 2019). This shift is urgently needed as global well-being is intrinsically linked to the health of global systems, and technology use has had an environmental impact on those systems (Praskievicz, 2021).

The impact of the design practice on the environment has long been recognised in other design sectors (Borthwick, Tomitsch, & Gaughwin, 2022). For example, Papanek (1972) wrote, "There are professions more harmful than industrial design, but only a very few of them". The industrial design sector has responded to these concerns, resulting in various approaches and reference terms, such as eco-design, sustainable product-service systems and the circular economy (Bhamra & Hernandez, 2021). It is becoming evident that we must seek an approach that goes beyond human needs. We need to rethink the way we live and create value in connection with the larger systems that surround us, including nature.

In this sense, the design philosophy called *life-centred design approach* goes one step further. It is understood as a collaborative, inclusive, holistic design approach that expands human-centred design to also consider its sustainable, environmental and social implications (Lutz, 2022). Inglold (2013) believes that part of design's potential is its capacity to speculate and restore environments for life. Tironi, Albornoz and Chilet (2022) further evolve that notion, generating narratives and actions to make us aware of and responsible for the interdependencies that constitute us as earthly beings. One of the challenges of planet-oriented (life-centred) design is precisely to promote modes through which more-than-human agencies, bodies and corporealities that have been ignored by the modern regime can be incorporated into design processes. It is not simply a question of establishing protocols of careful coexistence with these agencies. Rather, it involves developing designs that let us reconnect with the earthly condition, recognizing how these same agencies and bodies can redesign the spaces that we inhabit, generating forms of cohabitation based on mutual care.

Applied to the packaging value cycle, the packaging system is interpreted here as a complex phenomenon with a high degree of economic and cultural cross-sectorality, making design a mediator (Celaschi, 2008) between these processes, needs and actors. The expressions of such a design can lead to new regenerative systems, regrowth of nature, new relationships, reinvented products, manifestos, etc (Spoelstra, 2022).

From a human perspective, according to the Accenture *Survey* (2022a), people are facing a world that feels out of control. At a time when economic, social, environmental and political upheaval is turning almost everything upside down, people are finding themselves in a multi-directional tug-of-war. Faced with the pressure of all these external forces at once, their decisions boil down to trade-offs between what they want, what they need and what options are available. The results can seem contradictory. People are prioritising themselves, but want to effect change for others. They want to follow their values, but not at the expense of value. They're taking matters into their own hands, but also want companies to hold their hand (Accenture, 2022a). These kinds of inconsistencies might not be new, but they're increasingly considered normal — and even good

(Heracleous & Robson, 2020). In fact, the latest Accenture research reveals that up to 69% of consumers globally who admit to behaving inconsistently think that paradoxical behaviours are both human and acceptable (Accenture, 2022b). To stay relevant, businesses must move past customer-centred models and embrace a life-centric view that views people more fully (Accenture, 2022a).

In the area of corporate governance, where strategic decisions are being made about the future of organisations, a growing number of leaders are making statements and manifestos about sustained value creation. As an example, Klaus Schwab (2020), the founder of the World Economic Forum, published the *Davos manifesto* stating that the purpose of companies is more than to exist as economic units generating wealth by fulfilling human and societal aspirations. In the Fourth Industrial Revolution, company performance must be measured not only by the return to shareholders, but also by how the company achieves its environmental, social and good governance objectives. Executive remuneration should reflect stakeholder responsibility. Another example is the initiative of the RISE Research Institutes of Sweden and the Swedish packaging industry association Packforsk in collaboration with GROW, which calls for a paradigm shift in the packaging industry towards truly circular packaging materials and value cycle-based business models (RISE, 2020). Furthermore, the Global Commitment 2022 (Ellen Macarthur Foundation, 2022) unites businesses and governments to commit to change how we produce, use, and reuse plastic, including companies representing 20% of all plastic packaging produced globally.

Holistically, the life-centred design of a packaging value cycle can be visualised conceptually within a system-thinking perspective, giving it the ability to interconnect within and between ecosystems while creating sustainable value in economic, social and ecological terms (see Fig. 1). It triggers new ways of innovating, with value cycles designed in an explorative and iterative manner.

The varying design practices used by different life-centred approaches draw from a mix of circular design, systems thinking, biomimicry, futures studies, and others (Lutz, 2022). Here, the circular economy is based on three principles, driven by design: eliminate waste and pollution, circulate products and materials (at their highest value) and regenerate nature (Ellen MacArthur Foundation, 2023). While there is no single solution, one may consider designing packaging that becomes an integrated part of the product it packs, thereby eliminating the need for packaging waste management. One such example is the cellulose fibre-based Billerud D-Sack® cement packaging that “disappears” or dissolves when mixed with the cement (product), water and other components for concrete production (Billerud, 2016). Another may consider designing packaging for technical (e. g. material recycling) or biological (e. g. biogas production) systems to create circular packaging value cycles. All in all, the packaging value journey should be explored through systems thinking in order to maximise the potential of sustainability and minimise the potential of risks.

In this journey, important questions arise: where is the packaging value created and for whom? Is the value created in the production

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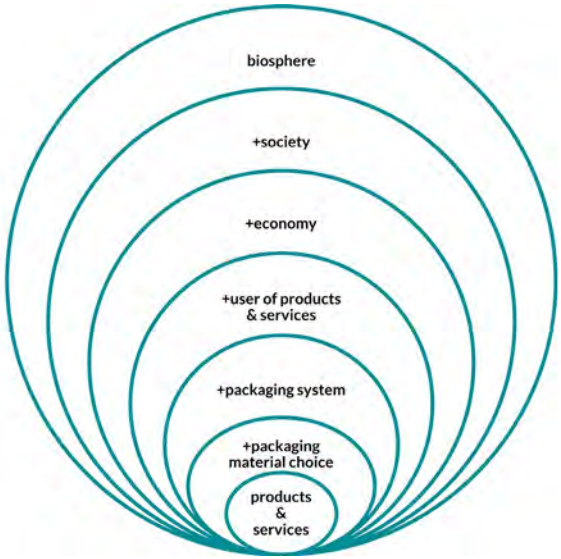

Fig. 1
Conceptual visualisation of systems thinking as the ability to interconnect within and between systems such as ecosystems, including economic (value creation through products and services), societal and ecological environments, elaborated through the lens of a packaging value cycle.

processes or is it created by the user, and in this case who is the user (e. g. a direct user or also nature as user or both)? How do we define and measure environmental, economic and social values inclusively? Thus, in the packaging area, the focus clearly evolves from packaging production in terms of optimization of packaging material performance (technical properties) to packaging as a service where value is created for broader, multi-dimensional ecosystems. Under consideration are the inclusive perspective of a product to be packaged, consumer needs and behaviours, as well as possibilities and limitations of the larger economic, social and environmental systems that surround us.

The Open Debate Section in a Nutshell

Following the Fig. 1 life-centred design approach, the article by Béland and Granberg in this Open Debate section is dedicated to the packaging material creation process where multiple potential material properties are discovered and matched with multi-dimensional performance requirements of the products they shape and the environment. By introducing material demonstrators into the material innovation process, the article pinpoints nine roles that demonstrators can have to help reduce the lab-to-market gap. One of the important insights in the article is related to an early interaction between researchers and designers through the tangible and inspiring media of material demonstrators. This creates a deeper mutual understanding of sensory material qualities and the Research, Development and Innovation (R&D&I) process and thus accelerates the innovation process. The article presents a practitioner's point of view on how coupling technology-driven results with user(market)-driven needs can be facilitated by a multidisciplinary approach.

Dominic and Olsmats dive into the life-centred packaging design approach through the lens of a four-dimensional concurrent engineering (4DCE) approach for the development of product, logistics process, packaging and supply chain. The case study from the fresh food industry in which a holistic packaging development concept was used pinpoints the complexity and interconnections within and between the different systems in a packaging life cycle.

The research by Crisigiovanni and Agante unleashes the user perspective. Enablers of sustainable products and services, including packaging, such as digital platforms with information about the product life cycle, choices of biobased and circular packaging materials and guidelines for municipalities were detailed in order to identify user barriers and incentives for change and find common behavioural patterns. One of the research findings strongly involved design, which may determine 80% of the environmental impact that a product or service generates in its life cycle.

Furthermore, Huerta provides a deep insight into designing and developing packaging with environmental responsibility. By applying a hybrid approach of prescriptive (such as environmentally responsible design) and descriptive (such as Life Cycle Assessment (LCA)) methods in packaging design, the ultimate objective is to minimise the environmental impact of products and services, thus encouraging regenerative ecosystems.

Giardina elaborates on the primary need to design in a sustainable and circular way. In the contemporary "polycrisis", she emphasises the role of design and the emergent need for Transitional Industrial Designers, with their approaches, strategies and tools, in order to succeed in both including and simplifying all the new variables of contextual complexity within a project.

Pletto expands the topic to the global network of institutes, research centres and observatories - key players in the development and innovation of packaging systems. The analysis identifies regional concentrations of areas of expertise, supported by six selected case studies that illustrate different experimental approaches to packaging research.

Indeed, today's environmental, social and economic sustainability challenges are so complex that they can no longer be solved by scientific thinking or creative thinking alone, both need to be combined into an intertwined and inclusive approach, i.e. life-centred design. In exploring the life-centred design of packaging value cycles, it is important to consider that sustainable packaging is as sustainable as the system you are choosing to design it for. With both scientific and creative courage, we can together start the journey of designing well-being and healthy interaction within and between all ecosystems thereby creating a positive impact from packaging value cycles.

Tatjana Karpenja
She has 15 years of experience in sustainability and circularity strategies for materials in packaging value cycles. At RISE, which is an industrial research institute, she supportssmall & medium size companies in their transition to sustainable packaging by taking into account a holistic approach to sustainability, i.e., the environmental, economic and social sustainability implications.

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Holistic Approach in Design Research

Made in Italy Circular Packaging Innovation by Transitional Industrial Designers

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Abstract
We are going through uncertain times due to the "polycrisis", a context which makes us wonder about the role of Design in simplifying complexity into projects with a *5P* perspective. The hypothesis is that the figure of a Transitional Industrial Designer (TID) is emerging to support complex industrial sectors such as Packaging, someone able to interact with all stakeholders, manage digital tools and design project flows. The article illustrates the Packaging Innovation Observatory and Spoke 1 – MICS PNRR Project, in which Design — in terms of process-oriented design research with a systemic approach — is a crucial element in bringing different areas of expertise together to achieve sustainable and circular solutions. In addition, a mapping was carried out of the Italian Universities that deal with packaging design, in terms of the approaches and tools used: it shows that the design methods they apply are contributing to training a Transitional Industrial Packaging Designer, who can brings these practices into the manufacturing sector, in a time lapse closer to the market time.

Keywords
Circular design
Packaging innovation
Transitional Industrial Designer
One Health
Made in Italy

Producing Goods and Projects within Contemporary Complexity and Crisis

On a global level, we live, produce, consume and move in a scenario of great complexity, both as individuals and as administrators, institutions and companies. The latter in particular act in a changing period defined as highly VUCA (Bennis, Bennis & Nanus, 1986), an acronym for Volatility, Uncertainty, Complexity and Ambiguity: these variables influence supply chain relations and force companies to be resilient, a necessary but at the same time challenging skill, especially for micro enterprises and SMEs[1].

We are living in a state of "permacrisis"[2] (Turnbull, 2022), or "polycrisis" (Lawrence, Janzwood & Homer-Dixon, 2022), defined as "an array of grave, long-term challenges, now often labelled *global systemic risks*" (Cascade Institute, 2022), such as climate change, biodiversity loss, pandemics, widening economic inequalities and financial system instability. Although crises are necessary for progress and, according to the ancient Greek definition of *krisis*, represent a moment of choice and opportunity, modern philosopher Reinhart Koselleck (Koselleck & Richter, 2006) sees a semantic shift in that notion today, speaking of a contradiction between opposing forces that accelerates the transition from the past to the future (Turnbull, 2022). Looking at the different crises, it can be observed that they are synchronised with deeply interconnected impacts.

A WWF (World Wide Fund for Nature) report defines Covid-19 as "the indirect consequence of our impact on natural ecosystems", and clearly outlines how deforestation paves the way for species jumping, the so-called "spillover" phenomenon (Pratesi, Galaveri & Antonelli, 2020). According to virologist Ilaria Capua, "If you act in an ecosystem and damage it, it will find a new equilibrium, which can have pathological consequences on human beings". She first coined the concept of "Circular Health" (Capua, 2020) and today promotes "One Health", an integrated approach that aims to sustainably balance the health of people, animals and ecosystems[3].

That today's extractive economy is polluting and dangerous for the environment is widely documented: "45% of global greenhouse gas emissions come from how we make and use things, how we grow our food, and how we manage land" (Ellen MacArthur Foundation, n.d.). It is therefore increasingly evident how the theme of sustainability — understood as an approach that takes care of life in all its forms and in all our actions and productions — requires special attention and above all strategic planning.

The path outlined by the United Nations 2030 Agenda (United Nations, n.d.) proposes a *5P* strategy (United Nations Foundation, 2019), replacing the concept of Profit with that of Prosperity Fig. 1, where progress takes place in harmony with nature and with inclusiveness, global solidarity and participation. Overlapping with these is the concept of Quintuple Helix innovation (Carayannis, Barth & Campbell, 2012), a system that moves "in relation to society, economy, democracy, and social ecology" Fig. 2 (Carayannis & Campbell, 2021, p. 2070).

1
Micro enterprises have less than 10 employees and represent 95% of the Italian business network. SMEs have 10-249 employees, a segment that accounts for 4.9% of the total in Italy (Politecnico di Milano, n.d.).

2
The *Collins Dictionary*'s word of the year 2022: "An extended period of instability and insecurity, especially one resulting from a series of catastrophic events".

3
One Health Center of Excellence-University of Florida, UF/IFAS.

diid No. 79 — 2023
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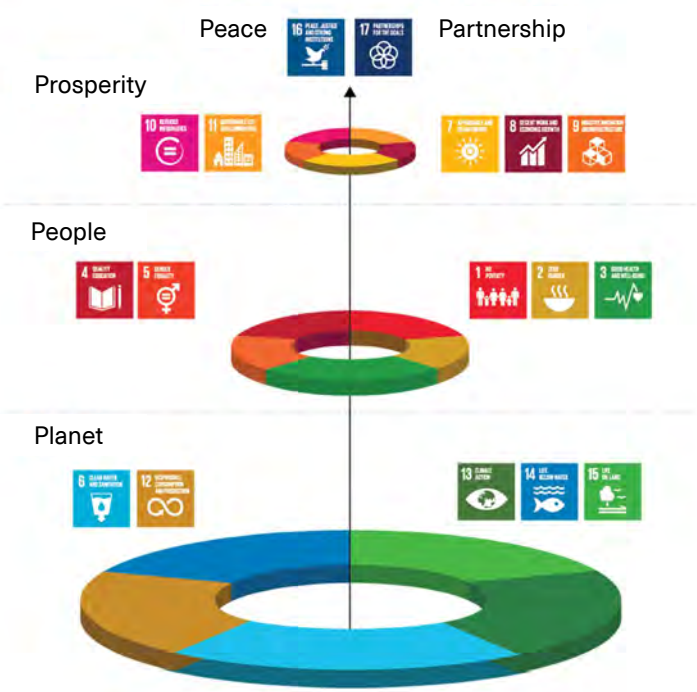

Fig. 1
5P and 17 Sustainable Development Goals integrated by SDG Move. Source: https://www.sdg-move.com/2017/06/01/goals/framework

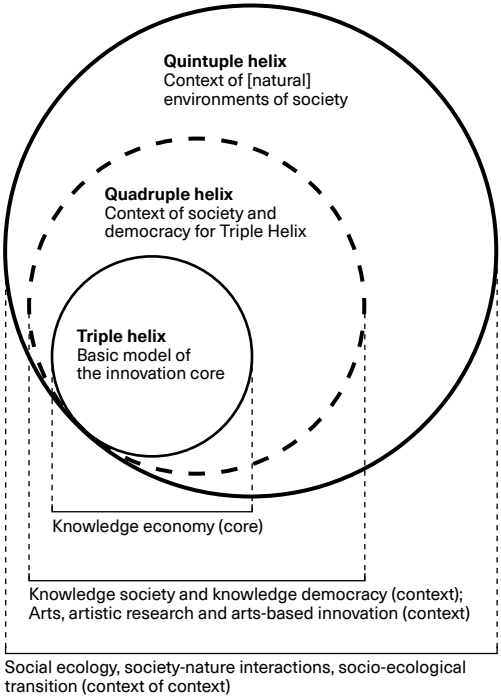

Fig. 2
The Quadruple and Quintuple Helix innovation systems in relation to society, economy, democracy, and social ecology by Carayannis & Campbell. Source: Carayannis, E., & Campbell, D. (2021). Democracy of Climate and Climate for Democracy: the Evolution of Quadruple and Quintuple Helix Innovation Systems. *Journal of the Knowledge Economy*, 12, 1-33.

As designers, it is unavoidable to ask how the production of projects, which is often distinct in time and space from the production of goods, moves in this new scenario? In other words, what role can design play, and what approaches, strategies and tools does the designer need to succeed in including and simplifying all the new variables of contextual complexity in the design project, including the primary need to design in a sustainable and circular way?

That the role of design is crucial in these processes is well established. We find this in the *Circular Economy Action Plan*, which states that "up to 80 per cent of the environmental impact of products is determined in the design phase" (European Commission, 2020). But the study *From ambition to action: an adaptive strategy for circular design* (Ellen MacArthur Foundation, 2023), also offers tangible actions and practices, and highlights the crucial role of design at multiple levels in the transition from our extractive economy into a circular one, and proposes an adaptive and holistic six-point design strategy Fig. 3.

4
A district with a business worth 3.1 billion, 170 companies and 13 thousand employees in which the top 4 big players together are worth 50% more than the top 4 big German players (Vesentini, 2012).

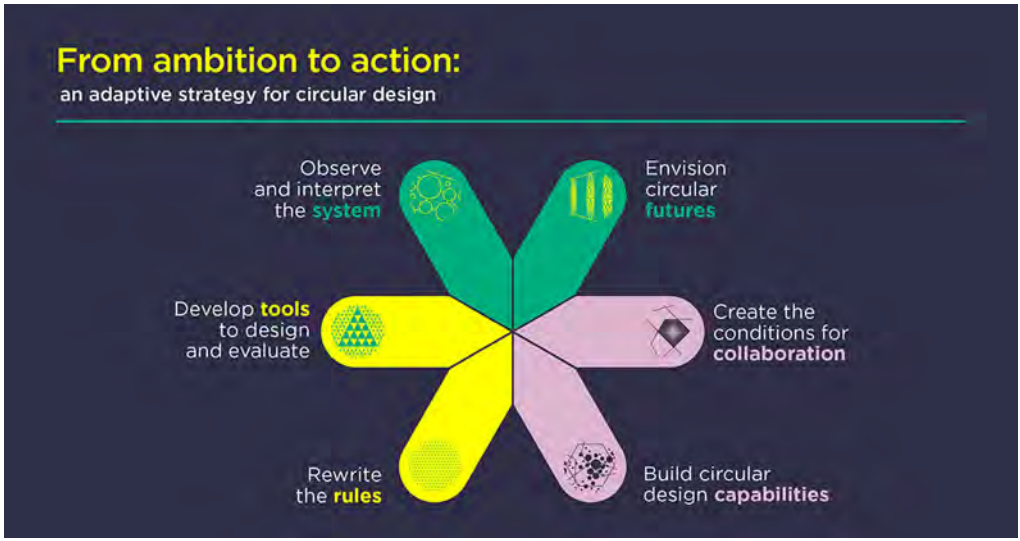

Fig. 3
From ambition to action: An adaptive strategy for circular design framework by Ellen MacArthur Foundation.

Packaging Project Production as a Case Study

In order to analyse the production of projects in the accelerated contemporary transition, it may be representative to observe the dynamics of the so-called Packaging System (Ciravegna, 2010; 2017) as a significant segment of reality, within the production of goods that moves within this complexity; in particular, we will observe the Italian packaging sector concentrated mainly in the Italian Packaging Valley, a highly specialised, territory-bound and global area[4].

It is meaningful to discuss packaging because it is a complex phenomenon with an elevated degree of economic and cultural cross-sectoriality, a "threshold" that hides and shows (Bucchetti, 2005) a multi-dimensional artefact that, beyond its nature as an object of use, works as an engine and accelerator of the social, economic and environmental phenomena in which it is immersed, and can convey relevant messages and information (Ciravegna,

diid No. 79 — 2023
Doi: 10.30682/diid7923b

2010; 2017; Bucchetti & Ciravegna, 2009; Mauri, 1996), acting on the quality of life and climate, monitoring safety, connecting people and companies.

Furthermore, in this sector we witnessed a major change in the value chain, also referred to as a "Value Web" (Bouwman & Janssen, 2010) which has become increasingly interconnected, due in part to the boom in e-commerce: a shake-up in the relationships that opens up new roles for the actors involved and for the packaging itself (Barbero & Pereno, 2020).

The regulatory framework referring to this sector on an international and national level has also repeatedly changed in recent years[5], with the aim of promoting the adoption of circular economy strategies playing a key role in enabling change. Another element of complexity that characterises the current packaging sector is accelerated technological empowerment, which has seen the integration of digital technologies in both packaging and processes.

5
As an example, some of the measures undertaken in Italy, in Europe and in the world, which have also largely involved the Packaging System: UN Agenda 2030 for Sustainable Development (2015); EU Directive 2018/852 about recycling rate for different materials; EU Single Use Plastic Directive and Green Deal (2019); Italian Plastic Tax and Sugar tax (2019); EU Circular Economy Action Plan (2020); PPWR-Packaging and Packaging Waste Regulation (2023).

6
A market aimed at companies belonging to different sectors.

Project Stakeholders in the Packaging Sector: Time as a Key Factor for a Transitional Industrial Designer

Coming back to the production of a project, and of a packaging project in particular, a research study conducted more than 20 years ago already revealed a packaging design chain fragmented in time and space (Badalucco et al., 2001): the design of packaging was described as the result of an integrated set of choices managed by a plurality of actors on two distinct levels: an "evident" design, understood as an activity clearly conducted by designers (e.g. the design of volumes or the way the packaging opened). And a "factual" design, which referred to all the choices that affect packaging design but are not manifested as explicit design activities, generally determined by actors apparently far removed from the creative sphere (e.g. choices related to logistical processes indirectly affecting the shape of packaging). A dual way of operating which, according to that investigation, can be linked both to the faceted nature of packaging and to an underlying inefficiency of the system itself, i.e. a lack of dialogue between players and specifically between machine manufacturers/packaging manufacturers and design studios/packaging manufacturers. Barbero & Pereno (2020) also highlight the lack of collaboration between the actors involved in the Horizontal e-marketplace[6], emphasising how everyone focuses on their own business and not on a shared strategy, thus generating inefficiencies in the entire supply chain.

The fragmentation in time and space and the difficulty of maintaining a dialogue between the actors of the supply chain still persist today, but reviewing the actors of packaging design in Italy in the light of the current context, we can identify several figures.

- Designers with technical and technological expertise usually belonging to the production chain, who need to act in the near future to respond to market times (T1). Their experience is linked to the potential of the machines and can lead to good optimisation. However, given the short time dedicated to design, this figure often has no way of bringing elements of complexity into the project.

- A second macro-group is made up of agencies or individuals who work on brand identity, often engaged by trademarks to act on aspects of communication or on limited formal aspects. Although aware of innovation trends, even in this case the action time is often quite close to production time (T2) and deep innovation could not be put in place.
- A third group is made up of the R&D and strategic design or marketing teams in large companies, units within their business that try to intercept trends and develop innovative functional and communication solutions over a longer period of time (months or even years). They work on a time-delayed capacity for impact (T4), with the limitation (until a few years ago) of dealing only with their own business.
- A fourth group of players-designers are university researchers, who work with the tools of anticipation, extreme design and mediation (Celaschi, 2016) and in a systemic perspective (Pereno & Barbero, 2020), with a double result. On the one hand, they have often succeeded in enabling collaborations between different actors. On the other hand, however, by acting in advance, they have often produced innovation that could be understood and enacted by the manufacturing sector only years later (T4), thus impacting reality within a time frame far from the immediate needs of the packaging production world.

However, it can be observed how complexity, "polycrisis" and the new regulatory and technological framework, are changing the relationships between project players and the world of packaging production: multiple emergencies require rapid responses to complex problems, and the time factor has become an even more crucial element than in the past, bringing the actions of the various stakeholders closer to each other. It so happens, for example, that packaging companies relate more often to universities in an open innovation perspective, in search of complex strategies and multidisciplinary solutions, while encouraging researchers to apply elements of anticipation in the present and in a short span of time.

Despite these attempts to establish more intense relationships and connections between research and business, the reality is often largely subject to other dynamics. The chart Fig. 4 elaborated by the designer Alberto Villarreal (n.d.), schematically explains the role of designers in the product development process today. Though it simplifies the most common phases, it also highlights how the role of the designer is currently almost eclipsed during the pre and post-production phases of the project, probably because the potential of the holistic vision of design is not fully understood in every context, and while design has not vertically mastered many of the production processes, it can strategically plan the choices to be made upstream, in an end-of-life perspective. The absence of the designer during these initial and final phases thus excludes the possibility of addressing the issues of sustainability and circularity in depth, issues that require a rethinking of upstream and downstream production processes to produce lasting impacts.

diid No. 79 — 2023
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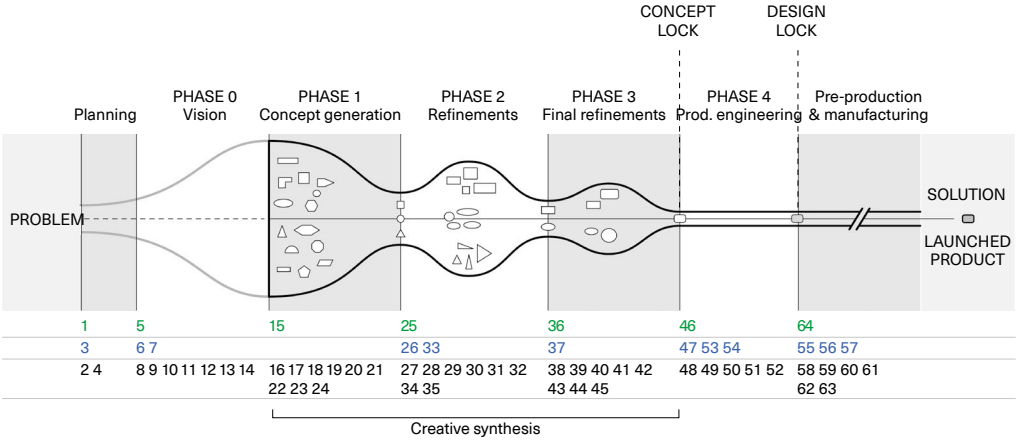

1 Prospect meeting
2 Non-disclosure agreement & request for information
3 Product requirements document / project brief
4 Proposal / quotation (budget & schedule)
5 Kick off meeting
6 Information provision
7 Research (user, ergonomics, market, context, etnography, etc.)
8 Problem definition & need analysis
9 Definition of user profiles (personas)
10 User scenarios & storyboards
11 Design language & themes definition (image boards)
12 Benchmarking & competitor landscape analysis
13 Technological & cultural factors research
14 Presentation production
15 Concepts kick off
16 Mind maps & brainstorming
17 Sketching
18 Materials research
19 Schematic & explorative mockups / models
20 Basic 2D & 3D CAD
21 Internal reviews
22 Liaison with engineering team & expert consultants
23 Liaison with client & suppliers
24 Presentation production
25 PHASE 1 REVIEW. Concept selection
26 Feedback
27 Advanced 2D & 3D CAD
28 Iteration & detail sketching
29 Prototypes for evaluation (ergonomics, function, appearance, etc.)
30 Internal reviews
31 Preliminary studies in color, materials & finishes (CMF)
32 Liaison with engineering team and expert consultants
33 Qualitative & quantitative research
34 Liaison with client & suppliers
35 Presentation production
36 PHASE 2 REVIEW. Variation selection
37 Feedback
38 Detailed 2D & 3D CAD
39 Iterative prototyping
40 Internal reviews and mid-phase evaluations
41 Color, materials & finishes (CMF) specifications
42 Appearance model for presentation / testing
43 Liaison with engineering team and expert consultants
44 Liaison with client & suppliers
45 Presentation production
46 PHASE 3 REVIEW. Design freeze
47 Feedback
48 ID Adjustments based on engineering & manufacturing fededback
49 Final color, material & finishes (CMF) specifications
50 Liaison with engineering team & expert consultants
51 Liaison with client & suppliers
52 Design intent supervision
53 Detailed design engineering & Critical To Function (CTF) drawings
54 Prototypes, pilot series and soft tooling parts
55 Final geometry (CAD) hand off to manufacturer
56 Proto builds fabrication
57 Tool fabrication
58 Proto build reviews (system level & part level)
59 Liaison with engineering & manufacturing teams
60 Liaison with client & vendors
61 Manufacturing supervision
62 Liaison with marketing teams, go to market support
63 Marketing assets supervision
64 Product launch / first customer ship

Fig. 4
Graphics created to schematically explain the role of designers in the product development process, created by Alberto Villarreal (Creative Commons Attribution-Non Commercial International 4.0 licence) and modified by the Author.

The hypothesis put forward by this article is that in order to respond to the most current emergencies around complex sectors such as packaging — first and foremost the need to design and innovate in a sustainable and circular way — a new figure of industrial designer is emerging, whom we will call the Transitional Industrial Designer (TID).

Transition Design has been defined by Irwin, Kossoff and Tonkinwise — who mean it as an approach that is complementary to, and borrows from, myriad other design approaches — though according to them it differs in some specific skills (Irwin, 2015). They describe a Transitional Designer who has multiple skill sets, e.g.

> the ability to devise solutions that integrate social and natural systems and to intervene sensitively in such systems; to devise solutions which take account of short, medium, and long horizons of time and all levels of scale of everyday life, and the ability to identify potentialities for transition in everyday life (Irwin, 2015).

The Transitional Industrial Designer proposed here is anchored into the social, economic, environmental and manufacturing context described so far, with the aim of integrating advanced (Celi, 2010; Celaschi & Celi, 2015) and systemic skills (Pereno & Barbero, 2020), — approaches developed by University Research and also applied to packaging design — with a faster project production timeline, enabling companies to keep up with contemporary complexity and challenges. This "designer-detective" (De Giorgi, Lerma & Dal Palù, 2020) moves in the 5th helix and between the *5P*'s, with a holistic approach that considers all material and immaterial elements as part of an integrated ecosystem. He must be able:

- To consider all contextual variables of complexity and uncertainty.
- To deal in a collaborative manner with all stakeholders and experts, with the design of the entire project flow from origin to end-of-life, including the redesign of relationships, production and consumption models.
- To handle advanced digital tools that guarantee more agile and widespread access to key factors of complex and transdisciplinary projects.
- To support and guide companies through incremental project steps, in a transition towards innovative scenarios.

The Packaging Innovation Observatory and MICS Project-Spoke 1: Tools and Practices for Transitional Industrial Design

In this framework of thinking that sees Design — in terms of process-oriented design research with a systemic approach — as a crucial element to knit together different knowledges and to achieve sustainable and circular solutions, it is relevant to analyse the results of the Packaging Innovation Observatory[7] project.

The Observatory of the Advanced Design Unit, Department of Architecture – University of Bologna, was created to interpret and act on the phenomenon of packaging as an expression of contemporary complexity. It has carried out research studies for organisations, associations and companies by aggregating and reprocessing knowledge, looking for best practices in a predictive logic and hybridising design

7 Packaging Innovation Observatory website.

diid No. 79 — 2023
Doi: 10.30682/diid7923b

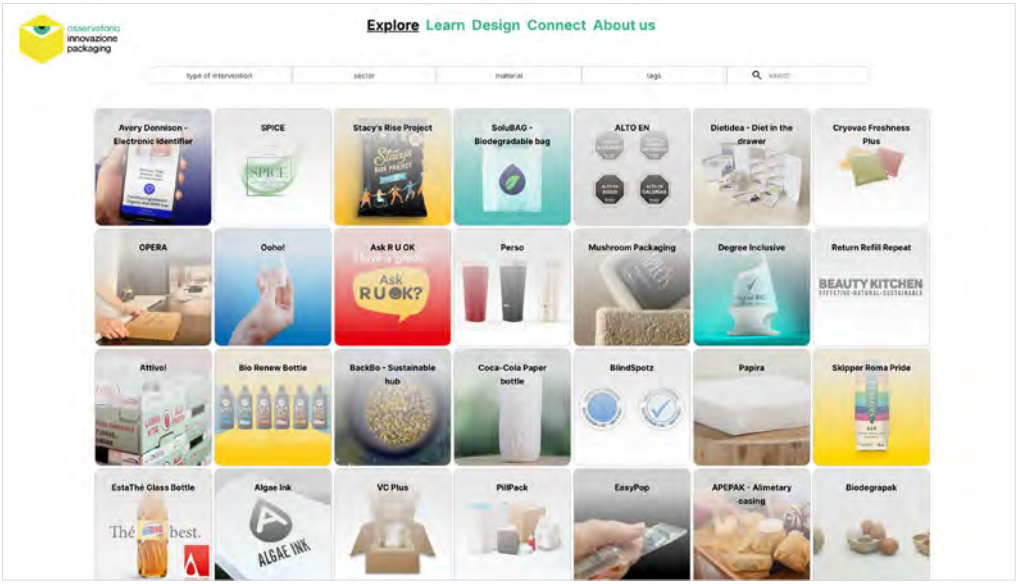

Fig. 5
Packaging Innovation Observatory platform. "Explore" web page illustrating a database of packaging industry case studies.

skills, with the aim of triggering and multiplying sustainable innovation within companies themselves. The Observatory's platform has collected over five hundred international case studies, plus reports, papers, books, podcasts and articles. Finally, it seeks to simplify the relationship between the different actors in an integrated systems logic, in order to create a national cross-sectoral network of stakeholders collaborating with various Italian universities and industry associations[8].

The successful results of the Innovation Packaging Observatory in terms of the mediation between disciplines to produce sustainable research results, were the starting point for the design of Spoke1 within the MICS project (MICS, n.d.). MICS is the PNRR[9] winning project, led by the Politecnico di Milano, for the Extended Partnership Circular and Sustainable Made in Italy[10], and involves 12 Italian universities and 13 private industrial partners with the vision of enabling closed-loop, safe and energy-conscious design and production for Made in Italy products and services. The project is organised in eight Spokes, thematic areas transversal to different industries, where public and private partners can work together along a common path.

Within this complex system — a multidisciplinary, national, inter-university, multi SSD[11], mixing industry and fundamental research organisation — Spoke 1 (led by the Università di Bologna and co-ordinated by prof. Flaviano Celaschi[12]) works on the theme "Digital Advanced Design: technologies, processes, and tools", putting Design and the Designer at the centre of this network of vertical competencies, as a director and enabler of circular and sustainable innovation[13]. This in itself constitutes a significant scientific achievement, and is the foundation on which the ten projects that Spoke 1 will pursue over the next three years are built.

The ambitions, objectives and activities of this Spoke — as designed by Prof. Celaschi together with the entire project team — are aimed at supporting a Transitional Industrial Designer capable

8
To date, the Unibo Packaging Innovation Observatory has 3 different Italian universities (Politecnico di Torino, Università di Scienze Gastronomiche di Pollenzo, Università Iuav di Venezia) and a foreign body (Circular Change) on its scientific committee. It has carried out research for Conai, Cosmetica Italia, Giflex, Quantis, and enjoys the patronage of seven national bodies.

9
The PNRR, National Recovery and Resilience Plan, is the Italian Government's programme to manage Next Generation EU funds, an economic recovery and regeneration tool introduced by the European Union aimed at restoring the losses caused by the pandemic. The research project in question is one of the Extended Partnership projects (PE), namely one of the investment streams planned by PNRR.

of controlling the highest number of consequences along the circular input-output system during the project phase, reinforcing the quality characteristics globally recognised as Made in Italy. The Spoke aims to achieve overall a "Tools and Practices Portfolio for Transitional Industrial Design": solutions, knowledge and practices[14] that enable industrial designers to act responsibly on as many impact-producing steps as possible, in order to activate an "Endless Design Responsibility (EDR)" in a productive and reproductive system in ecological transition.

We will look as an example at one of the projects that Spoke1 is carrying out, the "FuturE-Pack. Digital Advanced Design for the valorisation of packaging as a Broadcaster in the Made in Italy supply chain"[15]. The project is framed within a context in which sustainability, digitalization and e-commerce represent significant megatrends, and aims to investigate the application of labelling and digital solutions to packaging, enhancing its role as communication channel for the exchange of information in a complex supply chain such as Made in Italy. The project assumes that these solutions — meant as evaluation, design and assessment tools for the Transitional Industrial Designer — can foster the social and economic as well as environmental sustainability of products, thanks to the adoption of a design-driven systemic approach and the use of appropriate measurement methods.

While the structure of the MICS project and Spoke 1 in particular constitute an important milestone for Design, which is recognized as playing a central role in solving complex problems aimed at circularity and sustainability, the FutureE-Pack and the other Spoke projects constitute a promise that will have to be verified at the end of the journey: their intention is to build design tools that give the Transitional Industrial Designer the capacity to address new problems, needs and emergencies, recording qualitative and quantitative data useful to the entire supply chain from a circularity perspective.

A Mapping of Italian Packaging Design Research

To better understand design production processes in complex contexts such as the packaging sector, an online survey was conducted among Italian universities dealing with Packaging Design, both at research and teaching level. Considering in fact the urgency, in terms of time, to provide correct answers to the need for resilience and transition of companies in the sector, we consider it essential to think as a broad community, in a networked integration that goes beyond the knowledge of a single university. The survey was aimed at understanding the work of the different universities in the training of young designers and in the production of tools and methods to manage the accelerated transition, and not least how they relate to the Italian and international manufacturing world.

10
PE11 Made in Italy Circolare e Sostenibile, PNRR Mission 4 "Education and Research", MICS project. First code PE0000004, Ministerial CUP J33C220-02950001. Three main industries characterising the Italian industrial scenario, namely Fashion, Furniture and Automation, are within the scope of the project.

11
Scientific Disciplinary Sector, clusters of topics pertaining to the same subject area defined by the Italian Ministry of Education.

12
Spoke1 sees the collaboration of more than 50 people, 5 universities, 8 Departments of the University of Bologna and 5 companies into 10 Spoke and 3 inter-Spoke projects (number of projects approved to date).

13
In addition to Spoke 1, Spoke 2 and more than 20 projects in the remaining Spokes also put Design as the pivot for system operation.

14
For example, manufacturing and robotic systems, virtual tools in extended reality, digital-twins for predictive models, digitally-enhanced solutions for the design control of bio-based and waste-based materials, cross-sectoral platforms for circular materials.

15
Partners in the project are Politecnico di Torino and Università di Firenze.

diid No. 79 — 2023
Doi: 10.30682/diid7923b

The collection and analysis of excellent cases of Italian universities and research groups dealing with packaging design, took place in several stages:

- Identification of the main Italian research groups dealing with the topic.
- Selection by number of research projects, dedicated courses and masters, publications.
- Contact of reference figures.
- Supply of online forms, aimed at collecting information about the team's working methods.
- Analysis and synthesis of information.

According to the methodology explained, the investigation involved eight universities: Alma Mater Studiorum — Università di Bologna, Politecnico di Milano, Politecnico di Torino, Sapienza Università di Roma, Università degli Studi di Palermo, Università degli Studi di Parma, Università di Scienze Gastronomiche di Pollenzo, Università Iuav di Venezia.

A summary of the results follows, while the full document is provided as an online appendix to the text[16].

The survey asked each subject:

- *Design Driven Approach* applied to Packaging product-service-systems projects by the research team.
- *Methodology*, or main research tools and methods used in the collection, analysis and transformation of data in research projects, eventually mentioning example projects.
- *National/International Collaborations* activated, both with corporate/university and public/private partners.
- *Publications* related to the topic of packaging design written by research group members.

The analysis of the survey reveals the use of the following approaches by the universities surveyed:

- Advanced, systemic, transdisciplinary design approaches.
- Human-centred and holistic design approaches.
- Collaboration with different national/international supply chain players, on applied or research projects.

Methods and tools used by Italian universities researchers interviewed:

- Quali-quantitative benchmarking and analysis of case studies.
- Market analyses and business model canvas.
- Investigation of the reciprocal effects between content and container.
- Design and artificial intelligence for packaging.
- UX tools.
- Mapping and visualisation.
- Codesign workshops.
- Prototyping.

Organisations, also used as project tools, that have been set up by the Italian university research groups involved:

- Sector monitoring Observatories/Archives.
- Material Libraries.

16
A mapping of Italian Packaging Design Research, a survey conducted among Italian universities dealing with Packaging Design investigating approaches and tools used.

Research topics explored according to the survey:
- Sustainability and circularity of packaging.
- Study of materials.
- Design of communication aspects.
- Designing for the enhancement of the territory.
- Study of production and technological processes.
- Attention to social and ethical aspects.
- Analysis of the regulatory framework.

Product sectors covered in the projects are mainly:
- Food & beverage.
- Pharmaceuticals and cosmetics.
- E-commerce and logistics.

Main research outputs from the surveyed universities:
- Project guidelines and reports for stakeholders.
- *Ad hoc* portals to share outcomes of/for packaging innovation.
- National and European projects and results.
- Networking and dissemination events.

Almost all universities dedicate curricular design courses to packaging design topics, as well as Master's degrees.

Although the results clearly outline the directions, methods and tools used by the different universities involved in the survey, it can be argued that it would have been more effective to conduct a survey with multiple-choice checklists, with space for inserting texts, projects and point research, in order to produce a greater homogeneity of the results and a more coherent and straightforward interpretation of the data.

17
The employment rate of two-year Master's degree graduates in Design in Italy, surveyed in 2020 five years after graduation, is 91%; 84 % of these are in a profession consistent with Design (Fondazione Symbola, 2022).

A Transitional Industrial Packaging Designer

The survey analysis carried out among Italian universities dealing with packaging design reveals a holistic, transdisciplinary and collaborative approach. The application areas and research topics covered (often simultaneously) are different and complementary. In addition, the numerous inter-university and international innovation projects with different supply chain players (citizens included), enable them to act as translators (Caratti & Baule, 2016) and synthesisers of languages, with the aim of spreading knowledge and dialogue within the network and/or raising awareness and diffused "design capabilities" for participatory processes (Huybrechts, Dreessen & Hagenaars, 2018). Most of the projects mentioned by the interviewees also reveal a special focus on *5P* sustainability and circularity, applying them to projects that help associations, companies, communities and institutions to move step by step in this transition context.

From the surveys it becomes clear that the Italian research knowledge and approaches to packaging design, disseminated not only in academia but also in teaching, actually help to train designers who can move in this transition and apply this knowledge within companies (during internships or when they start working), acting with the intention of transforming material and immaterial aspects of human experience in the environment (Maffei, 2021).

diid No. 79 — 2023
Doi: 10.30682/diid7923b

We can therefore conclude that this analysis highlights the emergence of the Transitional Industrial Packaging Designer who, while learning from scientific research approaches and methods of advanced and systemic design, is able to apply them in the industrial world in which he or she will soon be inserted[17], in a T3 timeframe closer to the times and methods of the market, thus bridging a time gap. At the same time, he or she enters the world of companies and institutions with tools and approaches useful for dealing with complexity, crises and regulatory frameworks, and with the ability to handle digital and technological tools as well, enabling the dissemination of knowledge within the targeted work environment.

The hypothesis proposed in this paper, and the related investigation with respect to university education and research, could in the future be extended to a European scale, in order to assess the skills of outgoing students over a wider interconnected territory. It is also assumed that in the future these Industrial Designers of the Transition, while maintaining a transversal approach by vocation, could verticalise on specific themes and production areas, acquire deeper quantitative data-processing skills (to be systemised with qualitative ones) and increasingly improve their digital and technological abilities, meant as tools for understanding and spreading knowledge and awareness, that can and should reach all citizens.

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Methods for Life Cycle Evaluation and Design of Packaging

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Abstract
The current use of packaging provokes significant environmental impact. This impact comes from all stages of the packaging life cycle. In order to help in the design and development of packaging with minimal or no environmental impact, this article proposes a hybrid use that integrates descriptive and prescriptive methods. While descriptive methods aim at investigating and describing the environmental impact of packaging, prescriptive methods help to work on the planning and design of product packaging with environmental responsibility. Two descriptive assessment methods and three prescriptive design methods are proposed as viable options to be used in a hybrid approach to packaging design projects. Future work would inquire about case studies of the hybrid use proposed in real world or hypothetical packaging design projects.

Keywords
Methods
Life cycle
Packaging-system
Evaluation
Design

Introduction

When thinking about the environmental impact of packaging, the first thing that comes to mind might be packaging waste. However, the impact of packaging comes not only from waste at the end of its use life, but from every stage of its life cycle.

Product Life Cycle Environmental Impacts

A product's life cycle has been defined as the consecutive and interlinked stages of a product system, from the extraction of raw materials to final disposal (ISO, 2006). Thus, the product system and product life cycle are equivalent.

While packaging is used to contain products, it is also a product in itself. Typically, the life cycle stages of a product comprise the extraction of raw materials from nature, processing them to make usable materials, product manufacturing, product distribution, retail time, use or consumption at home, disposal of product as waste, reuse, remanufacturing, recycling or other forms of valorization, and final disposal of the remains to nature. Transportation within and between life cycle stages is also part of a product life cycle.

During the life cycle of a product, multiple processes are carried out. These processes use matter and energy as input, in order to provide intermediate or final products as output. By-products are also generated, which can be waste, emissions (into air, water and soil), heat and noise. When these substances or energy are exchanged with the environment, environmental impacts can occur (Wenzel, Hauschild, & Alting, 1997).

An environmental intervention takes place when substances or energy are released to the environment. Then, there is a pathway from the environmental intervention to potential environmental damage (Jolliet et al., 2004). Once in the environment, substances and energy can damage life and disrupt ecosystems, generating negative impacts. The environment can suffer direct or indirect, chemical or physical damage. For example, Climate Change and Ozone Depletion represent impacts of chemical origin which are caused by emissions. Other types of impact occur when the environment is damaged directly by physical means. Examples of this are the clear cutting of forests, and destructive fishing practices such as overfishing or bottom trawling.

Packaging-system

The term packaging-system, or packaging system, is currently used with different meanings. The United States Pharmacopeia - National Formulary (USP - NF) defines packaging system as "The sum of Packaging components and materials that together contain and protect the article. This includes Primary packaging components as well as Secondary packaging components when such components are required to provide additional protection" (2020). Here the focus is on packaging components and materials.

diid No. 79 — 2023
Doi: 10.30682/diid7923c

Packaging system is also used in the area of process and packing engineering. This includes the processes and machines used to put products into primary, secondary and tertiary packaging. An example can be a packaging system for liquids, in which projects often require a container to be filled with product, sealed or capped, and labeled for the consumer (Liquid Packaging Solutions, 2023).

The term packaging-system has also been used with a more humanistic approach. Ciravegna's definition of packaging-system focuses on the actors involved in the creation of the packaging, along with the relationship between them throughout its life cycle (2017).

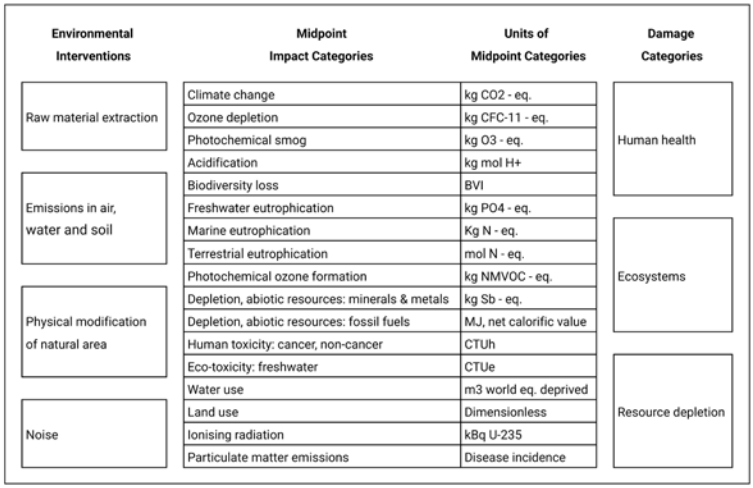
The meaning of the term packaging-system as used in this article includes the meanings mentioned above and more, since it includes all the life cycle stages of packaging components and materials, with a focus on the processes that are carried out, and their inputs and outputs. A product system as defined by ISO, in which the product is packaging, can be called packaging-system (Huerta et al., 2021).

Methods for the Life Cycle Impact Evaluation of Products

Life Cycle Assessment (LCA) has been used for more than five decades to evaluate the environmental impact of products. LCA has been defined as the "compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle" (ISO, 2006). LCA is one of the most relevant and comprehensive techniques to evaluate the environmental impact of goods and services (Baumann & Tillman, 2004; Bovea & Vidal, 2004; Gamage & Boyle, 2006; White, St. Pierre & Belletire, 2013).

Classic Impact Assessment Methods

Within LCAs, environmental impacts have been assessed using two main types of methods. On the one hand there are the classical impact assessment methods, derived from quantitative modeling, with results in midpoint impact categories (Jolliet et al., 2004). The amount of impact in each category is expressed by units that are specific to each category. One example of a midpoint impact category is Climate Change, for which the unit used is CO2 equivalent in mass units such as kilograms or tons. A comprehensive set of midpoint impact categories is displayed Fig. 1.



Environmental Interventions	Midpoint Impact Categories	Units of Midpoint Categories	Damage Categories
Raw material extraction	Climate change	kg CO2 - eq.	Human health
	Ozone depletion	kg CFC-11 - eq.	
Emissions in air, water and soil	Photochemical smog	kg O3 - eq.	
	Acidification	kg mol H+	
	Biodiversity loss	BVI	
	Freshwater eutrophication	kg PO4 - eq.	Ecosystems
	Marine eutrophication	Kg N - eq.	
	Terrestrial eutrophication	mol N - eq.	
Physical modification of natural area	Photochemical ozone formation	kg NMVOC - eq.	
	Depletion, abiotic resources: minerals & metals	kg Sb - eq.	
	Depletion, abiotic resources: fossil fuels	MJ, net calorific value	
	Human toxicity: cancer, non-cancer	CTUh	
	Eco-toxicity: freshwater	CTUe	
	Water use	m3 world eq. deprived	Resource depletion
Noise	Land use	Dimensionless	
	Ionising radiation	kBq U-235	
	Particulate matter emissions	Disease incidence	

Fig. 1
From environmental interventions to areas of protection by Oscar Huerta, based on information published by Hillege, 2019; Lindner et al., 2019; Ligthart, Thoden van Velzen & Brouwer, 2019; White et al., 2013; and Jolliet et al., 2004. The figure shows the relative relationship between environmental interventions, midpoint impact categories, and damage categories in LCA. Environmental interventions can have impacts in several midpoint categories, and these can damage one or more areas of protection.

Damage Oriented LCA Methods

In damage-oriented LCA methods on the other hand, the cause-effect chain is modeled qualitatively from environmental interventions to environmental damages (Jolliet et al., 2004). Damage categories represent areas of protection (UNEP-SETAC, 2011). The areas of protection are damage to human health, ecosystems, and natural resources (Goedkoop et al., 2013, as cited in Ligthart et al., 2019). Environmental interventions can have impacts on several midpoint impact categories, and both environmental interventions and midpoint impact categories can have effects on one or more damage categories.

Methods for Environmentally Responsible Design of Packaging

Environmentally responsible design, in this case, means designing with awareness of the negative impact that products have on the environment, and acting through design to reduce or minimize the negative impact of new products on the environment. Next, three methods for environmentally responsible design which address packaging design are presented.

Ecodesign Guide for Packaging

Ecodesign is a design methodology in which environmental considerations are included early in the product design and development process, side by side with traditional economic and other criteria, to make a product that is environmentally sound throughout its life cycle (Tischner et al., 2000). Clearly, ecodesign has a life cycle approach.

Ecodesign can be used for any kind of product, including packaging. However, the Ecoembes' Ecodesign Guide for Packaging is a specific methodology for packaging ecodesign (2017). Ecoem-

diid No. 79 — 2023
Doi: 10.30682/diid7923c

bes is a “non-profit environmental organization that promotes sustainability through recycling and ecodesign of household packaging in Spain” (Ecoembes, 2017, p. 4). In this Guide, ecodesign is defined as the technical, creative, and multidisciplinary process for the development of packaging that is: feasible, technically industrializable, and financially profitable; desirable for clients and consumers; and sustainable, with optimum consumption of resources and generation of emissions (Ecoembes, 2017).

The Guide indicates seven steps in the ecodesign process. They are: Step #1 Start: define human team, company goals, and packaging to improve; Step #2 Know: define sustainable vision for packaging, and gather environmental data; Step #3 Evaluate: consensus about sustainable vision opportunities, and identify environmental hotspots to define an ecodesign challenge; Step #4 Ideate: draft potential ecodesign strategies as answers to the environmental hotspots; Step #5 Solve: decide the most viable strategies from the technical, economic, and commercial points of view; Step #6 Concretise: develop the sustainable packaging solution in detail, ultimately applying techniques for its industrialization; and Step #7 Verify: validate if the solutions are better than a product of reference in environmental terms, and set the basis for communicating the results of the ecodesign process (Ecoembes, 2017).

Design Guidelines for Sustainable Packaging

The Sustainable Packaging Coalition (SPC) provides a useful definition of what sustainable packaging is. Sustainable Packaging would comply with eight criteria which combine sustainability and industrial ecology objectives with business considerations and strategies to address the environmental concerns in the packaging life cycle (SPC, 2011).

To support sustainable packaging creation (design), SPC has developed the Design Guidelines for Sustainable Packaging. While there is abundant guidance about design for the environment that can be used for packaging, SPC identified a need to consolidate the rationale, information, and best practices specifically for the case of packaging (Greenblue, 2006).

The Guidelines cite the Cradle to Cradle sustainability framework, developed by McDonough & Braungart (2002). Some elements of this framework are fundamental for the Guidelines, such as: use solar income, waste equals food, and celebrate diversity (Greenblue, 2006). Furthermore, the materials flow management proposed in the guidelines is based on Cradle to Cradle, in order to eliminate the concept of waste by managing material flows in biological and technical cycles (Braungart, McDonough & Bollinger, 2007).

The Guidelines propose four design strategies, each including a number of actions. The strategies and actions are as follows: Optimize Resources: practice source reduction, use recycled content, and design for transport; Responsible Sourcing: design with environmental best practices, design with fair labor and trade practices, design with renewable virgin materials from sustainably managed sources, and support green chemistry and green engineering; Material Health: know the chemistry of the materials in your

package; Resource Recovery: design for reuse, design for recycling, and design for composting (Greenblue, 2006). The Guidelines rely on a life cycle approach. This concept is part of the Guidelines vision: it is present in the biological and technical cycles proposed, it is used to address cost, and is inherent to the original 1997 LCA General Principles ISO Standard 14040 that are cited as relevant.

SPC's definition of sustainable packaging acknowledges the systemic nature of sustainability to aid the packaging value chain by sharing a common vision and providing a comprehensive set of criteria by which action can be taken by the packaging industry to evaluate current efforts, identify opportunities, and pursue strategies for the development of sustainable packaging materials and systems (SPC, 2011).

Method for Strategic Design in the Food Packaging-system

The Method for Strategic Design in the Food Packaging-System was developed to aid in food packaging design projects. This method is one of the outcomes of a food packaging research project carried out at the School of Design of the Pontificia Universidad Católica de Chile, by Oscar Huerta and colleagues. The method comprises a manual and a toolkit, and is used in three main stages: I, diagnose; II, define; and III, validate (Huerta et al., 2022). Within these stages, several activities take place using the tools provided Fig. 2.

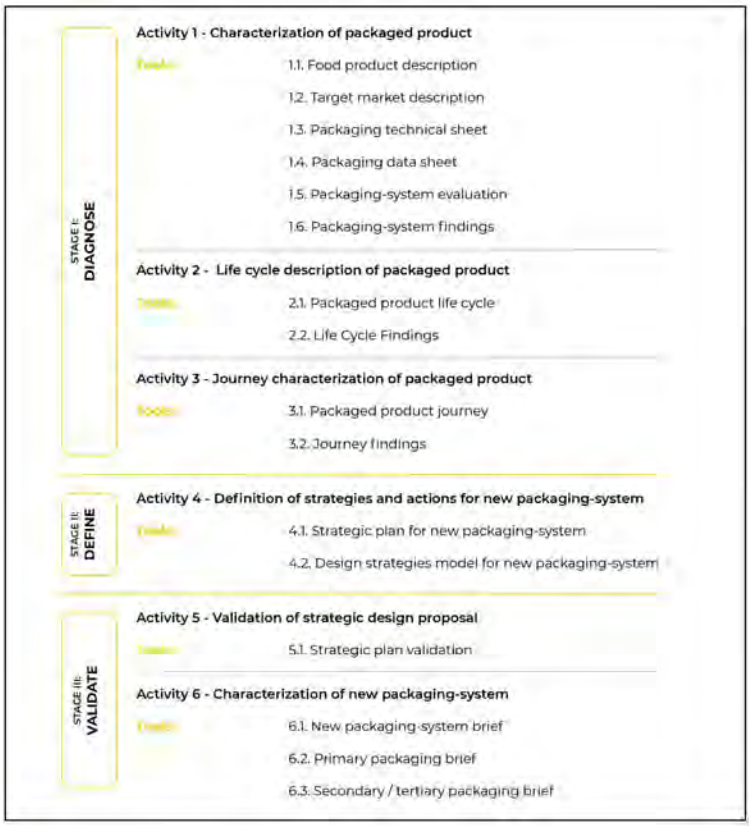


Fig. 2
Stages, activities and tools of the Method for Strategic Design in the Food Packaging-System by Oscar Huerta, Carolina Melo & Maximiliano Rubio. Source: Huerta, O., Melo, C., Rubio, M., & Tiska, A. (2022). A Life Cycle Toolkit for Food Packaging Design. 13th International Conference on Life Cycle Assessment of Food 2022 (Lima, Perú).

diid No. 79 — 2023
Doi: 10.30682/diid7923c

These activities should be carried out by an interdisciplinary team with people from different areas within a product's packaging-system. These people can be the food producer and other actors in the product value chain, either upstream or downstream.

The toolkit consists of sixteen tools that enable teams to describe, analyze, plan, and produce a brief for food packaging projects (Huerta, Melo & Rubio, 2021). One of the tools, the Packaged Product Life Cycle tool, is especially useful to configure and understand the packaging-system. It has a diagram that helps model a packaging-system, to identify the processes in its life cycle, and their inputs and outputs Fig. 3. The tool is printed on a sheet of paper size 279.4 x 431.8 mm.

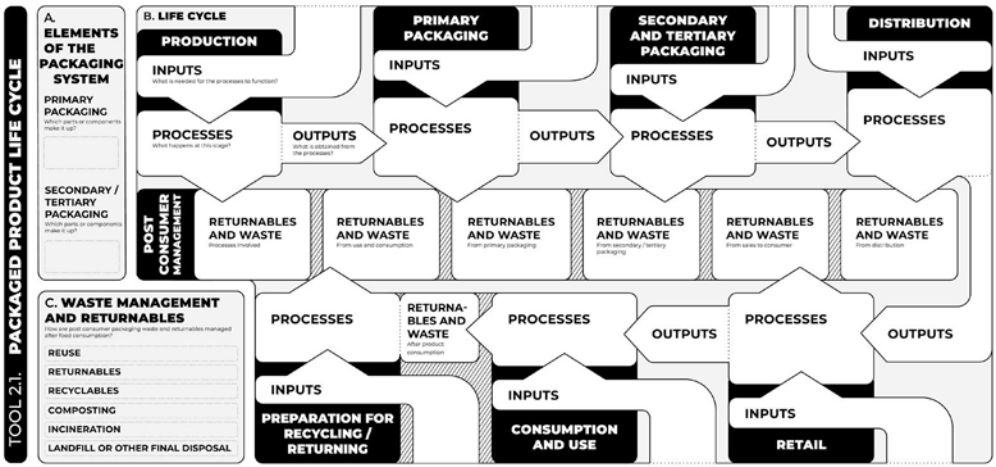


Fig. 3
Packaged Product Life Cycle Tool by Oscar Huerta, Carolina Melo & Maximiliano Rubio. Source: Huerta, O., Melo, C. & Rubio, M. (2021). Method for strategic design in the food packaging system. The 10th International Conference on Life Cycle Management (Stuttgart, Germany).

A team working on a packaging design project should complete the information requested. Inputs are matter and energy, while the outputs are products and by-products. Team members from different areas can provide information that is specific to the life cycle stage they are working in. The information can be written down directly on the sheet of paper, or using sticky notes. Once the tool has collected the information, the findings are synthesized and recorded in another tool developed for the purpose, named Life Cycle Findings.

Each activity using the tools produces input information for the next activity. After completing the first five activities, Activity 6 will end with briefs for a new packaging system, as well as for primary, secondary, and tertiary packaging.

Proposing a Hybrid Use of Life Cycle Evaluation and Design Methods

Designers who incorporate methodology to design for minimal environmental impact are likely to be more effective than designers who do not.

In the context of this article, descriptive methods aim to investigate the environmental impact of a product to "describe" it comprehensively. The two LCA methods reviewed in the Methods for Product Life Cycle Impact Assessment section belong to the descriptive type

of method. On the other hand, prescriptive methods aim to "prescribe" what to do, that is, provide rules, laws, or instructions. The three methods reviewed in the Environmentally Responsible Packaging Design section belong to the prescriptive type of method.

The information deriving from the use of descriptive methods is relevant as input for the use of prescriptive methods. In other words, the information derived from the use of impact assessment methods is relevant as input for the effective use of environmentally responsible design methods.

The proposal put forth in this article is that both descriptive and prescriptive methods should be used in packaging design projects with minimal environmental impact. In this proposed hybrid use of methods, LCA is performed alongside environmentally responsible design, to obtain the best results in products with minimal environmental impact.

Next, the three methods for the environmentally responsible design of packaging will be analyzed in terms of their need to incorporate information derived from life cycle impact evaluation.

Discussion

The Packaging Ecodesign Guide focuses on packaging design to facilitate the proper future integration of packaging waste into management systems. The first step is choosing which packaging will be redesigned to improve the environmental profile. Then, in Step 2, information is gathered about the environmental impact of the product. During Step 3, environmental impact hotspots are identified. Steps 2 and 3 require the LCA to be optimally conducted. Then, from Step 4 to Step 6, ecodesign is used to create a new product. Finally Step 7 is about validating the new proposal by showing that the new product is better than a product of reference. In Step 7, using LCA would be best to assess impacts following a design proposal, in order to verify if the impacts are indeed lower. So, LCA should be used in three of the seven steps proposed in the guide. Basically, half of the design activities in the Guide need input derived from the LCA to be carried out properly.

SPC's Design Guidelines for Sustainable Packaging include four main design strategies: optimize resources, responsible sourcing, material health, and resource recovery. The concept of life cycle is addressed in the Guidelines as part of a sustainable packaging vision statement. It is also included in the definition of quality provided, and when designing sustainably is addressed, and is part of all the design strategies. Information from the LCA is the best quality input for SPC's design strategies and actions. The actions proposed by SPC are specific indications of what to do when designing packaging. Most actions have sources in the ecodesign literature. The influence of Cradle to Cradle is also clear, especially in the action "know the chemistry of the materials in your package". Another notable element is the concept of sustainability, which is used throughout the guidelines citing the 1987 UN report Our Common Future. Sustainability is mostly present in the action "design with fair labor and trade practices", with a focus on socio-economic issues.

The Method for Strategic Design in the Food Packaging-System has a life cycle approach that can be seen in most of its elements. First, one of the main tools in the toolkit is the "Packaged Product Life Cycle

diid No. 79 — 2023
Doi: 10.30682/diid7923c

tool", which enables modeling the packaging-system with a life cycle approach. This is the main stage in which LCA information can be an input. The rest of the work is then organized around this model. Strategies and actions for improved environmental performance take shape as handouts for use during design sessions. The recommendations contained in the Method are part of the packaging, ecodesign, life cycle, and sustainability literature, and are mostly derived from LCA knowledge.

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Implications and Limitations

With regard to the descriptive methods, one implication of the proposed hybrid use is that at least two methods must be used. This increases the complexity of a design project. It may also increase costs. For example, to obtain an LCA of a packaging product being designed, an external consultant may need to be hired to conduct it. This increases costs. However, there is abundant information available for use in the public domain, as well as free LCA calculators. Using these resources can be very useful and inexpensive but the problem is to discern the quality of the resources available, and to choose wisely what to use. To do this properly requires knowledge, and some companies, organizations or people may not have it. But many times they do have this knowledge, either as individual companies, groups of companies, or business associations.

With regard to the prescriptive methods, the three methods proposed here have already been published and are available free of charge in the public domain. This prevents a potential issue of cost, which is always a limitation in projects. But lack of knowledge might still be an issue, since the use of prescriptive methods may not be straightforward for everybody.

Future Work

The next steps to take are to test the hybrid use of descriptive and prescriptive methods together in packaging design projects aimed at minimizing environmental impact. These could be new projects conducted in professional or academic environments that can be analyzed as case studies. They could also be projects that have already been developed in industry or by companies that make either packaging or packaged products.

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Exploring How Material Demonstrators Accelerate the Transition to a Circular Bioeconomy

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Abstract
Taking ideas to market can be a long, iterative, and complex process. When dealing with new bio-based materials, understanding factors that help bridge the lab-to-market gap and how materials are selected for new product development have the potential to speed up the transition to a circular bioeconomy. This article defines abstract and conceptual material demonstrators and explores how they support the innovation process in different ways. Nine roles are identified, including how material demonstrators contribute to generating and expressing new ideas, enable a shared understanding of technology, support the discovery of market value and the visualization of potential applications as well as helping to articulate internal and external strategies and communications. Abstract and conceptual material demonstrators are exemplified with both technology-driven and market-driven bio-based materials used in packaging.

Keywords
Bio-based
Materials
Demonstrators
Lab-to-market gap
Bioeconomy

Introduction

Innovation, the process of creating and delivering new customer value in the marketplace (Carlson & Wilmot, 2006), can be a lengthy process, especially in cases where new technologies need new markets. The timeline for a lab-to-market success can take over 18 years (Von Windheim & Myers, 2014). The increasing demand to replace fossil-based materials with materials from renewable sources is putting pressure on companies to shorten the lab-to-market timeline and accelerate the transition to a circular bioeconomy, in which environmental, social and economic sustainability drive resource efficiency. For this to happen, collaboration between industries and disciplines will increase, recovery and recycling of materials will become a priority, and waste-streams in one industry will become feedstock to another industry (Stark & Matuana, 2021; Corrado & Sala, 2018).

Materials have two roles in products: performing technologically and contributing to product personality (Ashby & Johnson, 2014). Materials must function according to the intended use of the product and have properties that impart the desired levels of durability, recyclability, etc. Active materials that can change their properties based on changes in their surrounding environment can be both attention-grabbing (e.g. open in an oven like a blooming flower) and functional (e.g. space-saving before activation thereby transporting less air).

Material demonstrators are useful in the innovation process, especially for bio-based materials, which can be shaped, formed, modified, and functionalized in almost infinite combinations. This article explores how two types of material demonstrators can contribute to bridging the lab-to-market gap. Some of the methods that exist for closing the lab-to-market gap are identified, and how material demonstrators can assist in achieving this goal is exemplified with biobased packaging materials. We present these findings from the point of view of research, development, and innovation (RDI) practitioners.

Methods

We performed a selective literature review to provide a context for how narrowing the lab-to-market gap is approached in the management literature. We scanned the literature for innovation management, creativity management and elements of design thinking addressing the research-to-market gap. We then performed a conventional content analysis (Hsieh & Shannon, 2005) to identify factors stated as important to narrowing the lab-to-market gap. The inductive category development method (Mayring, 2014) resulted in nine potential roles of material demonstrators.

diid No. 79 — 2023
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Results. The 9 Material Demonstrator Roles for Bridging the Lab-To-Market Gap

Generating and expressing new ideas is an important first step in innovation (e.g. Mathews, 2010), where a compelling business case is built on telling a story rather than listing technical properties (e.g. Steen et al., 2014; Markham, 2002). While tools and analysis are important, sparking dialogue is crucial (Terwiesch & Ulrich, 2008; Moultrie, 2015; Lindberg et al., 2016) to seeing new connections between technology and markets. Material demonstrators make R&D results more concrete. First-hand experience of a material supports effective decision making and contributes to the design of the user experience (Barati et al., 2019; Karana et al., 2015).

Promoting a shared understanding of technology and demonstrating their key principles (Moultrie, 2015) and feasibility (O'Connor & Veryzer, 2001) are important to establishing new materials on the marketplace. The exploration of material properties (Boren et al., 2012) and tinkering with the material to explore its characteristics (Karana et al., 2015) promote a shared understanding of materials and what they can and cannot do. A shared understanding of technology creates an absorptive capacity to track and evaluate competing and complementary developments outside the organization (Dahlander & Gann, 2010). This shared understanding is often the result of an iterative process.

Discovering and visualizing market value is important for establishing a business case where new materials are used. Market visioning linking technologies and materials to market opportunities (O'Connor & Veryzer, 2001) helps create contexts for thinking about future products. Technology demonstrators assist in showing market feasibility (Moultrie, 2015; Terwiesch & Ulrich, 2008), in inspiring design thinking (Dunne & Martin, 2006), and in building a portfolio of new business ideas and concepts (Hamel, 2000).

Sorting and prioritizing the ideas generated from a shared understanding of materials is about analyzing the ideas you have and choosing the most promising ones to move ahead with. The process can foster better selection of ideas early on and improve attrition decisions (Mathews, 2010) because materials are better linked to market opportunities.

Articulating corporate strategy and building internal support are both enabled by tangible objects that support decisions about which ideas/concepts will go to the next phase of development (Mathews, 2010). Innovation and corporate strategy are highly intertwined as companies often use current strengths to explore future opportunities at the same time as future opportunities can be used to redefine strategy (Terwiesch & Ulrich, 2008). Demonstrators, mock-ups and prototypes facilitate the exploration and evaluation of technology options and their benefits with users (Steen et al., 2014; Moultrie, 2015), helping shape strategy and build internal support of promising ideas.

Articulating the business case for the innovation and building external support are important steps in accelerating commercialization. Design strategies for different phases of technology adoption often require different attributes to be brought forth (Canada et al., 2007).

Early feedback is valuable for better prototyping (O'Connor & Veryzer, 2001) and helps to better articulate the innovation concept and its business case.

Reducing uncertainty and risk eases the implementation of a business case. The more radical the innovation, the greater the need to "de-risk" big aspirations (Hamel, 2000). Evidence-based experimentation can quickly test the merits and risks of ideas because something tangible in the hands of potential users can help to understand customer behaviour and open new possibilities that were not apparent before (LaBarre, 2016; Steen et al., 2014).

Communicating the fit between technology benefits and market needs internally is a key ability of material demonstrators. Companies that effectively communicate their capabilities internally can eliminate some of the barriers to innovation (Bond & Houston, 2003), formulate strategies, and plan the market introduction of new products more efficiently. Demonstrators can also facilitate dialogue between project teams.

Communicating the fit between technology benefits and market needs externally is aided by material demonstrators for communication both within and outside the scientific community (Moultrie, 2015; Lindberg et al., 2016). Tangible material demonstrators enhance the interaction an organization has with its customers and end-users (Canada et al., 2007), but also enable a more productive communication with potential funders and investors.

Discussion and Examples of Material Demonstrators as Enablers

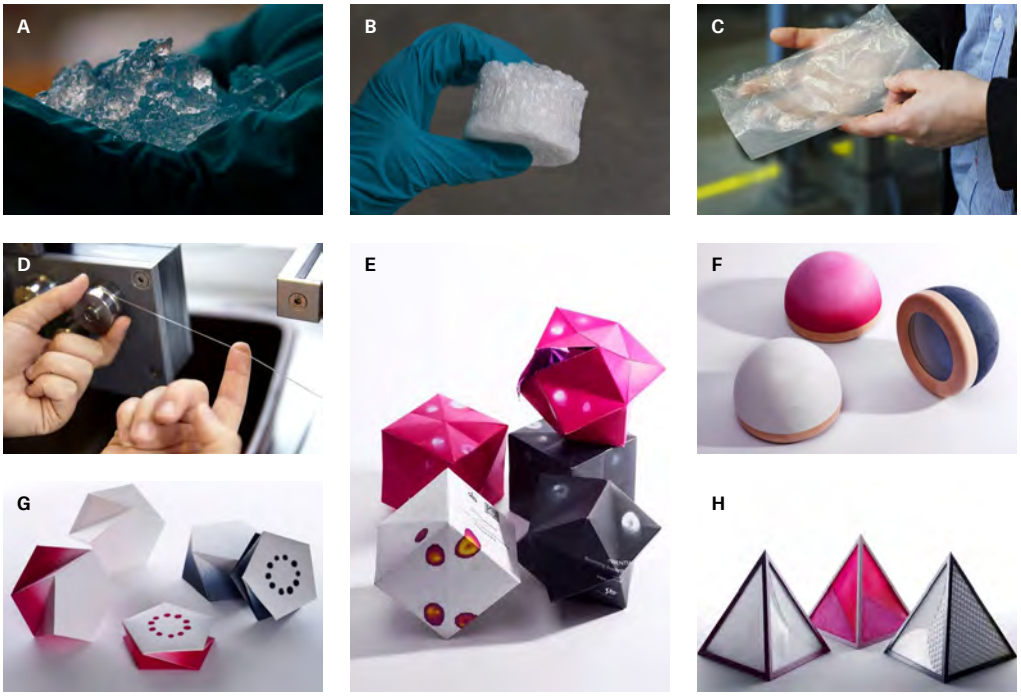
Cellulose-based materials can display a wide variety of states, from gels (Benselfelt & Wågberg, 2019; Khan et al., 2016), foams (Erlandsson et al., 2016), films and filaments (Håkansson, 2021) and particles to networks, sheets, and boards. They can be used as stand-alone materials or be part of other materials. Each material can in turn show a wide array of properties from stretchable to rigid, from opaque to translucent or transparent, from fragile to strong, and material properties can be combined in many ways. A material can also be made active, e.g. respond to a change in temperature by changing its shape. Countless possibilities exist when it comes to demonstrating what the material is and what it can do. Many teams are working to demonstrate these possibilities, e.g. the ChemArts collaboration at Aalto University[1].

Physical products can be thought to bind physical aspects, psychological aspects and design intentions linked to a product's purpose, users, and other possible intentions (Ashby & Johnson, 2014). A functional product meets technical specifications and one that also has personality also provides emotional delight and aspects of satisfaction in ownership. Material demonstrators are one way to express both how a material performs technologically and how it can contribute to the personality of a product. We defined two types of material demonstrators having different levels of abstraction: *abstract* and *conceptual*, which allowed us to show and communicate different aspects of innovation with different audiences. Abstract material dem-

1 See, https://chemarts.aalto.fi/

diid No. 79 — 2023
Doi: 10.30682/diid7923d

onstrators are presented as technical material samples or swatches Fig. 1 (A,B,C,D). Conceptual demonstrators show a concept that is in between a swatch and a product. Showcasing both the materials and the RDI competence behind them, conceptual demonstrators were produced under the theme "different faces of cellulose" Fig. 1 (E,F,G,H). They were given classical geometric shapes and showed different properties, from soft and translucent to strong, rigid, and opaque. The intention was to show that they could be developed into packaging materials. Demonstrators stemming from technology development represent the technology-driven side of the gap.



We found that the conceptual demonstrators assisted in better formulating the value of the material and the potential benefits to be had. Both abstract and conceptual demonstrators helped spark the dialogue between material researchers and designers in the team. Researchers had a better appreciation of sensory material qualities and designers better understood the RDI process. As they generated first-hand experiences and understanding of the materials, they allowed the team to creatively explore technology-market possibilities and better prepare interactions with potential clients.

The conceptual demonstrators displayed what the material can do in a specific context or application. The technology-driven concept demonstrator Fig. 2 (C), RISE's *Self-expanding Bowl* (winner of the *Dieline Sustainability Award* 2013; winner of the *Plastovationer Innovation Award for Bio-based Materials* 2013; named one of the pulp and paper industry's most innovative products 2015 (CEPI, 2015)) "spoke" to a wider audience and created market demand for more knowledge about what other possibilities exist. Ideas were sorted and prioritized, and the demonstrators helped to reduce uncer-

Fig. 1
RISE AB. Technology-driven abstract (A, B, C, D) and conceptual (E, F, G, H) demonstrators of cellulose-based materials. a) hydrogel b) aerogel c) film d) filament e) transformable cube/star showing grip stiffness f) dome with formable pulp (Nilsson et al., 2010), transparent film, and wood ring g) pentagon with moisture barrier (Gällstedt, 2004) concept, before (white area) and after (dotted circle) activation h) pyramid made of a cellulose composite (Larsen et al., 2012) processed to give either rigid and strong (edges) or soft, translucent, and patternable (faces) materials.

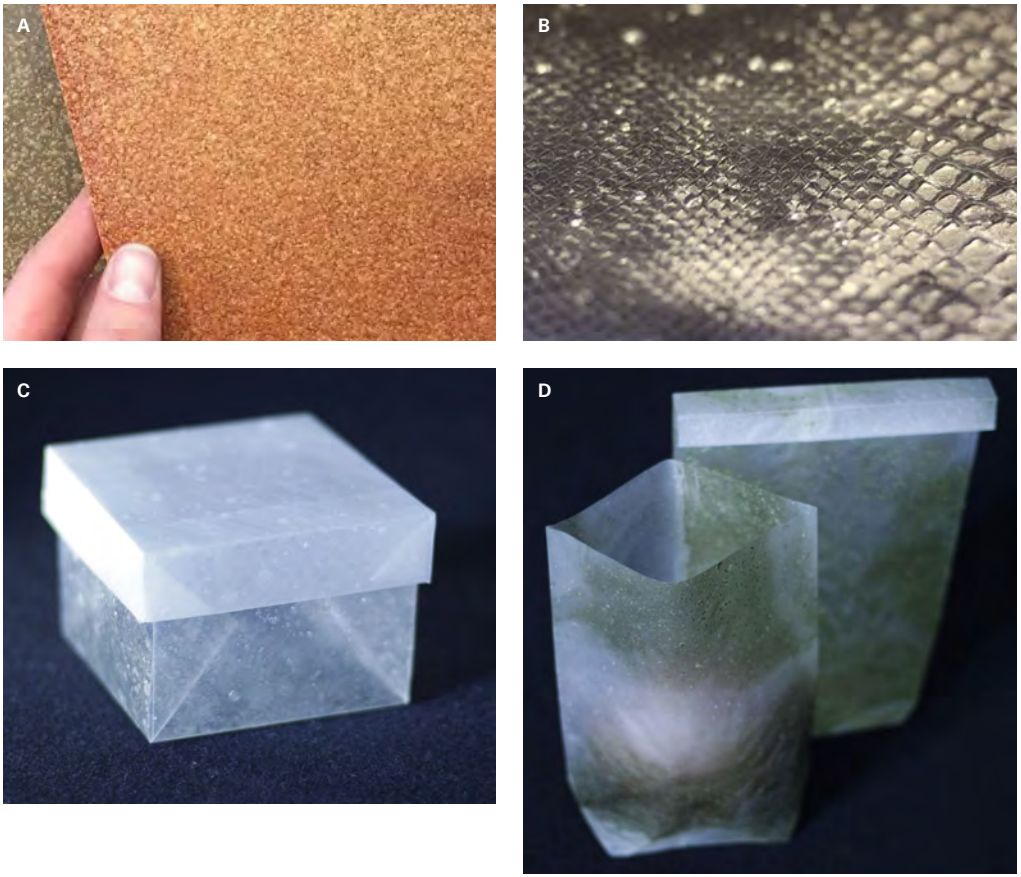
tainty and risks by enabling a dialogue on client expectations. They also helped us articulate possible value chain strategies, thereby contributing to narrowing the lab-to-market gap. They were central to both internal and external communication about new bio-based materials, potential technology benefits, and identifying market needs.

Fig. 2
RISE AB. The material is cellulose-based and developed by RISE. Cellulose-based active material as a) abstract (more technology-driven) demonstrators (swatches) of the material before activation b) conceptual demonstrator as self-opening cone before (left) and after (right) activation c) a (more market-driven) conceptual material demonstrator in the context of a self-expanding packaging used when rehydrating dry foods with hot water.

The demonstrators for the active material helped members of the team to better understand the materials and thereby better discuss them internally. They allowed the team to identify developments outside the organization that could potentially impact on potential market developments. They were also used as a basis for discussions with potential partners.

We also worked with market-driven demonstrators to assist a manufacturer in showing the potential use of new cellulose-based materials in packaging applications. Here, materials were designed to replace leather, snakeskin, rigid plastic and flexible plastic Fig. 3. Demonstrators stemming from potential new markets represent the market-driven side of the gap.

diid No. 79 — 2023
Doi: 10.30682/diid7923d



Abstract and conceptual material demonstrators that stemmed from showcasing technology assisted in generating and expressing new ideas, promoting shared understanding of technology, discovering and visualizing potential market value, and communicating the technology benefits to market needs fit (internal and external). Conceptual material demonstrators that stemmed from a desire to address an identified market need also helped with sorting and prioritizing, articulating corporate strategy and building internal support, articulating the business case, reducing uncertainty and risk. Not only are demonstrators of these types very useful for communicating with the public at large but they can also help focus discussions with potential partners for specific market applications.

Fig. 3
RISE AB and Stora Enso Oyj. Market-driven cellulose-based conceptual material demonstrators a) with tomato waste stream to form a leather-like material used as a skin for paper-based packaging b) glossy film having a snakeskin pattern for luxury packaging c) rigid box needing no adhesives d) flexible bag decorated with dried leaves.

Conclusions

The innovation and creativity literature describes many ways to decrease the lab-to-market gap and our analysis led to the identification of nine significant roles material demonstrators can play to help close the lab-to-market gap and accelerate the transition to a biobased circular economy. These are: generating and expressing new ideas; promoting a shared understanding of technology; discovering and visualizing market value; sorting and prioritizing ideas and concepts; articulating corporate strategy and building internal support; articulating the business case; reducing uncertainty and risk; and communicating the fit between technology benefits and market needs both internally (between business units and project teams) and externally to potential clients and funders of R&D. We explored how material demonstrators can accelerate the transition to a circular bioeconomy, and even if the time from idea to market is not known for all our materials, demonstrators are an efficient way to generate insights. They sped up our part, as a research institute, in the commercialization of new materials by allowing better decisions based on a common understanding: the scale-up of production processes from lab to pilot scale was pursued for the most promising materials, defined market analyses were carried out early on, and tech transfer steps were initiated much sooner.

We described how abstract and conceptual material demonstrators impact different aspects of the lab-to-market gap. They can help promote and communicate a tacit understanding of different aspects of materials that can sometimes be difficult to describe in words. We exemplified the demonstrator types with new biobased materials that can be used in packaging applications. The technology-driven demonstrators designed from an RDI perspective allowed us to show physical objects at packaging fairs that sparked insight into potential applications. When working with market-driven demonstrators designed with an industrial manufacturer in mind, the client used the demonstrators to talk to their customers and increase their understanding of what could be feasible in the marketplace, helping to further reduce the lab-to-market gap.

Reducing the lab-to-market gap for new bio-based materials involves coupling technology-driven results with market-driven needs. Abstract and conceptual material demonstrators are useful in doing this in tangible, inspiring ways. They open the doors to development teams building upon each other's ideas for the next generation materials and to clients "asking for the impossible" because they understand the potential that new materials can have in their applications.

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Ph.D., MBA, works with the commercialization of new bio-based materials, including active materials, in many market segments. She is interested in material circularity and has initiated many national and international R&D projects with industry partners that are now working in new value cycles.

Hjalmar Granberg
Ph.D., works with research, development and innovation of active materials including initiating and managing several large and cross-disciplinary projects that have many customers. He is interested in the innovative processing of renewable materials, and how working in a multidisciplinary team can generate new ideas.

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Life-Centered Concurrent Packaging Design: Integrating Packaging, Product, Logistics Process and Supply Chain

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Abstract
Using a life-centered packaging design approach in the context of packaging applications for consumer goods, this paper presents a conceptual model for the concurrent development of packaging, product, logistics process, and supply chain (SC). The objective is to enhance the understanding of packaging logistics and logistics management in SCs and to identify current packaging logistics issues in the SC. The four-dimensional concurrent engineering (4DCE) framework, based on the alignment of and interaction between SC, logistics, packaging, and product, is used to increase overall SC efficiency. The model is applied and tested via three case studies within different industries. The results indicate improved understanding and knowledge-sharing between SC actors, with collaborative efforts leading to an increased overall SC performance.

Keywords
Supply chain
Logistics
Packaging
Competitiveness
Coordination

Introduction

In increasingly competitive environments, a business can survive and succeed only if it can fulfil the challenges of the present demands regarding logistics (Azeez & Al-Tayar, 2021). For supply chain managers, this involves interaction and coordination with other businesses, working to minimise costs and create effective logistics and distribution operations which provide customer value. Channel arrangements move toward managerially coordinated initiatives to increase efficiency, continuous improvement, and competitiveness (Freichel et al., 2020; Bowersox & Closs, 1996). While increased competitiveness and efficiency have great potential for the businesses involved, there is high complexity as the number of interactions in coordination and collaboration increases (Bode & Wagner, 2015).

In light of life-centred packaging design which is understood as a collaborative, inclusive and holistic design approach (Feng et al., 2018), this paper explores the potential to integrate packaging with the concept of concurrent development of product, process, and supply chain (SC), as suggested by Fine (2009), Ellram et al. (2007) and Ellram & Stanley (2008), to obtain a more holistic packaging design solution. This research takes on the challenge of integrating packaging and extends the concept into the four dimensions of the product (Dahmas et al., 2019), packaging, process and SC. Supported by empirical data, the paper proposes and explores a conceptual model which aims to contribute to a better understanding of the interaction and potential integration of a packaging system when applying concurrent engineering practices. Specific packaging performance in the SC results from an interwoven network of aspects, often partly unknown in the design stage but with implications for all the actors involved in the SC. However, it is difficult to systematically identify and convert all impacts into helpful information for further packaging development.

The objective of this paper is to enhance the understanding of packaging integration in the SC using a life-centred holistic packaging design approach; and to develop and apply a conceptual concurrent engineering model that integrates packaging, product, logistics process and SC to improve overall SC performance. A conceptual model is developed based on a literature review and three case studies.

Literature Review

The role of packaging is gaining strategic importance as it covers both potential customer value enhancement and cost-efficiency aspects (Lockamy, 1995; García-Arca et al., 2017). In addition, the overall increase in the trade of products has led to an immense demand for efficient packaging which functionally and commercially performs at the right time (Blackwell, 2017) and in the right place. Another concern is the changing role of packaging (Coelho do Vale & Verga Matos, 2015; García-Arca et al., 2017; Prendergast & Pitt, 1996), including sustainability concerns, fierce global competition, future legislation, increased product returns, and customers' environmental consciousness.

diid No. 79 — 2023
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Efficient performing packaging increases logistics efficiency. A packaging system often has its unique impact performance profile, indirectly impacting the overall SC performance (Chan & Chan, 2010). Consequently, with significant impact stemming from indirect effects, monitoring the packaging system's overall performance is problematic (Pålsson & Sandberg, 2021). Minor modifications in the packaging system could have a significant impact on the SC. However, such impacts are not always easy to detect, and this may cause inefficiencies and create unnecessary waste, product damage, and costs (Fugate et al., 2006).

Packaging is an essential component in the SC (Lockamy, 1995). It facilitates efficiency for businesses directly involved in SC activities by increasing product safety and protection while providing added value by passively selling the product. Packaging thus involves many considerations and often brings with it conflicting or at least challenging demands and requirements. These must be known and jointly managed, or at least considered, by the actors in the distribution system to achieve a sustainable and efficient flow of products to the consumers (Abbasi & Nilsson, 2016).

A holistic view is required to understand packaging system performance within the SC (Vernuccio et al., 2010; Twede, 1992). Similarly, Min et al. (2019) concludes from a process perspective that, in the development of new products, logistics processes have a strategic role to play. Chapman et al. (2002) conclude that increasing knowledge-sharing with logistics functions and providers in the SC increases efficiency. Achieving greater efficiency, increased customer satisfaction, and better strategic planning can lead to more flexibility and adaptation to market changes, rapid and flexible SC management processes, and other benefits which lead to rapid innovation capabilities. Coles & Beharreil (1990) state that "with high distribution costs, increased profitability from product or packaging innovation can be wiped out immediately if new packaging units do not fit existing distribution systems". Failure to consider distribution and logistics aspects in the development process may be very costly, especially if special handling is needed, warehousing procedures are unsuitable, or a complicated, inappropriate distribution system is chosen. As a result, rethinking distribution and logistics processes can create innovation potential for packaging by focusing on handling, delivery, hand-over and service features to the customer/consumer. In line with this suggested rethinking, Fine (2009) presents the concept of three-dimensional concurrent engineering (3DCE), in which the product, process and supply chain are designed in parallel. Dominic et al. (2000) and Bramklev (2007) both suggest an integrated product and package development procedure model. They state that it is preferable to consider the functional decomposition of a product and its package when specifying the product. Dominic et al. (2015) focuses on product strength versus packaging mechanical protection properties. The integrative aspects will depend heavily upon the product sector, where joint modelling of product and package can lead to technical, organisational, process, and goal-oriented modifications. When the market segment is also known, relevant measures to integrate product, packaging, logistics processes and SC at the operational level could be outlined. Thus, packaging could be integrated and become the fourth dimension in concurrent engineering (4DCE).

Methods

The tool Packaging Scorecard (PSC) (Olsmats & Dominic, 2003) was used in the case studies to evaluate the concurrent packaging performance in a specific SC. The focus was on partially conflicting yet crucial criteria for the actors involved in a specific SC. The performance level for criteria i for actor j is denoted as τ_{ij}, and each performance criteria i (i=1 to n) is assigned a weight factor γ_i. The model systematically evaluates performance criteria and indicates the performance of each actor, which can then be summarised to a holistic SC level, schematically illustrated in Figure 1. The model can be represented using the following formulas:

$$A_1 = \sum_{i=1}^{n} \gamma_i \tau_{1i}, \quad A_2 = \sum_{i=1}^{n} \gamma_i \tau_{2i}, \quad A_3 = \sum_{i=1}^{n} \gamma_i \tau_{3i}, \quad \ldots \quad A_N = \sum_{i=1}^{n} \gamma_i \tau_{Ni} \qquad (1)$$

where:

A_N =Total packaging performance score at Actor N in the SC
γ =Performance criteria weight
τ =Performance score

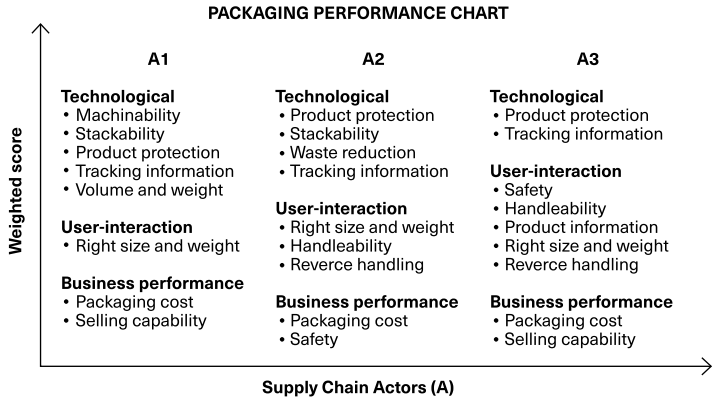

Fig. 1
Bar charts indicating packaging performance and criteria for different SC actors.

The packaging system involves many actors, and Fig. 1 illustrates an example of how the packaging system performs for three actors in a supply chain. The requirements for each actor are classified as Technological, User-interaction, and Business performance related. Finally, the weighted score for the requirements are summed up to indicate overall performance.

diid No. 79 — 2023
Doi: 10.30682/diid7923e

Four-Dimensional Concurrent Engineering (4DCE)

To increase the efficiency of the SC, alignment between the logistics processes, product and packaging system is suggested and conceptualised in the developed 4DCE framework. The 4DCE has its basis in the interaction between SC, logistics, packaging and product, where a correct alignment between them can enable effective and efficient operations throughout the SC. The actors within the SC should work together to satisfy customers' requirements and needs through deliberate coordination and self-organisation. At the same time, each actor is typically primarily interested in making their processes efficient and, as a result of this risk to sub-optimise the whole SC with their specific demands on the packaging level, that they primarily interact with within the SC.

Consequently, when it comes to the packaging system, no single actor has a holistic approach regarding the SC. No one actor owns or controls the overall packaging system or the entire logistics processes. Therefore, a concurrent approach can facilitate SC actors to work together with a focus on packaging-related problems. The concept of 4DCE could facilitate such interaction and thus improve overall SC efficiency.

The 4DCE framework starts by evaluating the SC's packaging using PSC. The SC actors can interact with the overall and specific assessment results, aiming to increase efficiency through reflection, discussion and creation of packaging modifications, process improvements and/or SC set-up changes. Dialogue is encouraged and processes are incorporated to facilitate focused meetings. From this interactive process, outcomes emerge concerning modifications and reengineering as well as results which indicate increased understanding and knowledge-sharing between the actors. Hence, the overall performance of the SC can be increased as participants broaden their understanding of and become integrated within the SC.

Case Studies

To explore the potential of 4DCE, empirical verification and testing of this concept have been crucial, as suggested methodologically by Eisenhardt & Graebner (2007). This has been done through three in-depth, action-oriented case studies, as defined by Yin (2018). The case studies were carried out within three different industries present on the Swedish market: brewery, vitamin-producing industry (non-pharmaceutical), and fresh food industry. Each case study has served as a different data source, providing rich data for further quantitative and qualitative analysis or, as Dubois & Gadde (2014, p. 555) states, a relationship between "everyday language and concepts". Snowball sampling was applied to select the informants. The initial informants were packaging and logistics managers who introduced informants involved in solving strategic and operational tasks in the SC, e.g. packaging and development manager, supply chain and sourcing manager, transport and operation manager, technical manager, and sales and marketing manager at different SC actors.

The informants provided multiple data and perspectives for the studies. In-person visits were used to collect data for the PSC assessment through a series of unstructured and semi-structured interviews. Each interview was recorded, transcribed, and documented in written reports. The key informants were asked to verify that case facts were accurate and possible uncertainties were subsequently clarified by telephone. The interviews were printed and analysed based on the thematic areas of the PSC framework, and the packaging system performance was assessed. A report and presentation material were created as input for the subsequent meeting with the SC actors. In all cases, workshops were held, in which participants were given information in advance about the PSC assessment results. The workshops then focused on identifying and prioritising improvement potential in the SC from a packaging and product perspective. One of the participating researchers documented the workshops and analysed them afterwards based on content, process and outcome. One case study is presented below as a representative example.

The case study from the fresh food industry, in which the holistic packaging development concept has been used (see Tab. 1), will be presented in more detail in the following.

Case Studies	Primary packaging	Secondary packaging	Packaging system	Performance indicator value
Fresh food industri				2,63
Vitamin industry				2,83
Brewery industry				2,33

Tab. 1
Case study packaging systems studied for three industries. Performance value based on PSC evaluation.

The primary packaging in the fresh food case was a plastic tray with a lid, sealed with a label which provided information for logistics activities and the product. Secondary packaging was a reusable tray; tertiary packaging was a plastic pallet. The performance value is the current performance of the packaging system measured by applying PSC.

The retail supply chain for the fresh food product was a network consisting of various stages: packaging suppliers, product fillers, distribution centres, warehouses, convenience stores, supermarkets, and hypermarkets. A reusable system for plastic pallets was implemented. The product-filling actor adapted multiple sourcing strategies to avoid disruptions in the product-filling process and guarantee a continuous flow. There were reverse logistics systems to reuse or recover secondary and tertiary packages. Fig. 2 shows a

consolidated flow of how packaging is filled and assembled at the product-filling actors, re-packed by the distributor, and disassembled by the customer.

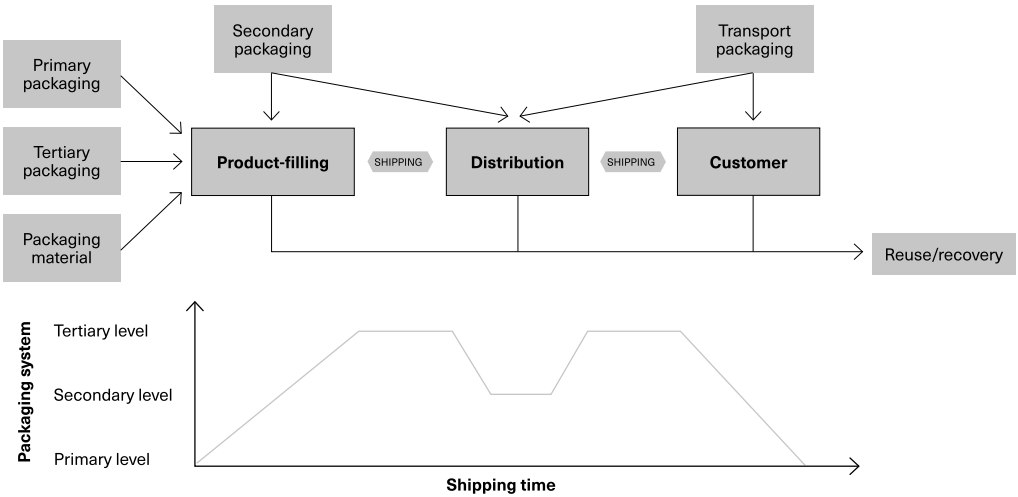

Fig. 2
Illustration of how the packaging system is mounted, and interactions with the SC.

There was a joint perception by SC actors that the packaging system was performing unevenly, underperforming in some functions and overperforming in others. Based on this perception, the target performance level jointly agreed by SC actors was three (out of four) in the bar chart corresponding to neutral performance, neither over- or underperforming, in all functions at all stages in the SC. Fig. 3 presents the results of the packaging system for fresh food by consolidating the performance for each SC actor. The packaging under examination was, at an aggregated level summarising all performance criteria, underperforming at all stages within the SC.

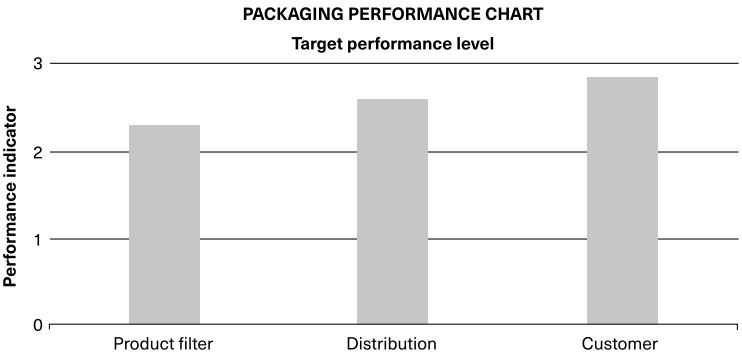

Fig. 3
Aggregate results for the fresh food case study.

The bar charts in Fig. 4 show the normalised criteria sorted in descending order for all the criteria, which the three main SC actors weighted. The packaging performance scores indicate a value for each criterion on the SC level.

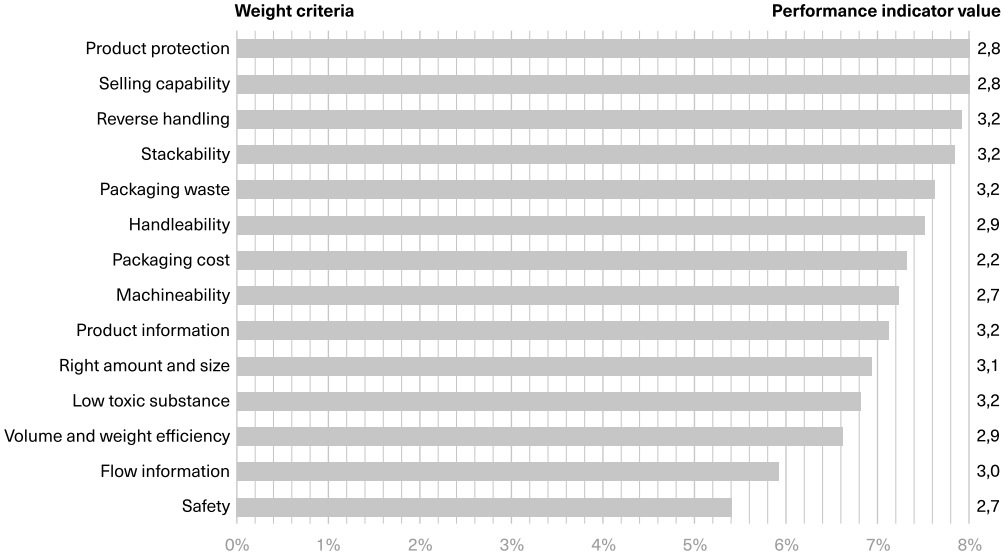

Fig. 4
Aggregate values for a fresh food case study, sorted by most important criteria and on a weighted level.

Fig. 4 shows that the most essential criteria were selling capability, product protection, reverse handling, and stackability. However, the performance indicator values for selling capability and product protection were slightly lower than the target value of 3.0. This underperformance was due to the primary packaging not being fully adapted to the number of products sold or secondary packaging. Moreover, pallets caused slight problems when handled manually, while reverse handling, stackability and packaging waste performance was slightly above target with a score of 3.2. On the other hand, the packaging cost performance indicator was significantly below target.

The PSC data was used as a starting point for the redevelopment, which was supported by a workshop. The purpose of the workshop was to systematically understand the performance of the packaging systems in the SC, with the support of ocular investigation, and to establish stronger links between the actors interacting within the SC. The idea was to rethink packaging and its interaction with processes and structures in the downstream SC. Several issues and problems were elaborated during the workshop, and suggestions for redesigned packaging solutions and logistics processes were made. Each participant expressed a long-term view towards creating efficiency along the SC.

The analysis carried out by the participants indicated a problem at the distribution centre with the packaging system packed with mixed products which required extra time for re-sorting. It was suggested that secondary packages be clearly labelled with different coloured labels to make the distribution actor's task more manageable. Fig. 5 illustrates how packages containing other products were placed on pallets. Colour-coded labels were added and pasted onto the trays, which helped when re-sorting the trays. This minor adjustment reduced re-packing time at the distribution actor by half an hour per load carrier.

diid No. 79 — 2023
Doi: 10.30682/diid7923e

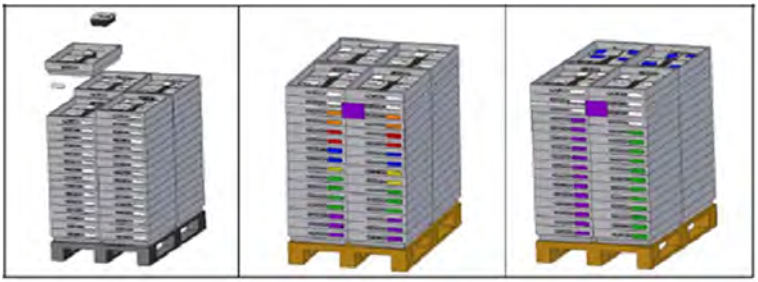

Fig. 5
The white trays (left) show the unsorted fresh food packages arriving at the distribution centre. Coloured labels (middle) made it easier to sort and re-pack the system (right).

By implementing colour-coded labels, the consolidated performance indicator value was raised by 15%. Insights from the other two case studies are to a large extent similar regarding performance impact. The space utilisation and usability for the vitamin packages were significantly improved after a design modification on the primary packaging. For the brewery case study, the product damage occurring during transport was significantly reduced after modifications in the design of the transport packaging. In all cases, improved SC performance and integration between the SC actors has been obtained using the 4DCE approach.

Discussion

Packaging has to fulfil many functions at various stages in the SC, and different actors make demands. Functional demands can be contradictory, e.g., low cost and minimum amount of material versus user functionality and convenience. The impact of a specific packaging design will vary considerably across the SC. It can be both direct and indirect, e.g., a design change to provide better product protection can result in higher direct costs at the product filler and lower direct costs for handling in distribution, as well as lower indirect costs for product damage during distribution. The effects of changes are often hard to assess as SCs habitually lack transparency.

The case studies covered both holistic aspects at the SC level and detailed analyses of the packaging system at various actors. The proposed 4DCE framework was applied by evaluating the packaging system in each process along the SC to obtain and assess each actor's requirements and needs. The PSC was used as a framework for the evaluation. The studies and subsequent dialogue provided sufficient input to rethink the packaging design using a more holistic packaging development approach. Workshops were conducted to elicit input from the SC actors. Based on the PSC assessment, the visualisation of these results was the input for the actors to interact, mainly to create increased efficiency by reflecting, discussing and making packaging modifications, process improvements, or SC set-up changes.

Nguyen et al. (2020) states that meetings, in which representatives from most SC actors focus on discussions of packaging-related topics, are very rare. Instead, mainly two or maybe three significant actors (e.g., customers and product fillers) meet to discuss various business issues, which are then transformed into

requirement specifications communicated to the other actors (e.g., distribution and packaging supply actors). With this partial view and separation of the SC, it is difficult to achieve integrated SCs. The case studies showed that the 4DCE integrative activities were essential in that they were viewed as part of the core of development for improved SC performance based on packaging and its related processes. Modifications and innovations resulted from this interactive process as well as increased understanding and knowledge-sharing between the actors.

Conclusions

In this paper, an approach for 4DCE has been proposed and tested via action-oriented case studies. The performance evaluation part of the concept is based on the PSC framework and is an extension of 3DCE. The 4DCE approach can contribute to packaging logistics theory and aid practitioners by suggesting an approach to balance and trade off conflicting packaging demands and functions to reduce sub-optimization for overall SC performance. Small changes in a packaging system can often lead to significant changes for the entire SC, thereby increasing (or decreasing) SC efficiency. Furthermore, the holistic packaging development concept is supported by transparent knowledge of the packaging system, how it interacts with its actors, and performs to fulfil requirements along the SC. In line with the above, it can be argued that 4DCE can be a valuable approach to support life-centred packaging design, understood as a collaborative, inclusive and holistic design approach with a view to the entire life cycle of the packaging system within the SC.

This research has certain limitations which can be addressed in future studies. For example, even though the case studies indicate that the 4DCE approach provides valuable data for packaging development processes, there is a need for broader studies within different industries to enable a generalisation of findings. Further research could also strive to deepen the analysis of the concept. Moreover, it might be interesting to develop studies which consider applying new technologies, such as rapid prototyping, to present at workshops involving SC actors to further boost the generation of life-centred innovative packaging concepts. This can be potentially useful when it comes to improving overall SC performance.

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diid No. 79 — 2023
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The Consumer Experience Perspective in European Projects on Packaging and the Circular Economy

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Abstract
During the last 5 years we have had the chance to develop and participate in European and national research projects in which the organizations belonging to Euroconsumers.org network were partners, and which investigated consumer needs and concerns about packaging and the circular economy. This article aims at sharing the main learnings and meaningful experiences of consumer involvement in four projects: Cirthread, Circkpack, Resss, Meno Plastica in Comune. Why is citizens' science so relevant in discussions about packaging? Because design's consumer-centric approach prevents usability problems that producers and retailers might discover too late, because UN Agenda 2030 SDG12 calls for sustainable production and consumption patterns (UN, 2022), and finally because in the New Consumer Agenda (European Commission, 2020) key priorities are green transition and consumer empowerment.

Keywords
Consumers
Experience
Packaging
Projects

Background

Both the potential spread of the war in Ukraine to other countries and the climate change emergency remain the leading concerns for 81% of EU citizens, according to the latest Eurobarometer survey recently published by the European Parliament (2023). The rising cost of living is currently the most pressing concern for 93% of Europeans; poverty and social exclusion follow (82%), but the fact that climate change worries remain high in the ranking tells us something about consumer and citizen readiness for change if presented with easy and sustainable packaging solutions. According to the latest data, the circular material use rate of material flows and resource productivity[1], which represents the circularity of an economy and refers to the share of the total amount of material used in the economy that is accounted for by recycled waste, reached an average value of 11,7% at the European level, an increase of only 2 percentage points since 2010. The EU aim is to double the amount of recycled waste between 2020 and 2030, which would reduce the extraction of primary raw materials for production, and increase the strategic autonomy of the EU in terms of its ability to meet its own needs. To meet these targets, in addition to an overhaul of the collection of electric and electronic waste, to improvements in the convenience of the collection service and improved packaging waste recycling, consumer engagement will also be crucial.

EU rules on packaging cover all types of packaging and packaging waste placed on the European market. This means all materials and packaging including industrial, commercial, household and other sectors. All packaging that comes on to the EU market must comply with essential requirements related to its manufacturing, composition, and reusable or recoverable nature.

The EU has revised and amended its laws on packaging several times. These amendments include mainly:

- a list of illustrative examples of packaging;
- adding sustainable consumption reduction measures for plastic carrier bags in 2015;
- setting additional waste prevention and reuse obligations for EU countries, and raising recycling targets on packaging waste;
- providing for mandatory establishment of packaging Extended Producer Responsibility (EPR) schemes as part of the legislative proposals adopted under the circular economy package in 2018.

What does it mean in practice? Companies should better inform consumers of the environmental characteristics of their product, often displayed on the packaging. They should avoid greenwashing, promote pledges that go beyond legal obligations, and encourage the purchase of more sustainable circular products.

When do we expect change to happen? On 30 November 2022, the Commission proposed to revise the Packaging and Packaging Waste Directive (European Commision, 2022). This review contributes to achieving the objective of the European Green Deal and the new Circular Economy Action Plan[2] to ensure that “all packaging on the EU market is reusable or recyclable in an economically viable way by 2030”. It will also contribute to the commitment of the 2018

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Eurostat

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Plastics strategy[3] to ensure that "by 2030 all plastics packaging placed on the market can be reused or recycled in a cost-effective manner". Without action, the EU would see a further 19% increase in packaging waste by 2030, and up to a 46% increase in plastic packaging waste .

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This revision aims to:

- prevent the generation of packaging waste, with a special focus on single-use packaging, reducing it in quantity, and promoting reuse and refill;
- ensure that all packaging on the EU market will be recyclable in an economically viable way by 2030, avoiding barriers to packaging circularity, especially the increased use of packaging design features that inhibit recycling and confusing labelling of packaging for consumer sorting;
- increase the use of recycled plastics in packaging, thus enabling more high quality ("closed loop") recycling to replace the use of virgin materials.

The key measures to bring about change on the ground include:

- targets to reduce packaging waste at the Member State level, and mandatory reuse targets for economic operators of selected packaging groups;
- restricting over-packaging and certain forms of unnecessary packaging, and supporting reuse and refill systems;
- establishing design for recycling criteria to be applied to all packaging;
- minimum inclusion rates for recycled content in plastic packaging;
- mandatory deposit return systems for plastic bottles and aluminium cans;
- harmonised labelling of packaging and waste bins to facilitate correct consumer disposal of packaging waste.

The Projects

CircThread

A key component of the CircThread project[4] is the development of a digital platform on which to collect and share important information on the lifecycle, repairability and durability of consumer products. Consumers would register their product on the platform, which would have its own unique digital ID enabling its performance to be tracked across its lifecycle. The platform would amass valuable information on durability, usage and common repair needs which would be open to consumers, manufacturers, retailers and repairers.

Providing open access to detailed information on product components, construction and how a product be repaired or recycled will help consumers make decisions about purchases, repairs and disposal. However, to maximise the platform's potential, consumer perspectives and needs must be considered at the design stage. They will be central to its success, and will need to see the value in it, be able to find the right type of information and be comfortable

uploading and sharing information about their products and usage. Consumer insights are vital for successful digital tools. OCU and Altroconsumo's knowledge of consumer product information and online behaviour is key to the design of the platform and to making sure that it works in theory and in practice.

Therefore in 2022 these organisations ran a survey with consumers in Italy, Spain, Belgium and Portugal to find out what would incentivize them to use the platform and what might put them off. The results will feed into the design specification of the platform. In total, 5,665 participants aged 25-64 years old were surveyed and asked about four product categories: small household appliances, large household appliances, high-tech devices, and heating systems.

There are currently significant gaps in the information, especially in terms of product breakdowns and disposal. When all the product categories were considered, at least 29% of respondents felt very well informed about buying and choosing products, but at most only 19% felt very well informed about what to do when they broke down. There were low figures too when it came to knowing how to dispose of or recycle products at the end of their lifecycle, with only 32% at the most feeling well informed.

Consumers' willingness to give feedback on product performance and repairs, and their appetite for more information and services to help with repairs and recycling is a positive sign. However, platform designers should make sure that product digital IDs are not linked to individual owners and that the platform is managed in a trustworthy and transparent way.

The research made clear that consumers' awareness of the need for more sustainable markets, and willingness to make an effort to help are not enough on their own — privacy, trust and the right information at the right time will be key to any solution.

The survey results showed how important it is to include consumer needs from the very start of any systemic solution. OCU and Altroconsumo can leverage their consumer research experience to help develop effective and long-lasting responses to the challenge of circular product markets, packaging included.

Circ-Pack

"Towards circular economy in the plastic packaging value chain" (Circ-Pack)[5] was a three-year EU-funded project that aimed at developing a more sustainable, efficient, competitive, less fossil fuel dependent, integrated and interconnected plastic value chain. To this end, the consortium worked in the following three areas with three demo cases:

- decoupling the chain from fossil feedstock;
- introducing innovative formats and reducing the negative environmental impact of plastic packaging;
- creating an effective after-use plastics economy.

A citizen survey conducted at the beginning of the project with almost 10,000 participants made it possible to identify social expectations and potential barriers that could help Circ-Pack innovations address consumers' sustainability needs by verifying habits and expectations regarding plastics and plastics packaging. A vali-

dation of seven demo case products with 180 real consumers was carried out by the middle of the Circ-Pack project. This test-with-consumers exercise intended to verify their acceptance, usability and added value when compared with traditional alternatives. An online survey at the end of the project with 4267 interviews looked for the most promising innovative proposals that might become a successful marketed product, and the advantages and constraints from a social approach.

Our testing showed that consumers approved the Circ-Pack innovations and bio-plastic packaging was often the preferred option when people didn't know what to choose. When informed of the products' environmental properties, the majority of interviewees chose bio-plastics over traditional plastics (indeed most of the time they were willing to pay more for the new packaging). But when there was not a great difference between the two types of packaging (i.e. the detergent box or sanitary pad film), we found that people were less motivated to spend more money.

However, weaknesses were still identified in some prototypes. For example, the tray for fresh products was thought to be less resistant than the conventional plastic tray. That's something producers had gone back to work on. Consumers expected that new types of plastics would have at least the same technical properties as the packaging they were replacing. When a bag made from bio-plastic is regarded as less resistant or more difficult to handle, the product would have less chance of success when marketed.

The objective of one of the demo cases had been to demonstrate the environmental, economic and technical feasibility of the closed loop applications made of AHP recycled. The new applications made of recycled plastics had to comply with the following success criteria in order to be validated: demonstrate the same technical performances as the current ones, guarantee at least the same cost; guarantee a reduction in the amount of primary raw material and increase the quantity of recycled material used for production. Following the above mentioned criteria, the main outcome was that high value cellulosic and plastics fractions were used as Secondary Raw Materials for the following two new applications: an innovative plastic box to be commercialised as secondary packaging for Pampers baby diapers, and mini-pallets used as displays for products in supermarkets and specialised stores after the end of the CIRC-PACK project.

For the design of an alternative to the detergent powder box, the subject of another case study, there were multiple important requirements to meet:

- firstly, consumers require the packaging to have aesthetic appeal, convenience, durability and versatility. Furthermore, environmentally friendly packaging becomes increasingly important;
- secondly, the packaging must provide the protection that the detergent requires, and must be adaptable to the fast and efficient filling machines;
- finally, there must be compliance with legislation regarding hazardous chemicals.

Today, multi-materials are widely applied by the packaging sector. This can be explained by the fact that both plastics and

packaging are subject to sustainability-related discussions. On the contrary paper and cardboard are often perceived as sustainable and good for recycling. For that reason, more and more packaging producers are shifting from plastic to paper packaging. Paper packaging can however not offer the same barrier properties as plastic packaging. Therefore, layers of plastic are added to the paper packaging, to ensure the protection of the enclosed product. This results in multi-material packaging.

Another reason for a shift to multi-material packaging is changing consumer behaviour. Consumers require convenience, since they have less time and want their products in easy- to-use, individual, ready-to-eat doses. Furthermore, transparency is an important trend: consumers want to see what they purchase, to check freshness and quality. All these trends, in combination with the trend to pack in paper and cardboard, are leading to the production of increasingly complex materials; windows are added to the paper packaging to facilitate visibility and layers of plastic are added to protect the product. Multi-material packaging is used in both food and non-food applications. Food products that are often packed in multi-material packaging are ready-made food, spirits, confectionery, pastry, dry food, frozen food and chilled food. Non-food products that are often packed in multi-material packaging are homecare products, tobacco, health and personal care products, and flowers.

There are currently other alternatives on the market. The first approach is trying to lower the environmental footprint by using biodegradable plastics in combination with paper. Since paper is biodegradable by nature, these alternatives aim to create an alternative route to the disposal of multi-material packaging: through composting. The second approach is to try to make the multi-materials separable into mono-materials, either by the consumer, or during the recycling process. This approach is preferred from a circular economy point of view, since it allows the recovery and reuse of the valuable materials inside the packaging, rather than returning them to nature (through composting).

To sum up, new multi-material packaging can rely on bio-based plastics to lower the environmental footprint of extracting the raw materials. One could also make use of plastics that are biodegradable as well, to improve the scenario of the packaging ending up in the environment as well. Multi-material packaging however is most likely to end up in the paper recycling process, since it can hardly be distinguished from normal paper. Therefore, one could better focus on the separability of the multi-material into separate mono-materials, either by the consumer, or during the recycling process. Whichever solution is adopted, clearer information on how to sort packaging is needed.

Resss

The Resss project[6] was funded by the Italian Ministry of Development, now renamed MIMIT – Ministry of Entreprises and Made in Italy. Thanks to this project, we were able to support consumers in securing the home renovation bonus for the purpose of increasing energy efficiency, but also to enquire about consumer behaviour with

regards to the circular economy. As a matter of fact, in the first six months of the project, a questionnaire was prepared for a panel in collaboration with the University of Catania, on the purchasing habits of consumers with regards to large appliances, hi-tech products, clothing, furniture, and more generally on environmental sustainability. The questionnaire ran last June through the AC makers platform, investigating the most important aspects taken into consideration by consumers: quality/price ratio, information contained in the instruction manual or the packaging concerning the correct maintenance of the product, behaviour in the event of a breakdown, replacement or disposal, in addition to second-hand shopping habits, information on the environmental sustainability of a product, and elements that do not allow for more sustainable consumption choices. The online panel was attended by 1,203 people from all over Italy (general population) between the ages of 18 and 74. A weighting procedure was applied to compensate for deviations of the sample from the general population in terms of distribution by sex, age, geographical area and educational level. The results of the survey were communicated in an article in the September issue of the magazine *INchieste* "Are you green? Go green" (issue 372), in the flashnews Green choices and watch your wallet: Altroconsumo investigated the sustainable habits of citizens in a document titled "Presentation of the results of the collaborative survey aimed at citizens" — created in collaboration with Circular Market — available for members and non-members on the web page dedicated to the project, also disseminated on the occasion of the webinar held on 24 November 2022 "Making sustainable choices simple: let's get involved".

7

In a nutshell, the main outcome was that the barriers for making sustainable choices identified in the above-mentioned survey were price, product availability but also reliable information all along the value chain. In this regard, packaging design could be considered a strategic element to trigger the best sustainable choice. For example, it makes a huge difference when there is clear information on the packaging that consumers can use to sort out waste more easily. If companies want to run a sustainable business they need to take the usage of their products into consideration, packaging included, collecting user experience as well as testing results when assessing safety issues is advisable.

Meno Plastica In Comune

Thanks to this project[7] we developed an analysis of consumer needs, along with pilot and accompanying actions to abate of the types and quantities of plastics used in public city buildings (schools, meeting places, libraries, etc.), focusing mainly on the consumers who frequent these places; training actions with a multiplier effect were targeted at consumers and young people, allowing them to verify the opportunities offered by a "plastic free" approach.

The use of compostable or alternative solutions, in fact, not only contributes to the protection of the environment but can also generate considerable economic savings for the entire community. Thanks to this project, which involved specific key actions aimed at the main categories of consumers who use single-use plastic materials the most, Altroconsumo activated a shared process of change,

involving several communities of citizens in the Lombardia region. As part of the project, we created a small rapid guide for virtuous municipalities interested in replicating elsewhere the initiatives deemed most interesting and useful for reducing the consumption of bottled water and the consequent production of waste, and for promoting conscious behaviour on the part of their citizens in order to reduce the environmental impact, making the best and most efficient use of available resources.

8

The guide shared the lessons we learned. Our hope was that it could help in the evaluation of the aspects to be considered in advance of adopting the actions proposed by other municipalities or stakeholders, providing elements to choose among the various options currently available on the market and make information and educational materials produced available.

Recommendations

The projects and reflections so far lead us to general considerations and recommendations that are important to bear in mind.

First of all, design determines 80% of the environmental impact that a product or service generates across its life cycle according to surveys on the circular economy carried out in the RESSS project in 2022.

A general recommendation is to be made with respect to the increasing "easy to use" information and transparency. This is true for all stakeholders but in particular for consumers, and was confirmed by several project outcomes. In the circular economy domain, the risk is vagueness, and it is important to avoid green washing (Sobrero, 2022). There is a need for substantiated claims: this is true for both the production and innovation side, but also when building brand image and credibility in relation to end users. Environmental self-declarations of products should be based on verified and easily understandable data that relate to important aspects of the product's life cycle. For the sake of clarity, displayed information should not use legal restrictions to make environmental claims (see Clean project[8]).

It is also of primary importance to make food packaging safe. Consumers do not feel sufficiently informed when buying or using food packaging and containers. While they are generally aware that some packaging or containers can release chemicals into food, our very recent survey results (BEUC, 2023) suggest they may not be receiving the full information they need – such as directions for safe and appropriate use. As a result, people may be inadvertently increasing their exposure to chemicals leaching from containers and packaging into food.

Considering the increased availability of tools and technologies, it may be a good practice to make packaging interact with its surroundings by using different forms of information, physical and digital when appropriate, creating new opportunities and addressing new challenges (European Commission, 2019). Designers may have to invest in exploring new best practices, as conventional wisdom is challenged. Concurrently, more tools and technologies become available.

A key factor for success will be to go in the right direction, keeping in touch with consumer organisations, collecting consumer

experience and gathering evidence of new research projects, testing outcomes, knowing in advance what consumers want, shaping environmentally friendly packaging and effective messages (Martello & Vazzoler, 2022). Best practices in this regard may also include initiatives such as the Best Packaging award (istitutoimballaggio.org) in which Altroconsumo participates, providing its feed-back.

Last but not not least, it is also important to invest in stakeholder engagement and in reporting process and project outcomes, as this is not merely a "nice to have" approach for forward looking businesses, but a kit of strategic tools to address the green transition and implement the New Green Deal.

In conclusion, circular economy is the new economic model for sustainable development (Rossi, 2022). It plays a key role in achieving the UN Sustainable Development Goals (SDGs). In this model, nothing is wasted, everything lasts longer and is shared, reused, repaired or recycled. While this model reduces pressure on natural resources, it also carries economic and social advantages. Circular economy performance depends on a combination of several factors, from the way in which the most varied consumer goods are produced to minimise the use of material and energy resources, preventing waste production, to the level of management of the various waste streams. Only through a combination of measures, at various levels, is it possible to evolve in terms of sustainability indicators. However, there are over 8,000 chemicals used to produce and treat food packaging materials. There need to be rules which cover all food packaging so that they are safe under all foreseeable conditions of use, including reuse. Consumer organisations have a role to play in this regard, providing information to consumers to help them select the most sustainable products and services, promoting best practices in terms of usage and sustainable consumption, but also serving as a driving force for other stakeholders to improve their products and services, packaging included. They will thus contribute to a more inclusive society where the most sustainable products and services are accessible and affordable for consumers (BEUC, 2022).

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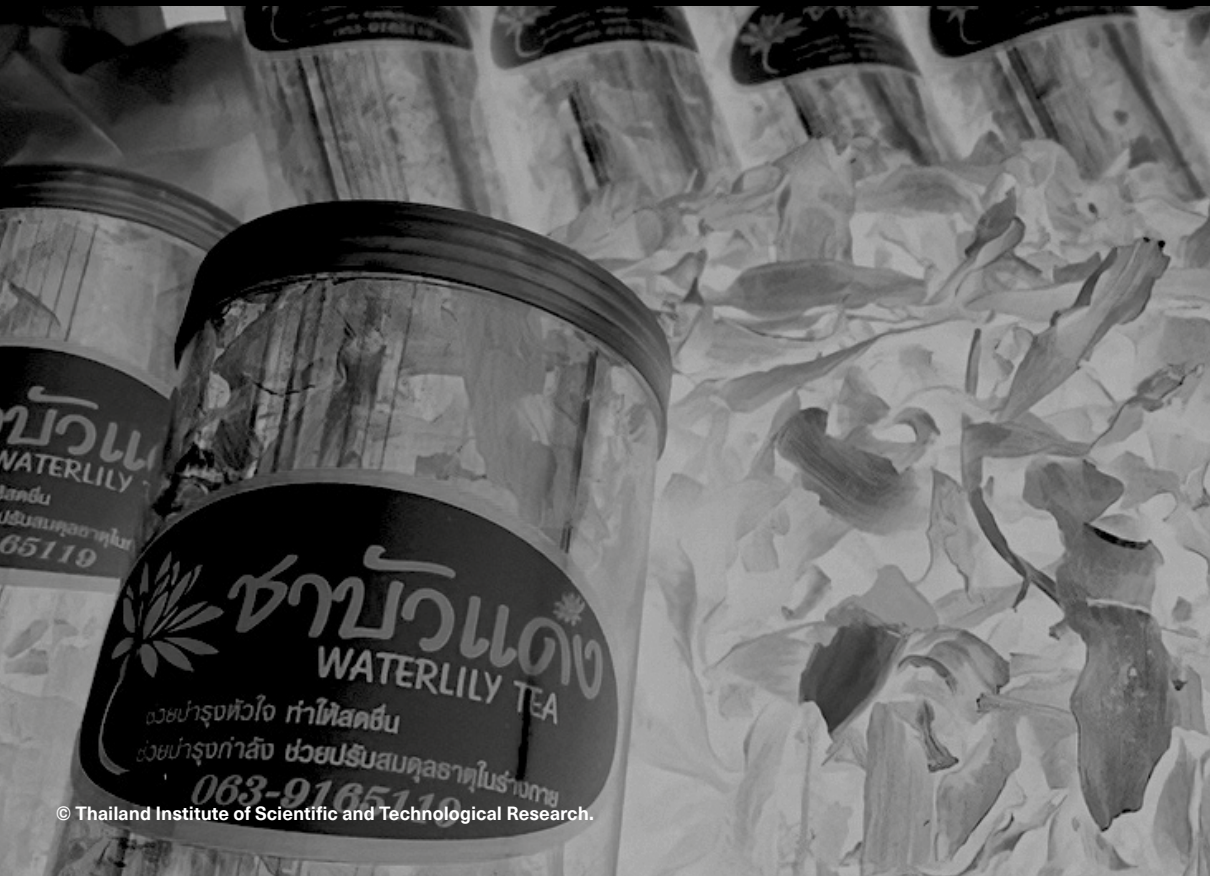
Stories



Geographical Mapping of Case Studies in Packaging Research

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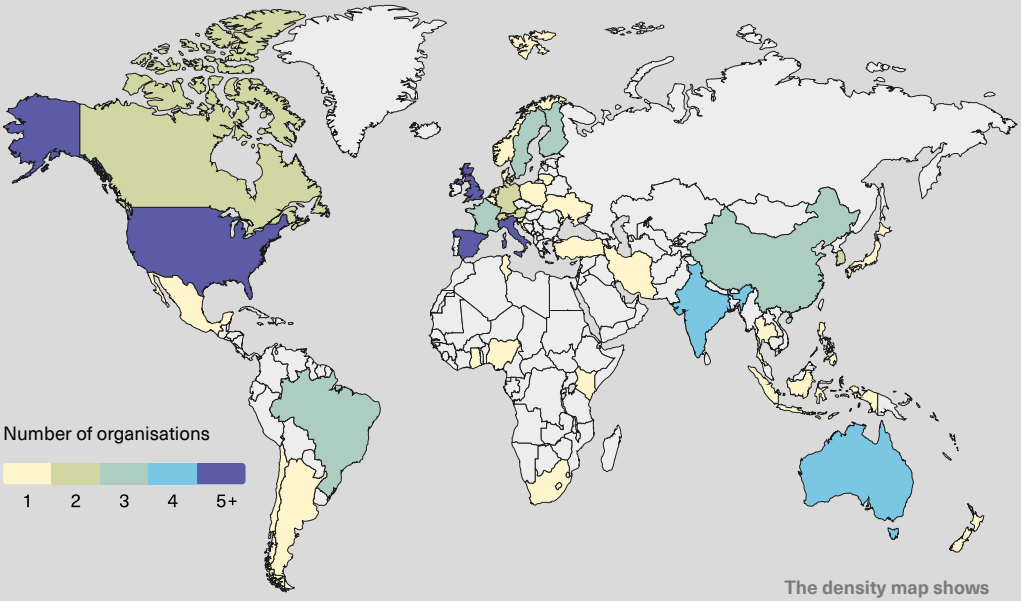
Research centres, institutes and observatories are key players in the development and innovation of packaging systems, whose growth is influenced by a multitude of factors, including research and development of new packaging materials and technologies, packaging protection, interaction with other systems such as logistics, distribution, communication and environmental impact, as well as the efficiency of production processes. This study emphasises the importance of mapping the organisations involved in packaging issues, both geographically and in terms of innovation and knowledge drivers in the sector. However, it is recognised that the analysis carried out is not exhaustive as the tools used to collect case studies, mainly digital, language barriers and communication technologies used in the different countries do not allow for the development of a comprehensive map of all stakeholders involved in the sector. It is a qualitative-quantitative analysis that provides an overview of the distribution, objectives and main topics of the various organisations identified.

diid No. 79 — 2023
Doi: 10.30682/diid7923g

Number of organisations by country



The density map shows the geographical composition of the case studies in the analysis.

Chart of the distribution by geographical region of the organisations analysed

In this research, a systematic analysis was adopted, including research centres, university research groups, observatories, institutes, innovation business companies and materials libraries belonging to governmental organisations, higher education, non-profit organisations and private entities with a recognised identity. In order to obtain a detailed understanding of the state of the art of packaging research, a case study mapping was undertaken to identify, catalogue and provide a qualitative view of such facilities dedicated to innovation. Some organisations, such as newspapers and in-house innovation centres of manufacturers in the sector, were excluded from the analysis. The collected data was mainly derived from the analysis of academic literature and trade journals, cross-referencing the information with associations and networks, which allowed us to identify many of the actors involved in the sector. A total of 92 case studies were collected and subdivided by geographic region to provide a more detailed understanding of the distribution, so that it was possible to identify any regional concentrations of expertise or areas where further research might be needed[1]. In addition, the analysis included a study of research trends and topics as well as an analysis of the services offered by the various institutions.

1
Digital map of all analysed organisations.

The different organisations identified can be grouped into six different categories:

RESEARCH CENTRES: are organisations that carry out scientific and technological research and development with the aim of increasing knowledge. They can be national or international in nature.

UNIVERSITY RESEARCH GROUPS: consist of academics, researchers and students working together to conduct research on a particular topic or theme. They may receive funding from public or private institutions, or from other sources, and often aim to produce original and innovative knowledge in a specific field.

OBSERVATORIES: focus on research, monitoring and surveillance activities on specific issues and trends, collecting and analysing data on a particular topic or phenomenon.

INSTITUTES: have a specific mission and work towards achieving specific objectives in line with that mission. They may be involved in activities beyond research, such as education and science dissemination.

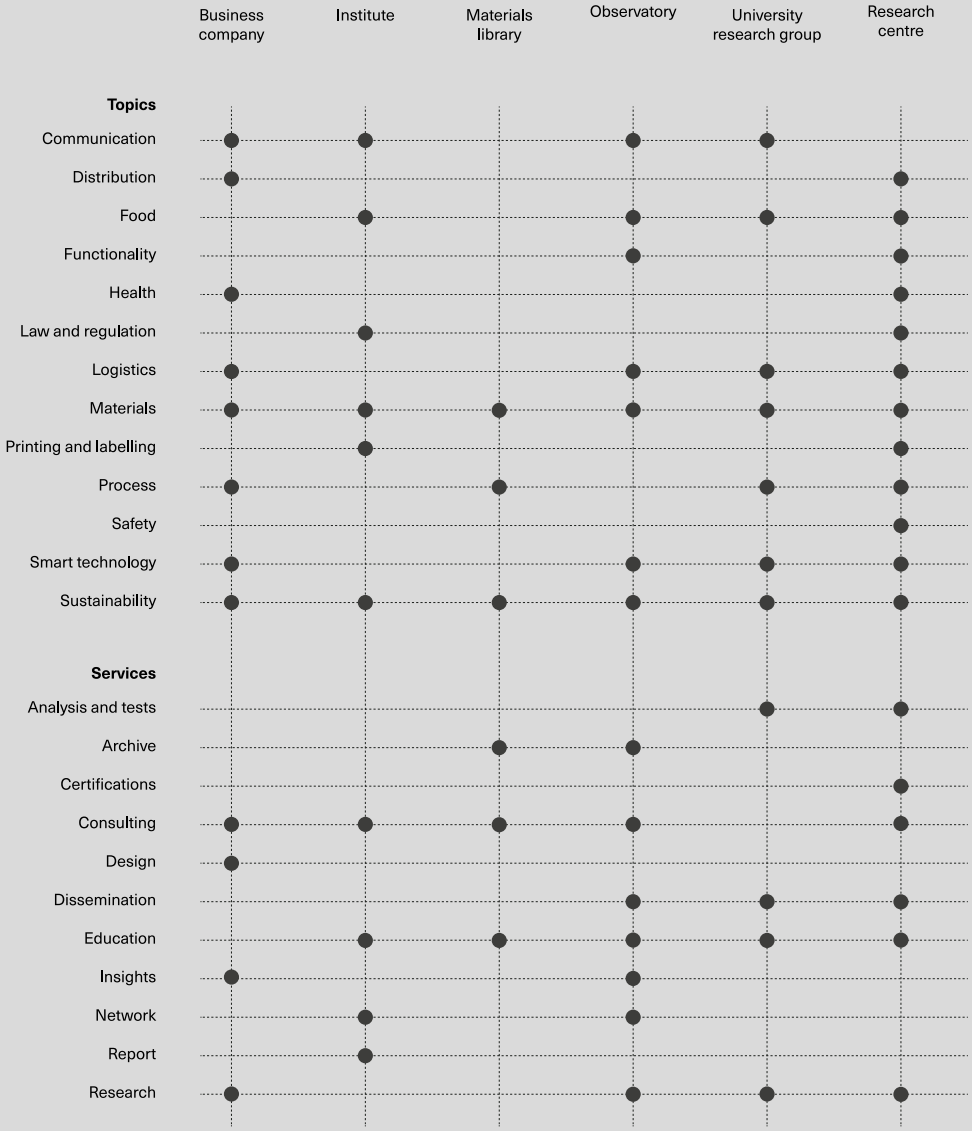
INNOVATION BUSINESS COMPANIES: are private organisations that aim to promote innovation through research and development of new products, services or technologies, or through collaboration with other companies and research institutions.

MATERIAL LIBRARIES: are places where samples of materials and products are collected, classified and stored. They can be used as a resource by designers and engineers to find inspiration and information about materials and their properties. In addition, material libraries can be used for education, research and development of new materials.

diid No. 79 — 2023
Doi: 10.30682/diid7923g

Classification of organisations by geographical region found in the research.
The table below shows the distribution by type.

Table of services offered and topics covered by type of organisation



In order to illustrate the different methodologies used in packaging research, the study presents six selected case studies. The selection of cases was made taking into account a wide geographical distribution and the adoption of different experimental approaches in order to provide a more comprehensive and representative overview of current trends in packaging research.

diid No. 79 — 2023
Doi: 10.30682/diid7923g

Circular Design Co

Materials Library and Business Company
Oceania
https://circulardesignco.com/
Services: Archive, consulting, insights.
Topics: Materials, process, sustainability.

Circular Design Co is a design studio dedicated to creating innovative solutions to sustainability problems since its foundation in 2021. Their approach is based on three core principles: design for durability and product life extension, for sharing and reuse, and circular end-of-life solutions. The Circular Design Co team shares a strong commitment to reducing the negative impacts of waste and destruction on the environment and works to solve these problems from the design stage, considering the entire product life cycle. Furthermore, through their online platform, the Circular Material Library, which contains a wide range of materials suitable for use in the circular economy, they help customers choose the right materials for their product, taking into account both performance and the ability to be easily recycled or reused at the end of the life cycle.

ITEGA

University Research Center
North America
https://itega.ca/
Services: Analysis and test, consulting, education, report, research.
Topics: Food, materials, process, smart technology, sustainability.

The Institut de technologie des emballages et du génie agroalimentaire (ITEGA) is a Montreal-based technology transfer centre founded in 2007 by the Collège de Maisonneuve. The ITEGA team is dedicated to product and process research in the food industry, with a focus on packaging systems. Their field of application can be divided into three interconnected areas: innovative packaging development, agrifood processes and by-product valorisation. Part of their work focuses on the development of innovative preservation systems that extend the shelf life of products, as well as the study of active or intelligent packaging and the development of compostable materials. The main objective of the research centre is to support SMEs through technical assistance, analysis of packaging performance, and optimisation of its recyclability.

Instituto Argentino Del Envase

Non-profit Institute
South America
http://www.packaging.com.ar/
Services: Archive, consulting, education, insights, network.
Topics: Logistics, law and regulations, materials, sustainability.

The Instituto Argentino del Envase (IAE) is a non-profit organisation dedicated to promoting innovation and sustainability in the packaging industry through the dissemination of more efficient and environmentally friendly practices. Founded in Buenos Aires in 1969, IAE's main objective is to collect and disseminate scientific and technological information on material properties and production technologies in order to promote the overall development of the packaging industry. The association offers advisory services to its members on packaging regulations and waste management, and is also involved in training and information for packaging professionals, offering courses and seminars to help professionals develop specific skills. In addition, the IAE acts as a mediator between public and private entities to solve problems related to packaging waste management and the environmental sustainability of the packaging industry.

RISE

Government Research Center
Europe
https://www.ri.se/
Services: Analysis and testing, certification, consulting, education, research.
Topics: Health, law and regulations, materials, process, safety, smart technology, sustainability.

The Research Institutes of Sweden (RISE) is a government research institute dedicated to innovation. Founded in 1997, it operates in more than 25 Swedish cities. It focuses on industrial research and innovation. Through international collaboration with industry, academia and the public sector, it addresses business competitiveness and contributes to a sustainable society. RISE is divided into five organisational divisions: bio-economy and health, materials and production, digital systems, built environment, safety and transport. The centre collaborates with academia, industry and the public sector to explore, among other topics, the opportunities and challenges of packaging. Through its networks, RISE provides expertise on standards and regulations and courses on topics such as sustainability. In addition, RISE carries out testing and certification to ensure that packaging meets safety and quality requirements. The centre also works to develop innovative material solutions and interactive functions for packaging.

TheCircularLab

Non-profit Observatory
Europe
https://www.thecircularlab.com/
Services: Design, dissemination, education, research.
Topics: Materials, sustainability.

TheCircularLab is an innovation centre for the circular economy founded by Ecoember in 2017 in Spain. In collaboration with companies, administrations and the public, it seeks to study, design, test and apply best practices in a real environment through all stages of the packaging life cycle, from conception to reintroduction into the consumption cycle through new products. CircularLab develops its activities in different areas of innovation: it works in the field of ecodesign, identifying new sustainable materials and incorporating recycled components into production processes; in order to promote efficiency and thus increase the percentage of recycled packaging, it is working on the development of an innovative technological application for the management of packaging collection and recycling processes; through citizen science, it has created a direct communication channel that increases citizen involvement in waste collection.

TISTR-TPC

Government Research Centre
Asia
https://www.facebook.com/tistrinter
Services: Analysis and testing, certifications, consulting, research.
Topics: Health, law and regulations, materials, process, safety.

The Thai Packaging Centre (TPC) is a research centre located in Thailand and established in 1984 as the central agency for the development of packaging standards by the Thailand Institute of Scientific and Technological Research (TISTR). The TPC is responsible for the development of packaging that conforms to international standards, ensuring product quality to promote exports globally and prevent losses due to poor quality packaging. The centre conducts research and development and promotes knowledge of packaging technology in the industry. The TPC consists of two laboratories: the Packaging Development Laboratory and the Packaging Testing Laboratory. The Packaging Development Laboratory is dedicated to the development of packaging for food preservation and the use of sustainable materials. The Packaging Testing Laboratory provides accredited testing services on materials, and sales and shipping packaging that comply with international standards, as well as testing of hazardous goods packaging.

Davide Pletto
His current work focuses on the study of circular design in the packaging industry to find solutions that are more recyclable without reducing the barrier properties that ensure the freshness and accessibility of the contents. During his research career, he has had the opportunity to broaden his studies to a range of topics involving different aspects of the packaging system. He is interested in issues related to circularity, materials, and their sensorial interaction, as well as aspects of experimentation and prototyping.

diid No. 79 — 2023
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Designrama

The Designrama section is open to international debate and is not characterized by any specific theme. It is conceived as a space for the scientific community to give evidence of where research is heading worldwide.

The Critical Catalyst: A Critical Approach to Design Futures Literacy

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Abstract
Design and Future Studies are intrinsically related fields. Both fields pursue the goal to introduce potential visions of the future to achieve a sustainable future for humanity. However, future challenges are becoming more evident with the increasing ubiquity of socio-technological advancements. Over the past three decades, several movements have emerged with the shared objective of being critical of design (Mazé, 2019); these movements are attempting to operate outside the external borders of market-driven enquiry (Malpass, 2017). These practices require a critical examination of the possibilities to achieve change that mitigate unfavourable consequences. This paper reflects on the way that the Research through Design approach can affect these practices through the activities and devices we have developed and refer to as the Critical Catalyst (CC). We applied this approach to MSc students in Integrated Product Design at the Design School at the Politecnico di Milano. The results of this experience are condensed into nine provo-types (provocative prototypes) presented at the end of the course. This paper examines the CC design future process and reflects upon the experience and tools by analysing the critical choices.

Keywords
Critical design
Futures studies
Futures literacy
Speculative design
Design fiction

Context

In an attempt to challenge future uncertainties, several movements have emerged over the past three decades that share the concept of being critical towards design (Mazé, 2019); these movements are attempting to operate outside of the external borders of market-driven enquiry (Malpass, 2017). Representative examples of these movements are Speculative Design (Dunne & Raby, 2013), Design Fiction (Sterling, 2005), and Experiential Futures (Candy, 2010). In this paper, we focus on the futures-oriented critical design movements and define them as "Critical Design Futures" (CDF), a notion developed to identify the set of design practices that are meant to address the uncertainty of the future by examining possibilities critically, and effecting change to mitigate unfavourable consequences. CDF emerged from Critical Design, which is described as a practice that uses design tools and processes not to solve a problem, but to rethink its boundaries and parameters from a critical perspective (Mazé, 2014). CDF was developed in response to the adverse effects over the past decades that are attributable to design. In their influential book, *Design in Crisis*, Fry and Nocek (2021) argued that while there have been many attempts to transform design to be socially and environmentally responsible, "[...] the modern metaphysics of design remains unchanged" (p. 2). The design discipline has faced these challenges for decades, and to date, they are still evident. The authors acknowledge the discussion among scholars about critical and alternative design practices and the complexity of proposing new terminology to address or describe this set of practices. However, the goal of proposing CDF is not to broaden or create new territories, but rather to further clarify the specific practices that focus on critiquing aspects related to the future rather than alternative practices that focus on political activism or other types of criticism in design.

Critical Design Futures: Bridging the Gap

Although CDF sounds very profound, and examples are abundant, the theoretical academic literature on CDF practices is still not fully comprehensive with respect to theory and the relation with other design practices; further, enquiries about method, performance, and development remain unresolved (Bardzell et al., 2012; Mazé & Redström, 2007; Ozkaramanli & Desmet, 2016; Pierce, 2021). This type of design futures practice is not intended to produce market products, but to analyse the factors and enact change in what could be proposed to the market. CDF refers to a type of design and object typology intended to communicate ideas, as well as raise awareness of controversial, psychological, ideological, or sociological issues (Tharp & Tharp, 2013). In addition to being a vehicle for communication, CDF are tools to problematize and investigate design problems. Thus, the design language used to make ideas tangible is not intended to solve problems, but to "[...] critically rethink the parameters of the problem itself" (Mazé & Redström, 2007, p. 11). The goal is to encourage discussion about an issue. It is not the discussion's result or solution, but its initiator and trigger (Bardzell et al., 2012).

diid No. 79 — 2023
Doi: 10.30682/diid7923h

Researching Futures Through Design

Building on the discussion above, it is noteworthy that there are few established conceptual models to study futures through design in general, and in CDF in particular, other than Ollenburg (2019), Lindley & Coulton (2014) and Candy and Dunagan (2017). However, CDF can be considered constructive design research (Krogh & Koskinen, 2020) and be read with a Research through Design (RtD) approach (Frayling, 1993; Friedman, 2003). Nevertheless, the question remains: What constitutes RtD in the design futures practice, and how could CDF operate within the boundaries of design research paradigms?

There are evident parallels between RtD as action research and CDF with respect to their common ground. As Pierce (2021) noted: "Alternative design approaches implicitly if not explicitly align with a research through design (RtD) approach, another recent expansionary specialisation wherein methods and outcomes of design are used to conduct research inquiry and to generate and communicate knowledge" (p. 1). The parallels are evident in the following three aspects: 1) Both use either a design artefact or design output as the central point of the research (Ollenburg, 2019; Bardzell et al., 2012); 2) CDF is a reflexive practice, and RtD's core value is to generate knowledge by reflecting on practice (Kelliher & Byrne, 2015); and 3) participation is a key element in both, as they engage the audience in action and the research is an active part of the process.

The model we propose, the CC, is built on RtD as an iterative framework, as CDF's ultimate purpose is not to design a future product but to research futures through design.

The Critical Catalyst

We view design as a "critical agent or catalyst", a concept to steer the process of designing for the future context. It helps young designers problematize a future challenge and examine its hidden and intangible sides. The Critical Catalyst (CC) is a set of reflexive design activities and devices developed to fill the gap in the methodological approach of CDF. The CC serves to initiate critical debates in design futures and as a catalyst to facilitate designers' reflections on future challenges. Its objective is to 1) help trigger critical enactments in design futures practices, 2) work as a self-reflexive tool for practitioners and researchers, and 3) facilitate critical design decisions during the process. The CC serves to support the methodological flexibility needed for CDF by offering the critical triggers throughout the process, without imposing a particular sequential or linear process. It is a means to offer wide and flexible choices of critical triggers for a practitioner to select from. It is not prescriptive; it does support and suggest certain guidelines, such as identifying the researcher's positionality and analysing the future issue, yet without a limiting sequential emphasis. The process builds on Voros's generic futures framework (2005), Ollenburg's participatory futures model (2019), and Jonas's RtD generic design process (2007). The model has four macro phases (Analysis, Projection, Synthesis, and Communication

& Reflection). Generally, the first three phases are nearly agreed upon in future studies, and the fourth is added as an essential phase in critical practices, as it is the main phase in which the interaction with the audience takes place.

The model is placed in the action research format of iterative cycles, in which the research process progresses from Analysis to Projection, to Synthesis, and finally, Communication & Reflection Fig. 1.

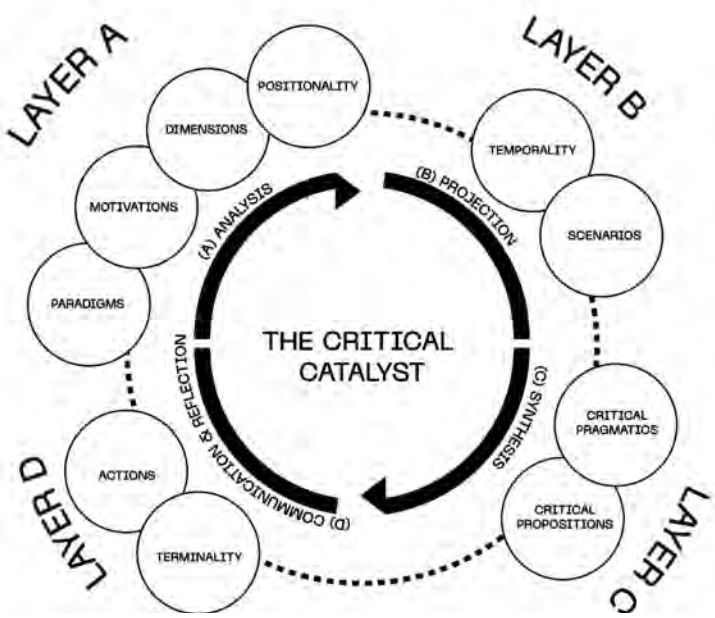

Fig. 1
The Critical Catalyst model by Harb, 2022.

A) Analysis

The Analysis is the primary stage in which design researchers explore the issue under investigation; this may include a vast number of tools and techniques that range from Horizon scanning and reviewing the literature to analysing emerging issues (Inayatuallah, 2013). With respect to the critical catalyst, there are three main layers that must be considered.

- Paradigms. Ramos (2002) and Voros (2005) raise the issue of the need for a "paradigmatic dimension", as models may help designers and researchers situate the CDF project within the scope of inquiry. The paradigms in CC refer to the inquirer's worldview and offer different project perspectives through specific lenses. For instance, an interrogative paradigm is designed to question future states and debate their implications and consequences. In contrast, a propositional paradigm builds an alternative worldview of the future and opens a space for inspiration and imagination about plural futures.
- Dimensions. Dimensions — driven by Inayatullah's (2007) Causal Layered Analysis — refer to the issue's complexity, such as defining what is clearly visible (litany), what is hidden (myth or metaphor), and what factors constitute the real issue. Dimensions help the inquirer investigate the future issue in

diid No. 79 — 2023
Doi: 10.30682/diid7923h

greater depth and gain insights from deep and abandoned factors that are usually overlooked or misused (Inayatullah, 2007).

- Motivations. Motivations refer to a designer or design team's internal or personal objectives. Perspectives, ethos, and direction embedded in one's personal qualities become the agency that allows designers to take up the project and embrace new challenges. A designer may be sceptical about particular social, technological, or political issues. Scepticism encourages an interrogative stance wherein the inquirer poses questions about the issue and attempts to identify and expose its roots and implications (Tharp & Tharp, 2019).

B) Projection

There are three main important elements in the projection phase:

- Temporality. This is a core element of the CDF project. Temporality is related to how far into the future the project strays and how the timeline of the future might be constructed. Here we identify two main pillars used to create the timeline — projection (the extrapolation of events over a period of time determined by the designer) — and tracing (looking at the roots of the problem) (DiSalvo, 2012). Temporality refers to the development of a timeline of counterfactual or hypothetical events. The timeline can go back in history to create a counterfactual (leading to an alternative present) but can also form a future hypothetical (that leads to alternative futures) (Dator, 2019; Inayatuallah, 2013).
- Critical Diegetic Scenarios. A fundamental cornerstone in CDF is scenarios in "world-building" and "diegesis" (story world). In CDF, we argue that scenarios are not the same as conventional futures scenarios such as DOS (Manzini & Jegou, 2003; Evans, 2010; Dator, 2019). Critical diegetic scenarios have a different purpose, to create a space of problematization in which the project should be situated. It follows the paradigms, motivations, and temporality, and shares their purposes, but shows them in terms of a story world. This world includes characters, as well as social, political, and economic values of the future state. We argue that this world should have a balanced level of defamiliarisation (uncanny) (Auger, 2014; Dunne & Raby, 2013), ambiguity (Gaver, Beaver & Benford, 2003), and plausibility (Tharp & Tharp, 2019).
- Positionality. Critical and speculative design is often interpreted as a position (Dunne & Raby, 2013). A position defines where the designer stands within the modes of the critical landscape, whether s/he is critical of a design or socio-political issue or is acting as a participant who works with the audience to identify issues for debate. It thus indicates where the designer stands within these interrelated aspects.

Synthesis

The third layer is the synthesis concerned with CDF's making aspects, which are the 1) Critical pragmatics, and 2) Critical propositions: briefly, both aspects work together to inform the way that aesthetics and form can be achieved in the CDF project. They build on techniques of unconventional design, such as Chindogu (Kamino & Stolterman, 2021), Para-functional prototypes (Dunne, 1999), and critical Jugaad (Butoliya, 2018). The intent of these critical propositions is to problematize the project's focal issue and inspire provocative diegetic prototypes that represent the diegesis that the scenario creates both tangibly and viscerally.

Communication and Reflection

Communication and reflection are the fourth pillar of the CDF project, which amalgamates all the previous activities. This is a fundamental part of the CDF project in which the audience experiences the prototypeand obtains insights. In it, the inquirer documents, digests, and observes the process. This stage closes the research through the design cycle, where designers reflect upon the experience overall, infer and map consequences, and if necessary, restructure the critical object for another cycle of iterations.

PoliMi Futures' Fictions: Testing the Critical Catalyst in Context

The researchers conducted a test in an educational context to determine how the CC could be used and identify how it might affect the participants.

The course is *PoliMi Futures Fictions* (POFF), the first module of the Concept Design Studio of the Master of Science program in Integrated Product Design at the Politecnico di Milano. The course is designed to expand the students' knowledge about the future and enhance their envisioning capabilities. It is intended to empower students with future literacy and improve their critical thinking skills when they encounter future challenges. Ten sessions that focused on the course objectives were conducted over the course of five weeks. The course was delivered to 58 international students who worked in 9 groups. The course's pedagogical approach focuses primarily on practice and the RtD approach by building on the results from both the CC and FUEL4Design projects (Future Education and Literacy for Designers), funded by the Erasmus+ program. The course is intensive, and each week is based upon a challenge related to specific objectives and activities, as well as a daily plan with lectures, seminars, and milestones to achieve.

The projects in the course were focused on researching futures. The intention was not to produce a product design of the future, but to research, investigate, and question the context and parameters of design in a future context. The investigation was conducted by creating objects that tend to push the boundaries and limits of conventional design practice to seek alternative paths and potential directions of the futures, as well as the implications and consequences of particular technologies.

diid No. 79 — 2023
Doi: 10.30682/diid7923h

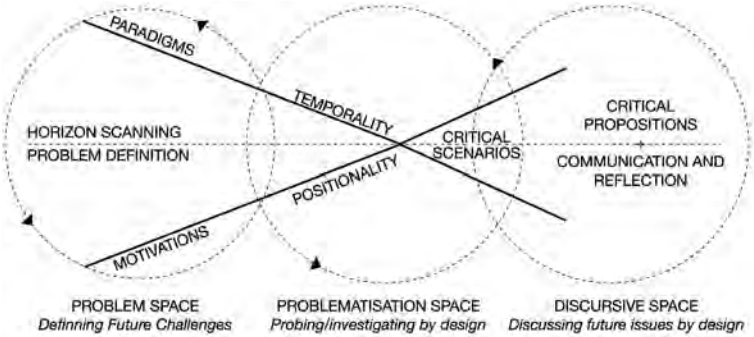

Fig. 2
The course process read through the Critical Catalyst lens.

The activities revolved around using the elements in the CC and applying them to the course structure that we developed Fig. 2 as follows:

Problem Space. For the first stage of the course, the students identified the topic and delved deeper into understanding the real issue and challenges. We asked the students to work with the Future Forces Canvas (FUEL4DESIGN, 2021), which we developed as an analytical tool for the horizon scanning stage, in which designers are asked to map emerging trends in 11 sections that drive the future. In addition to defining the topic and mapping trends, the first layer of the CC — the Paradigms — was introduced, along with the Motivations, in which the designers are asked to identify the purpose of engaging in the project and the perspective from which they want to approach it. Fig. 3.

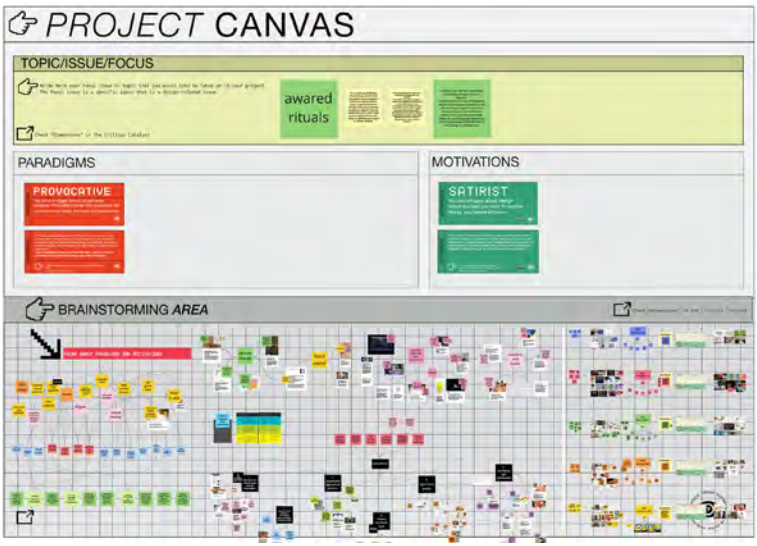

Fig. 3
Students' Paradigms, Motivations, and horizon scanning exercises (screenshot from the course Miro-board).

Problematization Space. The second stage is to analyse the findings of the first stage by building the future timeline. The future timeline is the projection of the potential implications and consequences of particular events or influential points in their futures timeline. Following the timeline is the Critical diegetic scenario. In this exercise, the critical diegetic scenarios cards were introduced, and the explanation of how they work with the timeline was supported with examples from projects.

Discursive Space. The third stage we proposed is the critical propositions cards, which is the stage in which designers can create concepts and provocative prototypes to debate the issue under investigation. The propositions are complemented with critical pragmatics, another layer that facilitates understanding and the design of a critical object's aesthetics Fig. 4.

Fig. 4
The CC cards of Critical Propositions by Harb, 2022.

Outcome

The first is *BOW* Fig. 5, which discusses the future of senses, particularly the perception of time concerning work/life balance. The project debates the unprecedented enhancement in human capabilities which led to the consequence of causing humans to lose track of time. *BOW* is an exoskeletal and prosthetic-like device that works through wires connected to the neuralgic points of the body. The ear cups are specifically linked to the user's heartbeats, which are always kept at their natural frequency, preventing them from feeling the passage of time from day to night thus keeping the user immersed in the digital world with little or no breaks.

Fig. 5
Bow by Helen Berhanu Tekle, Filippo Bugni, Matteo Corradini, Sabrina Gadotti, Elena Scarpelli, and Zixin Zheng.

diid No. 79 — 2023
Doi: 10.30682/diid7923h

The second is *Pissing Pants* Fig. 6, which discusses the future of food and how we may need alternative ways to produce non-synthetic food. The *Pissing Pants* are made of synthetic polymers to prevent leakage while the tubes are attached to the shell around the urinary organs and connected to the soil directly. The pants have big pockets on the front where the users can cultivate organic food of their own.

Fig. 6
***Pissing Pants* by Zachary Edwards, Jisoo Kim, Lars Lampani, Alberto Milano, Alexandra Spassov, Davide Stefani, and Chaoyi Zhang.**

The third is the *Embryo: fireflies' food can* Fig. 7, which discusses extreme migration in the post-Anthropocene. *Embryo* is a device that allows the growth and development of protected species, from their embryonic state to full development. The device is made from recycled or bio-based materials. *Embryo* is composed of three parts: the translucent shell in which the embryos of the species are deposited, equipped with access at the base that allows the inoculation of nutrients; the central part which contains thermoregulators for maintaining the correct environment regardless of external conditions; finally, an opening that facilitates the release of the living being at the end of the cycle.

Fig. 7
Embryo by Ka Chun Chow, Anna Dondini, Nuño González Rebaque, Elisa Melodia, Niccolò Maria Oliva, Elena Valle, and Zane Xie.

Reflections on the Critical Catalyst and Testing Experience

The discussion and analysis depended upon the results of a survey that was completed by 45 of 58 students at the end of the course. The most important insight into the experience of the CC is that the participants were able to grasp the meaning and purpose of being critical in design futures. The survey results showed no disagreement with the understanding of the purpose and the concept of CDF, as was also evident in the projects.

The first part of the framework was the analysis, which often conflicted with the participants' previous understanding of the typical research phase. The conflict derived from the fact that researching future trends, weak signals, or "the yet to be" is not always an easy task to conceive, segment, and put in order. Investigators require a significant amount of expertise, as the future itself is a very diverse topic, so that researchers who work in this area need to be aware of the many other factors that affect our futures. During this phase, the participants typically became confused until they understood the purpose of analysing the present and projected their understanding in a potential futures timeline.

The CC conceptual layers (e.g. paradigms and motivations) were more difficult to digest and reflect upon as they relate primarily to the users' perception of design itself, as well as their approach to it. Paradigms are positioned in the early stages of the process; however, some of the CC users found it difficult to identify the paradigm in the early stages, particularly when they did not have a clear position or direction from the beginning. However, the participants who had a definitive direction (either their own position or because they were able to define a clear project statement) found it easier to define their path through the CDF project. The users' paradigms were also affected by their cultural backgrounds. Different groups of CC users reflected upon the same paradigm in different ways. Western designers' decolonialism paradigm is not the same as that

diid No. 79 — 2023
Doi: 10.30682/diid7923h

of users from the global South, and the same is true for different genders, ages, and professions. Another insight into motivations is that they are more reflective questions themselves, and as a result the CC's users found them difficult to implement, particularly in short-term projects where the design output needs to be very quick and produced in a timely manner.

With respect to the Critical Diegetic Scenarios, Critical Propositions, and Critical Pragmatics, the CC's users found them very insightful and supportive in the creative process. However, some of the participants may have found them to be a constraint, as if they presented a set of options or choices that could limit the user's creative uptake. However, they are not intended to be prescriptive (e.g., a methods menu); they are rather a suggestive choice that opens up a space for discussion and likely makes it easier to ideate or create concepts. Pragmatics is the most difficult part to digest in the CC because it relies heavily on personal experience, artistic knowledge, and cultural background (which always prevails). Even the pragmatics in the CC cards are quite difficult to perceive, as they are presented as a very short note on the cards themselves, making it difficult to grasp their complex meanings. They also need elaborate visual references or examples to give them some sense.

While on the one hand, the CC may help young professionals and design students understand these entangled factors, on the other hand, it may not be easy for them to grasp its complexity, as it requires more experience and understanding of the world in terms of economics, politics, technology, and the environment.

Conclusion

This paper proposed and described the Critical Catalyst, which is a new set of devices, design activities, and prompts as an RtD approach to studying CDF. The CC is not a prescriptive process; instead, it tends to support, facilitate, and help designers throughout the design process. This process leads to a research outcome, not a design outcome, although it uses design as a means of enquiry. Nonetheless, the designed objects are a byproduct of a CDF project, not its main output.

Authors' Notes

This work is a partial result of the combination of Prof. Celi's interests in Design Futures and her role as a supervisor of Ammer Harb's Ph.D. research on Critical Design Futures. The work was supported by the Design Ph.D. of the Politecnico di Milano, as well as a grant from the Erasmus+ project (FUEL4Design - Future Education and Literacy for Designers). Roles: Manuela Celi wrote sections 1, 2, and 6, and Ammer Harb wrote sections 3, 4, and 5.

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Empathy Is Not the Way, Critical and Creative Thinking for Design for Sustainability Transitions

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Abstract
This qualitative research advocates for prioritizing Critical and Creative Thinking in professional design over empathy. The study involved 74 undergraduate Product Design and Engineering students from Brazil, Portugal, and India to explore the relationship between these thinking skills and sustainability. The students' Critical and Creative Thinking levels were evaluated using rubrics developed by Shively et al. (2018) and a multi-level framework developed by Ceschin & Gaziulusoy (2019) was applied to identify sustainable innovation levels. The research highlights the need to enhance tertiary students' skills in addressing wicked problems, a concern recognized by the Organization for Economic Co-operation and Development for the 21st-century workplace. This research contributes to the ongoing debate on the significance of Critical and Creative Thinking in professional design practice and emphasizes the importance of integrating sustainability considerations into design education.

Keywords
Empathy
Design practice
Critical thinking
Creative thinking
Design for sustainability
Transitions

In the field of Psychology, two types of empathy may be distinguished: Cognitive Empathy (*knowing*) and Affective Empathy (*feeling*). The first refers to the potential one has to understand someone's else reality or emotional state, and the second is the potential one has to recognize similarities one shares with someone else. Because they do not have a shared definition of empathy, designers continue to develop new tools that are "materially and phenomenologically distinct, existing as a point solution in a broad space of possible designs" (Pratte et al., 2021, Introduction section, para. 2). The development of new tools with limited awareness of previous knowledge usually leads to the repetition of past mistakes. Empathy has been in vogue as a critical component studied and discussed as an important skill that designers and engineers need to understand to solve problems from the perspective of their users. There are several traditional ways for product designers and engineers to solve problems that focus on empathy such as *User-centered design* (UCD), which involves end-users of design to create useful, usable, and enjoyable products. Research shows that it improves satisfaction, usability, and outcomes (Hassenzahl et al., 2010); *Contextual inquiry* observes users in their environment for empathetic design solutions (Beyer & Holtzblatt, 1998); *Personas* represent user groups' needs, goals, and behaviour to guide design decisions (Cooper, 1999); *Empathy mapping* identifies user experiences to address areas of frustration or confusion (Gray & Brown, 2010). Empathy is used by product designers and engineers to understand and solve problems from the perspective of their users.

However, research has shown that designers and engineers may not always have enough empathy to fully understand and address users' needs. Designers and engineers can rely on assumptions and biases, ignoring user input and feedback, which leads to incomplete design solutions and even new problems (Desmet & Pohlmeyer, 2013). Limited understanding of user experiences and needs, particularly for diverse users, can result in non-inclusive designs perpetuating biases and inequalities (Apte et al., 2018). Designers may rely on stereotypes and assumptions rather than seeking diverse input, resulting in designs that do not meet users' needs (Jung et al., 2016). Medical device design research reveals that engineers may not understand patient and healthcare provider needs, leading to ineffective and unfriendly designs (Hancock et al., 2011). In designing for social impact, designers may neglect stakeholder and community input, leading to solutions that fail to address the root causes of social problems (Kimbell, 2011). In summary, the above-mentioned studies imply that designers and engineers may lack sufficient empathy to effectively address people's problems. There is some debate among researchers about whether empathy is a fixed trait based on an individual's personality or whether it can be enhanced through training and practice. Although some evidence suggests that certain components of empathy may be innate, such as the capacity to identify emotions in others, other aspects such as compassionate behaviour and perspective-taking may be more adaptable and receptive to training (Eisenberg & Miller, 1987; de Waal, 2008). Studies have demonstrated that programs designed to

diid No. 79 — 2023
Doi: 10.30682/diid7923h

enhance empathy can be successful in improving different dimensions of empathy, including identifying emotions, adopting different perspectives, and expressing compassionate behaviour (Chen et al., 2011; Davis et al., 1996; Hoffman, 2000). Nevertheless, the efficacy of these programs might rely on different factors, such as the length and content of the training, the trainee's age and personality, and the context of the training (Decety & Cowell, 2014).

The marketable use of empathy so common these days may have overshadowed the development of vital skills such as Critical and Creative Thinking. Recent research from OECD (2022) has indicated that "more significant(ly) is the qualitative mismatch between the skills demand generated by the economic and social reality in labour markets and societies, and the supply of skills by higher education institutions" (Van Damme & Zahner, 2022, p. 15). The importance of focusing on the products developed by these professionals was pointed out by Papanek (1972) "There are professions more harmful than industrial design, but only a few of them". The economic and environmental crisis propagated throughout the world declares that replacing capitalism is overdue and a new system that considers this planet's boundaries shall be set. Product designers and engineers need to shift their focus towards sustainable practices as the current systems and mentalities that have caused wicked problems such as pollution and global warming cannot solve them (Rittel & Webber, 1973). Focusing strongly on profit in product design and engineering can negatively impact sustainability in several ways. It can result in the development of non-sustainable products, products that do not meet user needs, a lack of investment in sustainable design, and a culture that prioritises efficiency over sustainability. These factors can lead to short-term gains at the expense of long-term sustainability and user satisfaction. To address this issue, product designers and engineers should adopt a sustainable approach (Heskett, 2005; Kimbell, 2011; Tilley et al., 2017).

The present study aims to answer the following research questions:

1 Is the current tertiary education in PDE providing students with adequate critical thinking (CriT) and creative thinking (CreT) skills to meet the current demands of the field?

2 Should CriT and CreT skill levels increase when tackling wicked problems?

Additionally, the research seeks to demonstrate the importance of developing these skills in tertiary students to address wicked problems and integrate sustainability considerations into design education.

Critical and Creative Thinking

Research suggests that developing the critical thinking (CriT) and creative thinking (CreT) abilities of product design and engineering students is crucial for their success in academic and professional pursuits. For example, studies have found that integrating CriT and CreT in the solution development process of programmatic design exercises can lead to more impactful and original solutions to wicked problems that are complex and challenging (Gero et al., 2018; Tseng

et al., 2011). In addition, the development of CriT and CreT skills can help students become more proficient learners, adept problem-solvers and inventive thinkers, which are crucial competencies in the rapidly changing landscape of product design and engineering (Liu et al., 2021). However, research suggests that CriT and CreT are not always explicitly taught in product design and engineering programs (Liu et al., 2021). Therefore, it is important for educators in these fields to consider incorporating explicit CriT and CreT instruction in their courses and programs (Gero et al., 2018). By doing so, educators can better equip students with the skills they need to tackle wicked problems and contribute to the development of more sustainable and innovative products.

Shively's rubrics for CriT and CreT have been widely adopted in education and have been subject to several studies. One study by Çiltaş and Tarhan (2019) evaluated the use of Shively's rubrics for assessing students' critical thinking skills in a higher education course and found that the rubrics provided a clear and concise framework for assessment. The study also noted the adaptability of the rubrics for use in different contexts and subjects. A study by Kuo et al. (2020) examined the effectiveness of using Shively's rubrics to evaluate the critical and creative thinking skills of graduate students in a digital game-based learning course. The authors found that the rubrics were useful in assessing students' thinking skills and promoting reflection on their learning. The studies reviewed for this paper examined the effectiveness of using Shively's rubrics to assess CriT and CreT skills in different educational contexts: Gao and Zhang (2019) found that the rubrics were effective in evaluating the thinking skills of students in an engineering graphics course; Kuo et al. (2020) found that the rubrics were useful in assessing the thinking skills of graduate students in a digital game-based learning course; Peng and Zhang (2020) found that the rubrics were effective in providing feedback on the thinking skills of undergraduate students in an educational technology course; Tavakol and Rezvani (2020) found that the rubrics were effective in evaluating the thinking skills of undergraduate students in a course on management accounting. Overall, these studies suggest that Shively's rubrics are a useful tool for evaluating CriT and CreT skills in a variety of educational settings.

The two rubrics in question were developed by Shively (2018), one for CriT Tab. I and the other for CreT Tab. II, with a total of 14 criteria (8 for CriT and 6 for CreT), which were used in the present study to evaluate the level of these skills in Product Design and Engineering students. The rubrics presented several advantages, including a clear and concise framework for assessing these skills, comprehensive coverage of a broad range of skills, versatility, and adaptability to different contexts and subjects.

	Novice	Developing	Expert
Summerizes topic or argument	Does not organize information, leading to inadequate understanding	Inconsistently demonstrates ability to organize information, leading to inadequate understanding	Consistently demonstrates ability to organize information, leading to adequate understanding
Considers previous assumptions	Assumptions are defined, but not explained as having significance to the position	Assumptions are defined and linked to topic ideas, but not clearly explained or elaborated upon	Assumptions are defined and linked to topic ideas, but not clearly explained or elaborated upon
Communicates point of view	Does not identifies own position on the issue	Identifies own position on the issue, drawing support from experience	Identifies own position on the issue, drawing support from experience, and information not available from assigned sources
Provides evidence of research	No evidence provided to support argument	Accepts evidence at face-value, even if incorrect, inadequate, or misrepresented to support argument	Information is gathered from appropriate and credible sources to support argument
Analyses data	No analyses of a topic. Student only lists or defines concepts of topic	Demonstrates ability to analyse and make interpretations of topic	Demonstrates ability to analyse and elaborate on interpretations of topic
Considers other perspectives and positions	No identification of other perspectives and positions	Identifies other perspectives and positions	Identifies and assesses other perspectives and positions
Draw implications	Cannot ecxplain or testify to the impact of new information	Explains od testifies to the impact of new information	Explains the impact of learning new information, making predictions, and generates new ideas.
Assesses conclusions	No reflection of idea evolution on argument development	Limited reflection of idea evolution on argument development	Extensive reflection of idea evolution on argument development

Tab. I

	Novice	Developing	Expert
Fluency	Students considered one idea	Students considered 3 to 5[1] ideas	Students considered 5 or more ideas
Flexibility	Strudents considered one type of idea	Students considered one several tseveral types of ideas	Students considered many types of ideas
Originality	Students developed a common idea that many other students would have suggested and/or replicated and existing ideas	Students developed a interesting idea that several other students woulc have suggested and/or minimally added onto an existing idea	Students developed a unique idea that few other students suggested and/or substantially built upon an existing idea in a unique way
Elaboration	Students added minimal details and improvements to their ideas	Students added a few details and improvements to their ideas	Students added many details and improvements to their ideas
Usefulness	Students proposed ideas that may meet the end-user's needs in certain conditions	Students proposed ideas that would meet the end-user's needs	Students proiposed ideas that would meet the end-user's needs and significantly add value to their ideas
Specific creativity strategy[2]	Students randomly selected and implemented a creative thinking strategy, and/or they were unable to leverage the strategy to improve their ideas	Students selected and implemented a creative thinbking strategy to develop their ideas. They explained now the strategy supported creativity	Students deliberately selected and implemented a creative thinking strategy to develop their ideas. They explained how the strategy supported their creativity

Tab. II

Tab. I
Gallindo, V. Components of Critical Thinking (CriT) to Develop Assessment Criteria and their level of expertise. Source: Shively et al., 2018, p. 153.

Tab. II
Gallindo, V. Sample Rubric Anchoring Assessment Criteria on the Definition of Creativity. Source: Shively et al., 2018, p. 151.

Both rubrics consist of three levels: *Novice*, *Developing*, and *Expert*. *Novice* level criteria focus on identifying the problem and basic description, while *Developing* level criteria focus on the analysis of the problem and development of alternative solutions. The *Expert* level criteria focus on the evaluation and synthesis of ideas to provide original and creative solutions to the problem. The rubrics provide clear expectations for evaluating student work.

Design for Sustainability (DfS)

The author sees sustainability as balancing economic, social, and environmental factors to meet present needs while ensuring long-term resource and ecosystem viability for future generations. The goal of sustainability as viewed in this paper is to create a world where people can live well and enjoy quality of life while also protecting the planet's natural systems and resources. The UNESCO 2030 Agenda (Binagwaho, 2022) asks Higher Education Institutions (HEI) a critical question that is relevant to this paper: "How do we start thinking of alternative futures in campuses worldwide?" (p. 8). The evolution of Design for Sustainable Solutions expresses the growing awareness of design practice and its consequences on society at large, through the lens of Design for sustainability (DfS). As noted by Irwin et al. (2022), Designers now grasp the complexity of human problems, innovating businesses via strategic design and contributing to governance and policy in social sectors. Product design and engineering education are increasingly recognizing the importance of sustainability in reducing environmental impacts, increasing resource efficiency, and improving the overall sustainability of products. To assist designers and educators in integrating sustainability into their work, Ceschin and Gaziulusoy (2019) developed the Design for Sustainability (DfS) framework. The framework includes five levels:

- Material/Component Innovation: Develop, replace, and enhance materials to improve products.
- Product Innovation: Create new products considering their entire life cycle.
- Product-Service System Innovation: Combine products, services, value chains, and business models.
- Spatio-Social Innovation: Address innovation in human settlements and communities.
- Socio-Technical System Innovation: Promote radical changes in fulfilling societal needs to support transitions to new systems.

In this paper, we simplified the interconnected levels of innovation, reducing them to three. The first level improves individual product quality and life cycle through new or enhanced materials. It also involves developing new or improved products. The second level integrates products, services, stakeholders, value chains, and business models, and considers innovation in settlements and communities. The third level promotes radical changes in meeting societal needs and transitioning to new socio-technical systems.

Methods

The methodology details the experiment conducted in workshops across three countries with 74 participants. The participants received a design brief and presented their solutions, which were evaluated using rubrics by Shively for CriT and CreT after 3 to 5 minutes. Additionally, the sustainability of the solutions was assessed using a multi-level framework developed by Ceschin and Gaziulusoy and graded by expert judges. The participants were divided into two groups, A and B, tasked with finding profitable solutions and solutions that consider their impact on the ecosystem, respectively. The study began in early 2022 and will continue until late 2023. The participants consisted of 53 final-year undergraduate students and 21 first-year master's degree students from international programs in PDE without industry experience. Of the participants, 41 were female, 32 were male, 1 chose not to disclose their gender, and the age range was from 20 to 29 years old. Participants were randomly assigned to groups A and B, with 45 and 29 participants, respectively, tasked with designing a COVID-19 resilient classroom for PDE students or future pandemics. The brief evaluated the students' creativity and critical thinking skills on a familiar topic, with Group A proposing a profitable and attractive solution, while Group B prioritised the well-being of the planet.

Case Study — Results

The authors invited international universities from Brazil, Portugal, and India to participate in a 2-hour problem-solving workshop. The workshops were conducted in-person with local professors as judges and virtually guided by the main author of the paper, with student participants. The students were briefed on the workshop steps, then divided into Group A and B, instructed to work independently, and use the internet for research. Each student received physical briefings from their local professor with identical information, except for the group-specific objectives. Group A proposed a profitable and attractive solution, while Group B prioritised the well-being of the planet, including human and non-human life, as well as future generations. Participants had 30 minutes to develop solutions, followed by 3 to 5 minutes each to present their mental process leading to the solution. The workshop capped participation at 20 individuals to stay within the 2-hour time limit. Participants were free to propose solutions that met the briefing's requirements, from material/component enhancements to complex socio-technical systems. Each solution developed by participants was analysed and classified by expert judges based on the DfS framework by Ceschin and Gaziulusoy (2019) visualised in their original 5 levels of innovation Fig. 1.

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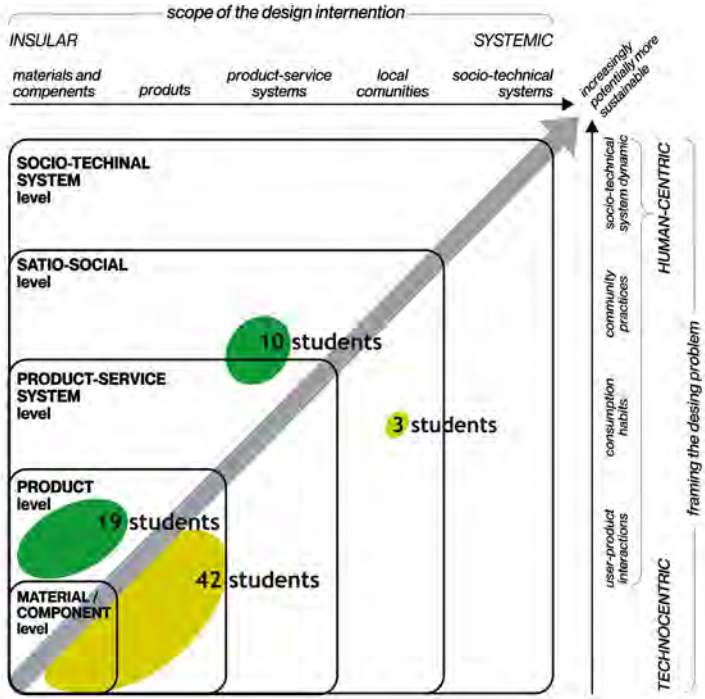

Fig. 1

From Group A, 42 students are at Level 1 and 3 are at Level 2 DfS, while for Group B, there are 19 at Level 1 and 10 at Level 2. Sustainability-focused problem-solving enhances DfS skills in product design education; the Sustainability-focused group has more Level 2 DfS students, indicating higher skill development. Most students in both groups have Level 1 DfS skills, indicating a need for improvement in design and engineering education. Improving CriT and CreT may enhance DfS skill development [figure 02]. Group B had a higher average CriT of 2.33 and DfS of 1.5 than Group A's average CriT of 1.78 and DfS of 1.18, highlighting the significance of sustainability in developing critical thinking and design for sustainability skills in product design.

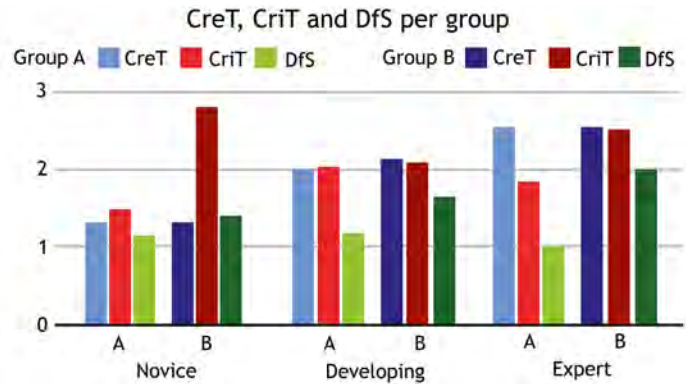

Fig. 2

Fig. 1
Classifying solutions from Groups A and B on the DfS multilevel framework. Groups A and B are denoted by yellow and green circles respectively. Circle sizes indicate the number of students at each level. Source: Viviane Gallindo.

Fig. 2
Correlation between CreT, CriT and DfS for Groups A and B. Group A represented by yellow circles and Group B by green circles. Circle sizes visually represent the number of students at that specific level. Source: Viviane Gallindo.

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The data shows a correlation between thinking level and CreT, CriT, and DfS. Novice students (n=43) scored lower: CreT 1.32, CriT 2.13, DfS 1.29. Developing students (n=27) scored higher: CreT 2.06, CriT 2.03, DfS 1.41. Experts (n=4) scored highest: CreT 2.52, CriT 2.15, DfS 1.5. Incorporating sustainability in product design education can improve critical thinking and design for sustainability skills. Designing curricula and assessments to consider these levels can enhance skill development among undergraduates. Practical implications exist for educators and industry practitioners in developing wicked problem-solving skills in product design and engineering.

Conclusion

The study aimed to demonstrate the importance of developing CriT, CreT, and DfS skills in students from tertiary education to address wicked problems by integrating a specific assessment into design education. Findings showed that (1) assessment of CreT and CriT levels are majoritarily, at the lowest levels, which corroborates with OECD (2022) report's findings; and, (2) that there is a positive correlation between thinking level skills and their level of sustainable innovation. This study supports OECD's recent research (2022) highlighting the need for a well-rounded education including CriT and CreT for DfS. A holistic approach to product design was emphasised, and rubrics covered the most important aspects of PDE, empowering students. Overall, this qualitative study offers industry and society transparency regarding the development and levels of CreT and CriT skills, contributing to the ongoing discussion about the importance of assessing and developing these skills in tertiary education.

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Design as/for Common(s): Decolonial Participatory Experiences for Post-Capitalist Resilient Future(s)

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Abstract
The catastrophic effects of the Anthropocene are evident. Manifestations of crisis are not only environmental, but also economic, social, political and ethical: combined with the dystopian imaginaries of the future, they suggest the need for a paradigm shift. The Commons are seen as an alternative for a transition to a post-capitalist economy. Yet, Design for social innovation is understood as a humanitarian action and remains linked to the logic of commodification; reason why some call for decolonizing Design from Western abstractions. The focus is on the relationship between Design and Commons, with particular attention to decolonial thinking. Following an action research approach that consisted in "inhabiting" the oasis of Chenini in Tunisia as a Commons in crisis, the idea was to understand the role of Design in the paradigm shift from an extractivist growth economy to a resource economy; Design as attached to situations rather than objects.

Keywords
Design
Common(s)
Anthropocene
Post-Capitalism
(Tunisian) Oases

The latest report by the Intergovernmental Panel on Climate Change (IPCC) (2021) confirms that human activities have been responsible for global warming since the late 19th century, and that we have limited time to reverse the current trajectory to stay within the 1.5°C warming limit to avoid uncontrollable changes. The term Anthropocene refers to the current geological era, in which our species is the primary driver of global environmental change and the primary geological force on Earth (Crutzen, 2000). However, we should go beyond the geological specification of the Anthropocene to view our industrialised present as part of a much longer timeline in the planet's history. The crisis is not only environmental but also economic, social, political, and ethical, suggesting the need for a paradigm shift. In the context of the Anthropocene, Design is called upon to reinvent itself. It is at the centre of unsustainable production/consumption systems; however, in many of its contemporary forms, it aims to improve the habitability of the world as a projector or corrector (Bonnet et al., 2019). Papanek (1971) sounded the alarm about the need for responsible and sustainable Design. Theory and practice around social Design evolved since the 2000s, indicating a movement toward change in the Design practice (Manzini & Jegou, 2003; Margolin & Margolin, 2002; Meroni, 2007; Thorpe, 2010). However, Human-centred Design and Design Thinking are still intrinsically rooted in artefact-centred Design and solution-centred paradigms (Tonkinwise, 2015; Tunstall, 2013). Designers seem to maintain a dual posture of guiltiness and bipolarity when addressing the question of sustainability. They are trying to pursue a "socialist" and a "capitalist" practice at the same time (Vial, 2010). The idea of doing Design for the "good of others" became real but also lucrative (Taboada et al., 2020). Design for Social Innovation appears to be more about achieving a feel-good effect than actually producing meaningful political change. Elzenbaumer (2013) denounces such practices, which are devoid of a political sense, taking for granted the social problems that the designers want to solve, not questioning the broader global mechanisms that produce them. Fry (2010) asks how designers can be providers of care by transforming themselves into politicised agents of change.

Many are dissatisfied with the term Anthropocene, considering it to be reductive, because it evades the real question i.e. what policies can anticipate the catastrophe enough to keep our futures open. Alternative terms, such as Capitalocene, Eurocene, or Technocene (Moore, 2016; Sloterdijk, 2015) have been suggested to highlight the side effects of capitalism and technological advancements on the planet, which should be laid at the door of European civilization and its technocratic elite. It would therefore be necessary to learn to die — as a civilization — to adapt to this strange new world, have new ideas, new myths, and new stories, a new way of thinking about our collective existence beyond and against capitalism (Scranton, 2015). The unsustainability of capitalism as a system of endless accumulation and compound growth has been denounced by many scholars, claiming it would lead to collapse (Meadows et al., 1972; Klein, 2014; Harvey, 2017; Patel & Moore, 2017). Inequality, injustice, and unsustainability have clearly been aggravated by capitalism's

recent phase of accelerated expansion (Rockstrom et al., 2009; Piketty, 2014; Steffen et al., 2015). The fact is that neoliberalism is not in crisis; crises seem to play a constructive or even constitutive role under neoliberalism (Saad-Filho, 2019). The rise of neoliberalism and Design are inter-connected, as Design serves the dual purpose of producing commodities for sale and making social, economic, and political changes appear reasonable (Julier, 2017). However, Heskett (2017) argues that the neoclassical (neoliberal) economic approach and Design are incompatible in terms of the notion of value. Neoclassical economics fails to grasp the true essence of Design, which is concerned with pushing boundaries and envisioning the future and reduces it to a mere production of commodities. However, critical social engagement in Design is often sacrificed to meet market demands, highlighting the precarious qualities of Design within contemporary capitalism (Elzenbaumer, 2013). This would be due to a crisis of imagination, where all values are subordinated to the value of money, and where even creativity has been integrated into the capitalist imagination through the rise of the creative economy (Haiven, 2014) or what Harvey (2017) calls "cognitive Capitalism."

The decolonisation of imagination has been proposed as a means to challenge the paradigms of modernity and development, which are seen as instruments of colonisation perpetuating the culture of consumption and mass production that originate in a Western-centric worldview (Latouche, 2002; Shiva, 1989; Sachs, 1992; Escobar, 1995; Rahnema, 1997). Examining structures such as colonialism can help to creatively reimagine the social relations that have led to the Anthropocene. Mignolo (2009) calls this epistemic disobedience, which involves refusing modernity and the "illusion of the zero-point epistemology" (Castro-Gómez, 2005). It assumes that European colonialism exercised violence not only physically and economically but also epistemically. Design, as a product of modernity, reproduces these mechanisms and serves a homogenising ontology that negates the aesthetic, functional, and cultural values of non-Western Design, craft, and art traditions, acting as a collaborative and oppressive force that reproduces ideas through symbolic violence (Boenhert et al., 2016; Tlostanova, 2017).

The (Re)Emergence of the Commons & Utopia: Implications for Design

Haraway (2016) proposed the concept of Chthulucene as a way to learn to live and die in response-ability on a damaged earth, to replace the Anthropocene. The question for designers is how to approach the state of the Anthropocene. One possibility is for Design to recognize the structural unsustainability of human fabrication and start at the end (Fry, 2020), acknowledging the process of defuturing as a new Design philosophy. This would entail the negation of world futures for humans and non-human entities. It has been suggested that we are entering an era of mutual aid (Servigne & Stevens, 2015) where collapse may not lead to chaos but instead create conditions in which humans act altruistically. New materialist environmental movements (Schlosberg & Coles, 2015) are also challenging the status quo by building small systems that can better withstand future economic,

social, and ecological shocks. The Degrowth movement and the Transition Town Network are examples from the Global North, while in the Global South, the Buen Vivir movement (Merino, 2016), Via Campesina (Martínez-Torres & Rosset, 2008) and Ecological Swaraj (Kothari et al., 2014) are promoting alternative societal concepts based on pre-capitalism, peasant agriculture for food sovereignty and permanence. Sharing, simplicity, conviviality, care, and the Commons are the terms used to describe these alternative futures (D'Alisa et al., 2015). The Commons is recognized as a link between all these different narratives and visions of transition that attempt to think beyond the logic of development or growth (Escobar, 2015).

The concept of the Commons has been explored in three different themes: Common Pool Resources (Ostrom, 1990), New Commons, and activist/political Commons. Common Pool Resources refer to shared natural resources vulnerable to social dilemmas (Hess & Ostrom, 2007), while the emergence of the network society and the internet gave rise to the New Commons, which embraces free software and Creative Commons licences (Hess, 2008). The activist/political conception sees the Commons not as shared resources, but as a relational quality that promotes social, ecological, economic, and political change (De Angelis, 2017; Midnight Notes, 1990). The community economies approach challenges the conventional use of the economy and focuses on commoning as a process (Gibson-Graham et al., 2013). These perspectives may lead to a new attitude in designers. The emergence of movements around the Commons presents political alternatives that respond to the imagination of collapse. These initiatives call for a new attitude among designers, such as Denoual's (2020) proposal for a Designer "objectant" who adopts an active reflexive approach. Designers need to resist, to slow down and give people pause. Rigot and Strayer (2020) propose a return to the '70s, as a pivotal moment in the history of Design that offered a very relevant point of view for positioning Design and economy in the face of collapse. Through a re-evaluation of Meadows's report on the limits to growth and a re-reading of Maldonado and Papanek, they propose an idea of Design that involves an economy of resources and not of growth. Like a growing number of Design theorists, they emphasise the need for a rapprochement between economics and Design (Boehnert, 2018; Heskett, 2017; Julier, 2017). In this sense, new approaches in Design are emerging; the most interesting phenomenon is Design for Permaculture or better yet the Permaculture seen as a particular form of Design activism (Fuad-Luke, 2009). The connection between Design and Permaculture was most recently made clear (Cassel & Cousineau, 2018). Permaculture has influenced and inspired the Transition Town movement, which in turn has influenced the birth of Transition Design (Irwin, 2015). The new approach calls for compelling future visions as a requisite of societal transition, by reframing wicked problems, as a first step, within larger space-time contexts. As with natural systems, Transition Design acknowledges the importance of knowledge and a slow pace in order to achieve resilience. From the Global South, the Autonomous Design proposed by Escobar (2018) centres on autonomy and the realisation of the communal, where designers could play a constructive role in the ontological and political reorientation of Design as an element in the struggles for autonomy.

The Anthropocene and its crisis of imagination challenge designers to adopt new approaches that recognize and resist the destructive forces of modernity and embrace a more sustainable and equitable future. The notion of Epistemologies of the South (Santos, 2014) offers critical anti-colonial, anti-capitalist, and anti-patriarchal visions to challenge the dominant Eurocentric view of Design. A shift towards a pluriversal perspective requires rejecting the illusion of objectivity and neutrality underlying scientific knowledge, and the idea of "help" in Design for social innovation (Busch & Palmås, 2016; Nussbaum, 2010; Tunstall, 2013) as a means of perpetuating power imbalances (Freire, 1970), as well as a recognition of the diverse and complex social relations that led to the Anthropocene (Ansari, 2016; Fry & Willis, 2017; Tunstall, 2013; Vaszquez, 2017). This shift requires a refusal of modernity and the illusion of objectivity, neutrality, and detachment underlying the universality of enlightened scientific knowledge. Some authors argue that real creativity is a collective and common pursuit (Haiven & Khasnabish, 2014; Marttila et al., 2014; Teli, 2015; Teli et al., 2020). This alters the perspective of Participatory Design moving it towards new forms such as Speculative Design (Dunne & Raby, 2013) or Design in the service of prefigurative politics (DiSalvo, 2016). Recalling the notion of Radical Imagination defined as a "common imagination" (Haiven, 2014), this rooted Design would involve three temporalities: past (searching for Commons as a historical actuality held in common memory); present (recognizing, enhancing and defending even the undercurrent of today's Commons); future (acknowledging that the ultimate horizon for humanity beyond capitalism is the Commons).

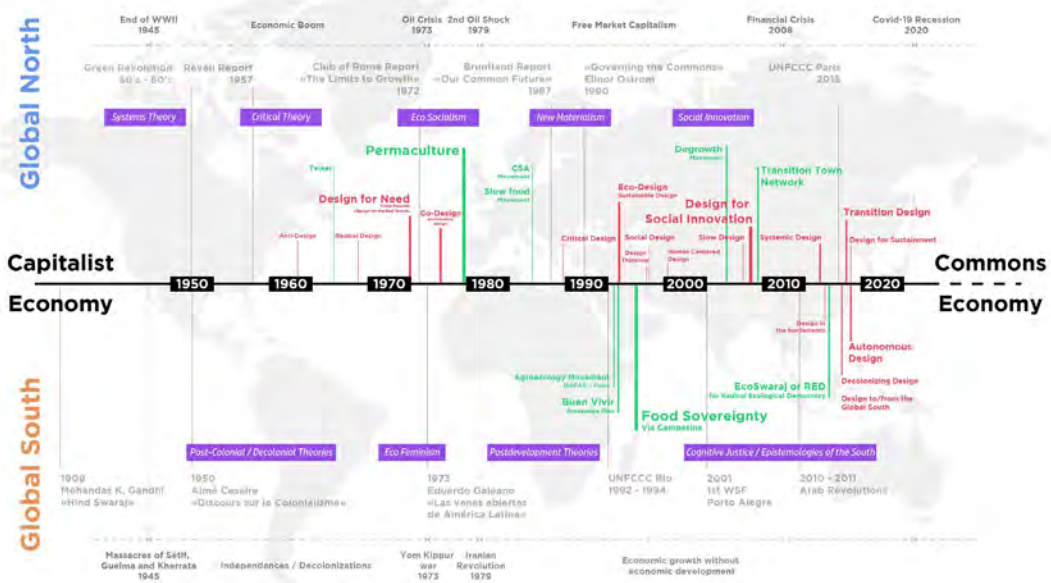

Fig. 1
New Materialist Movements and Alternative Design Practices in the Global North and South. Personal elaboration.

Environmentalism of the Poor and Food Sovereignty in Tunisia: The Oases Context

The Tunisian context was chosen as a sample from the Global South suffering the effects of Global Capitalism. Recent literature clearly links migration to the challenge of food security and climate change (FAO, 2018). Indeed, one could guess the beginnings of a political ecology in Tunisia (Robert, 2021) with the rise of environmentalist movements fighting for their livelihood.

This Environmentalism of the Poor (Martinez-Alier, 2002), would lead to inevitable ecological conflicts which are legion in Tunisia, around access to resources and the living environment. Several voices are calling for real change in the trajectory of the country's economic model, to reflect on new ways of developing the agri-food system, build food sovereignty and remedy the effects of dependent/exporting agriculture (Schwoob & Elloumi, 2018; Abidi & Riahi, 2019), thus moving away from the methods advocated by the Green Revolution.

The research has been interested in the specific contexts of oases as perfect illustrations of resilience and sustainability; they have been present for centuries and have been able to adapt to the many shocks (climatic, political, economic, etc.) that the region has experienced throughout its history (Cheneval & Michel-Queirel, 2015). Oases are sustainable spaces by definition, where the Commons are fundamentally a tradition and constitute a rich historical and cultural heritage. Today, oases are experiencing the effects of climate change, but also those of Global Capitalism, which have disrupted the social fabric around Commons. We can say that they are Commons/community economies in crisis.

We focused on the case of Chenini as a landmark of the social and environmental movements that have developed in Tunisia since the revolution. Chenini is located in the coastal area of Gabes, known for the pollution it suffers (and protest actions against it), caused by chemical fertiliser production, where farmers continue to preserve local seeds and perpetuate ancestral practices of flat cultivation. Considering the recent developments in the field of Design, we have tried to question its role through the analysis and direct application to the case of Chenini.

Fig. 2
Robert, D. Report in Gabes: Immersion in the heart of the citizen fight against pollution. Stop Pollution Protests in Gabes. Source: www.nawaat.com

Method

This research was conducted in the context of a Ph.D. research study and took into consideration the intricacy of all the themes mentioned above. I was not clear about an appropriate approach to adopt, however, I felt inclined towards several approaches: Participatory Design and its concepts of infrastructuring and commoning (Marttila et al., 2014); Transition Design (Irwin, 2015) for its idea of long-term intervention and visioning by providing a process for stakeholders to transcend their differences in the present by co-creating visions of a shared and desirable long-term future; Autonomous Design (Escobar, 2018) since it focuses on the struggles of communities and social movements to defend their territories and worlds against the ravages of neoliberal globalisation; Design for Sustainment and what Fry (2009) calls "dig where you stand"; or Prefigurative Design (DiSalvo, 2016), Design that could make political speculation easier to live, experiment with, and ultimately implement, where designers are not personally called to speculate, but can be called upon rather to enable speculation.

Interestingly, all of these approaches adopt a decolonial stance, which is undoubtedly the attitude taken during this field experiment. What I did know, however, was that there was no universal method or tools to apply as advocated by the Human Centred Design (HCD) and Design Thinking approaches. I also understood that Design for Social Innovation tends to frame problems within relatively narrow spatio-temporal contexts (Irwin, 2018). To help see more clearly, I contacted several researchers in and outside of Design working either on the same theme of applying Design in relation to Commons or more broadly on the different Design approaches mentioned above.

My conviction was that people in the context I was visiting already knew the problems. The initial hypothesis was that the role of Design was to enable speculation and co-envisioned futures that were relevant to them. The idea was a priori simple, I did not know what type of Design to practise or if it would still be Design, but I knew that faced with the future climate risks in addition to the damage already perpetrated by the chemical industry in the case of Chenini (Gabes), it was undoubtedly necessary to envision new horizons. "Radical Imagination", "Epistemologies of the South" and "Situated Knowledge" could be conceptual notions acting as landmarks to fulfil such a project. The chosen approach was finally that of "inhabitation", inspired by Rogoff's reflection on how meaning is produced differently through the multiple relationships that are generated when living through things (Elzenbaumer, 2013).

The research carried out a collaborative Design experiment rooted in the present, adopting a post-development/feminist line of thought. It took into consideration the concepts of "Radical Imagination", "Epistemologies of the South" and "Situated Knowledge" as conceptual notions. Following an auto-ethnographic process , observation, conversations and unstructured interviews were developed. The Ethnographic Experiential Futures (EXF) cycle (Candy & Kornett, 2019), a hybrid framework between futures studies and Design, helped to structure the intervention on the field.

The stay in the city of Gabes lasted 5 weeks (from April 22 to May 29, 2021); people were coming out of a period of confinement and were required to respect a curfew imposed at 8 pm. These conditions played an important role in the organisation on the field. The bicycle was the most convenient means of transportation through the narrow tracks of the oasis. The first 4 weeks consisted of a series of bike tours where I went from meeting to meeting building up a substantial address book. I planned the meetings day by day according to the availability of each one.

The "ride" from Gabes to Chenini is about 7 km, which was quite practical to explore the oasis, and its different areas (urban, agricultural). Knowing the place, speaking the local dialect, and having family in Chenini (and in Gabes more generally) helped a lot to make the first contact. On the other hand, it was also complicated to maintain an objective distance during the different discussions. Very quickly, I met key people, active in civil society, who allowed me to understand the problems of the oasis in-depth and in a tangible way . I also met other researchers and activists who were interested in the case of Chenini, networking with local associations and institutions.

Therefore, while I saw all these people living their lives and fulfilling their activities, they saw me pursuing my research: meeting people, networking, and conducting interviews to explore the local culture and history of commoning practices in the oasis. Based on the conversations and stories of the past I had during the stay, I noticed that the oasis (and its water) were marked by two major events: the French colonisation in the first place, then the advent of independent Tunisia, and probably the most significant fact, the construction of the Tunisian Chemical Group (GCT). The elders recounted that during the French colonisation, Chenini was one of the bastions of the resistance and the last one to fall after Jara and Menzel. Chenini was strategic because of the water. Taking control of Chenini meant taking control of the water in the whole area and consequently taking control of the totality of Gabes. The French would have understood from the beginning the importance of water (which flowed at a rate of 700 L/s) in this region by forbidding digging or drilling in a radius of 30 km around Gabes. Elders also spoke of old practices of commoning such as "Raghata" (neighbours meeting on each other's plots to divide the work and go faster), "Kholleta" (a system of contributions to buy this or that commodity) and "Hassaba" (a system of sharing the meat in equal parts when slaughtering cattle).

When speaking about the past of the oasis and the question of solidarity, everyone agrees that it was better before. Before what? All of them situate the disappearance of water around the 1970s; just after the establishment of the Groupe Chimique Tunisien (GCT) in 1972. During the stay, I was able to discover a certain (albeit biased) history of water in Chenini and see the close links between this history and the ancestral practices of commoning and mutual aid. These practices were lost little by little after the introduction of the chemical industry in Gabes. In my opinion, Gabes and Chenini are simply the victims of the global capitalist system. As in all the peripheries, the local populations suffer the effects of extractivism and dispossession hidden in discourses of modernity and development (Federici, 2019)

diid No. 79 — 2023
Doi: 10.30682/diid7923i

After 4 weeks of Inhabitation, I identified the different actors in the territory using rapid ethnography, observation, and unstructured interviews; we followed Textor's (1980) Ethnographic Futures Research model (EFR), conducting a series of interviews to draw out participants' projections.

I also identified 5 recurrent problems:

1 Water scarcity and groundwater depletion
2 Land parcelling and the question of inheritance
3 Increasing anarchic urbanisation
4 Reluctance of young people to practise agriculture and loss of ancestral knowledge
5 Lack of coordination between the actors of the territory

Futur: Chenini 2050 Workshop
First Day: Discussing Issues and Challenges of the Oasis

The question was not to define the problems and to map them with their different levels of complexity, which the locals knew as much as we did, if not more. The workshop was rather about the transition of Chenini towards food and energy self-sufficiency by 2050, i.e., within a generation. This first day could correspond to the "critical phase" of a Future Workshop (Jungk & Müllert, 1987). We also had to take into consideration the barriers to dialogue between men/women and old/young people. We were aware that this first meeting was only the beginning of a long series of workshops to be organised in the future. The participants chose to sit in a semicircle in order to discuss and classify issues by importance but also to define responsibilities.

We thought it was appropriate to talk about the work of Meadows and the theory of collapse. The idea was to describe a possible future scenario of collapse and the risk of seeing the oasis disappear, given the increase of climatic risks in Tunisia and the MENA zone in general. This would correspond to the "map phase" of the EXF framework. We introduced the work of Gibson-Graham using the iceberg diagram, which is used to reframe the economy. We adapted the diagram to include all the ancient practices of commoning and mutual aid that the elders had told us about. The first day ended with the screening of a series of videos. This could in some ways correspond to the "multiply phase" of the EXF framework.

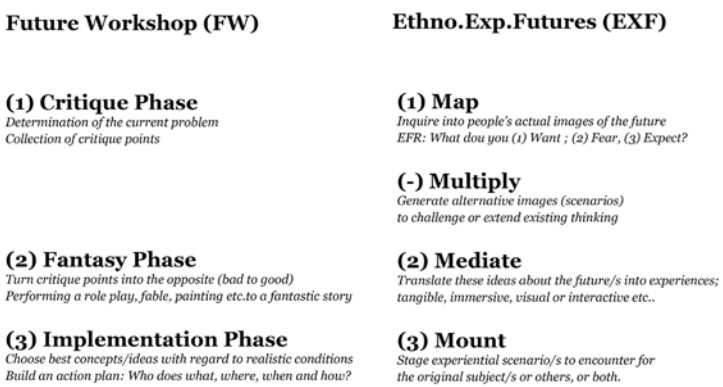

Fig. 3
A combination between the Future Workshop and the EXF protocols. Personal elaboration.

Second Day: Inviting People to Speculate for Themselves

We moved to the "fantasy phase" which could also correspond to the "mediate and mount phases" merged into one step. We summarised the talks of the first day and stated the points we had discussed, taking care, following the Future Workshop method, to turn them into positive points; turn critical points into the opposite (bad to good) as starting points.

In the "fantasy phase", the participants had to imagine a preferable future in light of the present and future constraints. Rather than focusing this phase on the creation of artefacts, we wanted to bring back to the forefront the ancient practice of "Khrafa" (the practice of telling tales) and the figure of the "Hakawati" (the storyteller) focusing on the oral aspect. Far from a rigid and serious exercise, the intention was to push the participants to imagine their future in a participative way. Each group took one of the 5 themes and developed a kind of story. This would be in line with the first phase of the Transition Design approach and the idea of co-creating visions of a shared and desirable long-term future.

Fig. 4
First day of the workshop.

Fig. 5
Second day of the workshop.

diid No. 79 — 2023
Doi: 10.30682/diid7923i

1 The first group to tell their story was the one that dealt with the theme “Young farmers and intergenerational dialogue”. In 2050 the inhabitants of Chenini would have agreed on an “ethical charter” based on the principles of mutual aid and governing the passage of ancestral knowledge between generations and between genders, blurring the differences between young and old as well as between men and women. The first Hakawati told us the story of Chenini becoming a “Smart Oasis” where IoT would be used, of a soilless agriculture that would respond to the constraints related to the narrowness of the plots, of machines that would help farmers pollinate the palm trees, avoiding the risks related to climbing the trees in view of the numerous accidents that workers often suffer. This use of IoT would also allow more efficient control of the water level as well as energy consumption. This would also make it possible to establish a database that would provide the locals with a comprehensive and detailed view of the situation in the oasis. We spoke of pooling the production and natural resources of the oasis. The resources and the production surplus would be shared in an equitable way between the inhabitants of the oasis.

2 The second group dealt with the theme of “pooling of plots and large farms”. In 2050, the inhabitants of Chenini would have voted for a law/agreement based on good faith and transparency to pool land. In order to circumvent the constraints linked to the inheritance of the plots, the different families (tribes) would have reached an agreement allowing the exploitation of the abandoned plots to provide work for the young unemployed. The plots would remain the property of one family or another and the owners would be able to reclaim their plot of land whenever they wished. The seed bank would be developed further to encourage organic farming based on ancestral techniques, which has become the rule throughout the oasis.

3 The third group chose the theme “Organised and ecological urbanisation”. In 2050 the houses in Chenini would be built like the old houses of bygone days. We would have returned to old techniques by mixing them with new ones. They would all be built of local materials that are easily found in the oasis such as lime, gypsum, sand, clay, or the “terss”, a type of local stone which was heated to extract a kind of paste used as cement. The “lifa” for example is used as a natural insulator for small 3-storey houses built on stilts. The lower floor would be dedicated to chickens, the second to family members and the third to guests and tourists. Chenini would indeed be a destination for the followers of ecological, social and solidarity tourism.

4 The fourth group dealt with the theme of water: “Water abundance and good governance”. In 2050 the local population would have succeeded after long struggles to put pressure on the GCT and the cement factory but not to dismantle them; the GCT would pay a kind of tax in order to accept the burden of their ecological and social responsibilities. Civil society and the local people would have succeeded in for-

mulating a plea in collaboration with researchers and experts of different fields to this effect. GCT and the cement company would now be funding various local projects, including helping the GDA improve the irrigation network and set up a water desalination unit, as well as building a water harvesting system in the surrounding hills. The pressure on the water table having diminished, the latter would once again become a common good shared by all in a sober and equitable manner.

5 The last intervention dealt with the theme of "Coordination and complementarity between the actors of the territory". The discussion was short but thoughtful. There was a hint of irony that is difficult to translate, but I have tried to get as close as possible to the original Arabic text: "Once upon a time, there was a hungry, thirsty and grumbling people came the malevolent one saying, that Chenini was lost, it is inescapable... the *Bouhattmya* palm tree [was] high and proud, [alongside] the banana trees, plum, apricot and other peach trees... the associations were present and the *Rais Baladya* (the mayor) with them, in the name of our *Mloukheya* (Knotweed) and our wheat, here is our new *Tansikya* (coordination) named Chenini *El Beya* (the queen)! A *Mahallya* (local) initiative united around the el *Wahya* (from the oasis) women."

Outcomes

Through the perspectives of the Commons and Radical Imagination we were able to ideate in a collective manner. We thus confirm that although Design was born and developed in the consumer economy, a Design practice to re-prefigure a Commons economy is possible. Design has a potential role in activating (and reactivating) diverse economies and has at its disposal a large set of practices and methods. All the approaches we cited seem valid; indeed, what this experience on the ground has shown is the relative importance of tools and methods. What was more important was the ontological posture of the Designer, being engaged in a specific situation of struggle i.e., communities and social movements defending their territories from the ravages of neoliberal globalisation.

It is possible to identify 4 levels of intervention for Design when dealing with the Commons, following the model proposed by Manzini and Margolin on the relation between Design and democracy:

1 Design of Commons, involved in the institutionalisation of the Commons;
2 Design for Commons, involved in the creation of devices/tools/means for the practice of commoning;
3 Design as Commons, intended as a common good in itself;
4 Design in Commons, involved in the development of initiatives inside the context of commoning to enrich the debate.

We see this research as a continuation of the discourses addressed by the Transition Design and Autonomous Design approaches, bringing a practical experience in the context of the oasis of Chenini; it also goes under the provisional category of Design by/for/from the Global South (Fry, 2017). We were aware of the shift in the posture of the Designer; in practice, we were not at the centre

diid No. 79 — 2023
Doi: 10.30682/diid7923i

of the project, instead playing a critical role as a facilitator or catalyst (Mages & Onafuwa, 2019). Speaking of new ways of Designing proposed by the Transition Design framework, we recognized ourselves, as the experience unfolded, in the figure of the "Designer questioner". We relied on the different representations of the past, present, and future to try and help the inhabitants make their future "visible" with words. Words were very important throughout the process, as we were convinced of the importance of orality in the local culture and tradition.

Regarding the practices, three profiles of the Designer emerged:

1 The Designer historian is interested in the past and seeks answers and solutions to present and future challenges;
2 The Designer commoner, works for the deployment of a diverse economy focused on the development of new Commons and the defence of old ones;
3 The Designer futurist recognizes the prospect of collapse and participates with citizens and communities to Design such a future now through radical imagination.

A first tangible result of this research work is the recent constitution (February 2022) of the National Collective of the Oases of the Gulf of Gabes, which is proof that the practice of such a Design is possible. The most interesting evidence that emerged from this experimental activity is the possibility of generating together a new/old economic imaginary in order to ground resistance in place (Tonkinwise, 2015) in the here and now: a different perspective that can indicate a new path for Design research and carry out not a collaborative Design approach that is not just theorised, but actually rooted in the present and able to carry the involved communities and contexts into a feasible future.

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Damasio's Concept of Homeostasis as a Useful Discourse for Human Wellbeing

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Abstract
The paper discusses Damasio's homeostasis theory and its potential connection to design. It starts with the evolution of physiological regulation from the Hippocratic theory of *body humours* through Claude Bernard's *milieu intérieur*, Walter Cannon's formulation of the concept of homeostasis, culminating with Damasio's homeostasis theory emphasising conscious homeostatic feelings, besides the unconscious mechanisms of physiological control. Next, it shows the importance of Damasio's homeostasis theory in perception, consciousness, as well as affect and wellbeing, and how it can inform the design discourse, specifically regarding emotions, embodiment, and environment. It poses questions such as whether design could be viewed as an extension of ourselves, acting as a psychic stabiliser or destabiliser. It argues that how we feel may eventually serve as a homeostatic design guide and that knowledge of homeostasis may improve wellbeing and the built environment.

Keywords
Antonio Damasio
Homeostasis
Neuroscience
Design
Wellbeing

Introduction

Contemporary neuroscience research, especially from the last 20 years and rigorous methodology have supported the scientific validity of the psychological and philosophical hypotheses addressed in design and architecture. The paper discusses the role of homeostasis and its connections to design from the perspective of neuroscientist Antonio Damasio, whose work has helped to clarify the significance of affect in cognition and decision-making. Damasio's homeostasis theory may be the most helpful for the design discourse out of all the research he has been developing.

Homeostasis, from the Greek words for "same" and "steady," refers to any process that living things use to actively maintain fairly stable conditions necessary for survival (Scientific American, 2000). However, the richness of the idea of homeostasis is not adequately reflected by the concept as it is traditionally conceived.

The paper, therefore, aims to examine homeostasis more broadly in light of Damasio's theory. It argues that design can illustrate such a regulating mechanism and that knowledge of homeostasis may be pertinent to this field. It poses questions, such as how Damasio's homeostasis theory could help us comprehend perception and emotion in design. Could design be viewed as an extension of ourselves, acting as a psychic stabiliser or destabiliser? It discusses how Damasio's homeostasis theory broadens our understanding of preferences and logical decision-making and how designers can use feedback to produce more intelligent and effective projects. Additionally, it reaffirms the significance of feelings and emotions as basic types of cognition and their importance in promoting wellbeing.

This topic offers a distinct possibility since the relevance of the body's homeostasis and wellbeing is becoming clearer in neuroscience (Damasio et al., 2000) and could be translated to the design areas. A discussion of Damasio's homeostasis theory, which is a self-regulating mechanism that enables an organism to retain internal stability while adjusting to shifting internal and external circumstances, leading to wellbeing, sheds light on how it might improve design and the built environment (Damasio, 2018; Damasio, 2000).

Concluding, this discursive theoretical paper employs an epistemological approach rather than a scientific one with the hope of imagining new design possibilities by extending existing neuroscience scientific proven information to the disciplines of the design field while raising exciting questions. Its objective is to employ interdisciplinary research to open new opportunities rather than present precise solutions.

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Background and Theoretical Underpinnings of Homeostasis

The Traditional Concept of Homeostasis

The understanding of physiological control has progressed over time. It started with the Hippocratic treatise, The Nature of Man, and the theory of the four humours (blood, phlegm, yellow bile, and black bile). According to this theory, good health is described as the balance and combination of the humours, while their imbalance and separation are the causes of disease (Hippocrates et al., 1931). The concept of homeostasis or *milieu intérieur* was first introduced by the French biologist Claude Bernard, who saw that plants' roots grew toward the area with the most water and nutrients (Damasio, 2021; Bernard, 2013).

The term "homeostasis" and the use of control theory (feedback and feed-forward regulation) were both created by the physiologist Walter Cannon to describe how a consistent internal environment is maintained (Cannon, 1929). For the homeostasis concept, this evolution was crucial. However, these traditional concepts of homeostasis typically fail to mention two different types of internal milieu parameter management, just mentioning the unconscious physiological regulation that happens automatically without the organism's awareness. For example, when it is hot, we sweat (Wagner & Silber, 2004).

The Concept of Homeostasis According to Damasio

The fundamental contribution of Damasio to previous homeostasis theories was the emphasization of a second regulatory mechanism in humans and most animals that involves feelings (Damasio & Carvalho, 2013; Damasio, 2021), especially those known as homeostatic feelings, which are the simplest ones, dealing with significant situations of life regulation. Examples include hunger, thirst, pain, desire, wellbeing, pleasure, and malaise. They are associated with affects: they have a valence or quality (positive or negative) and intensity or arousal (weak or strong) that determine whether they have a pleasant (joyful, energetic, relaxed) or unpleasant aspect (disagreeable, painful, sick) and the sum of these emotional dimensions is instructive because it provides a concise assessment as to whether the organism's current state is conducive to sustained health or flourishing, in the case of wellbeing, or whether it needs to be corrected, in the case of hunger and malaise (Damasio & Damasio, 2016; Damasio, 2022, 1:18).

Damasio's Concept of Homeostasis on Perception

According to Damasio, our perception is divided into three main parts Fig. 1. The first is the perception of the organism's interior, called interoception (the degree of contraction of visceral muscles, heart rate, and levels of metabolites in the internal milieu, among others). The interoceptive process begins with peripheral sensing of homeostatic changes, whether visceral or humoural, producing subjective and

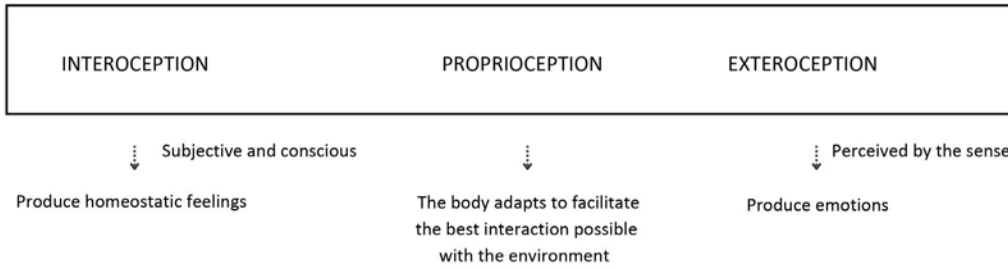

Fig. 1
Three parts of perception, according to Damasio.

conscious feelings called homeostatic (Carvalho & Damasio, 2021). The second is the perception of the organism's exterior, exteroception, and is perceived via the exteroceptive senses (smell, taste, touch, hearing, and sight), which produce emotions. They are perceived but not felt directly as feelings. Nevertheless, they may lead to what is called emotional feelings, becoming conscious. So, emotions don't contain intrinsic valence, although they are commonly labelled with valences generated from body states. They "borrow" the labels first developed as a component of homeostatic regulation (Damasio & Carvalho, 2013).

In between those two is proprioception, which concerns our ability to sense how striated muscles are as they contract and how they move skeletal parts. The body actively adapts itself to facilitate the best interaction possible with the environment. For example, the eyeball, head, and neck move into optimal positions to track objects effectively (Damasio, 2022, 1:18).

Therefore, for Damasio, perception consists of receiving and acting on messages from the environment. He emphasises the body and the physical and sociocultural environments in which it exists, as they are both necessary for regulation (Damasio, 2005).

Damasio's Concept of Homeostasis on Consciousness

Damasio believes that consciousness starts with homeostatic feelings. For example, when we feel hunger and pain, we are automatically conscious of those states; that is where their value resides. In addition, any form of experience or thought accompanied by one of those feelings will also be automatically conscious (Damasio, 2022, 1:18). So, according to Damasio's Somatic Marker Hypothesis, higher cognition processes such as rational choices and preferences, use the valence and intensity of feelings first developed as a component of homeostatic regulation; therefore, feelings are basic forms of cognition, influencing reason and decision-making (Damasio, 2005).

When a situation is present, memory performance is enhanced by mental states infused with positive or negative valences, incentives, or disincentives, and appealing or aversive conditions (Damasio & Damasio, 2016). Then, the conscious feeling of homeostatic regulation interacts with cultural group tunings, such as complex affects, drives, motivations, and emotions tailored through evolution and individual sociocultural experiences (Damasio et al., 2000).

According to Damasio, as perception depends not only on exteroception but also on interoception and proprioception, even sad external stimuli, such as music, for example, may lead to a pleasurable response and wellbeing. He explains that this might depend on whether there was an initial homeostatic imbalance and if the sad music could successfully correct it. He claims there is an interaction between personality, social context, learned associations, and mood in pleasurable responses to sad music, which can be understood in terms of homeostasis regulation (Sachs et al., 2015).

For example, if listening to sad music does not make one feel good, maybe there may not have a homeostatic imbalance, or the musical stimulus did not correct the imbalance. If listening to sad music leads to wellbeing, there might have been a homeostatic imbalance which was corrected because the music was aesthetically pleasing, engaged the imagination or specific memories, made the person feel understood or emotionally secure, diverted attention from current issues or stimulated intense emotions, among others (Sachs et al., 2015).

How Damasio's Concept of Homeostasis Can Inform the Design Discourse

Following Damasio's thought, one of the main messages of the paper is the importance of understanding emotions in design. Don Norman proposed one of the most significant theories of emotional design. He divides the emotional system into three primary levels, heavily connected, which combine to form the entire product experience. The first is the visceral level, referring to the first impression of a design and is related to non-conscious, quick affective reactions. The second is the behavioural level, the practical and functional aspects of the experience, largely subconscious, of the product in use. The third is the reflective level which considers a product's rationalisation and intellectualisation, the only conscious level (Norman, 2004).

For Norman, as for Damasio, emotions are usually underrated, but they affect how we feel, behave, and think. So, emotion and cognition can't be separated, always affecting each other. In his book *Emotional Design*, Don Norman mentions Damasio's work with people with brain injuries, impaired emotional systems, and decision-making, as well as Damasio's Somatic Marker Hypothesis (Norman, 2004, p.12).

Nevertheless, maybe it would be possible to re-think the diagram initially presented by Don Norman, proposing a feedback loop directly connecting the visceral with the reflective level, now knowing through Damasio's work the extent of the connection between emotions and rational thoughts and how the latter borrows the valence of the former Fig. 2.

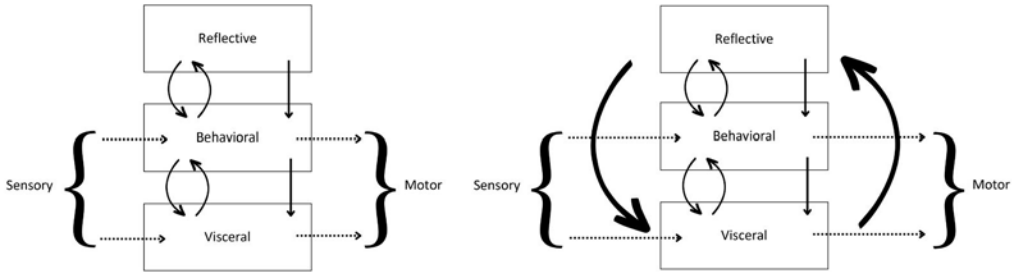

Fig. 2
Diagram initially proposed by Norman on the left and the new proposal on the right adapted from Norman, D. (2004). *Emotional Design: Why We Love (or Hate) Everyday Things*. Basic Books.

Another critical message of the paper is the importance Damasio gives to the body and the environment in which the body is placed, regarding perception, consciousness, affect, and wellbeing. One of the main theories of perception used in the design field is Gibson's ecological approach, developed during the 60s and 70s. He defined visual perception as the involvement of the entire organism as it moves through its surroundings (Gibson, 2014). Later, Francisco Varela, Evan Thompson, and Eleanor Rosch introduced the term 'enactivism' (Foglia & Wilson, 2013), related to 'enaction', which is how a subject of perception creatively matches its actions to the requirements of its situation (Protevi, 2006).

Evan Thompson also worked with the philosopher Alva Noë who claims that perceiving is both a kind of action and a way of thinking about the world. For him, perceptual awareness depends on the perceiver having "sensorimotor knowledge", an implicit comprehension of how sensory stimulus varies with movement (Noë, 2006). He says that "perception is presence and absence through time" because it depends on our sensory-motor and conceptual skills (previous knowledge), understanding that is also responsiveness to how things feel and matter to us (Noë, 2012).

All these theories resonate with Damasio's work, emphasising embodiment and environment. However, adding to that, for Damasio, subjectivity might depend considerably on the changes in the body state during and just before the processes leading to an object's perception. So a representational object, a responding organism, and a state of self-evolving due to the organism's response to the object are encompassed concurrently in working memory and attended, affecting how we feel and think (Damasio, 2005). The neuroscientist Anil Seth adds to that by stating that perception depends as much, if not more, on controlling regulations as on the signals coming into the brain from the outside world (Seth, 2017).

So, Damasio's work suggests that the perception of an object is never static, as it depends heavily on homeostatic processes and interoception, besides proprioception and exteroception. It also suggests that how we feel and think about a design may not be as objective as we thought, and they might even differ from each other, guiding behaviour unconsciously (Bechara et al., 1997). We always think about how design affects our wellbeing. However, in fact, wellbeing might start in the body of the individual and what it is capable of perceiving in terms of interoception. According to the neuroscientist Lisa Barrett, "We intuitively feel that what we see and hear influences how we feel, but it's mostly the other way around: how you feel alters what you see and hear" (Campbell, 2017).

In 1996, the philosopher Richard Shusterman introduced a theoretical framework he named "somaesthetics" through the compounding of "soma", an expression derived from the Greek word for body, and "aesthetics", from aesthesis, meaning 'sensory perception' (Shusterman, 1999). It led to the appearance of soma-based design, which includes first-person movement-based designs and methodologies focusing primarily on the aesthetics of those experiences, to examine connections between positive or negative subjective understandings in a determined environment. It considers the user's cultural background, habits, and values, unlike most user-centred design projects, which are created from a third-person perspective (Höök et al., 2017).

Paul Dourish, a computer scientist and anthropologist, also contributed to the exploration of phenomenology in design, especially regarding human-computer interaction, by bringing sociological, anthropological, and cultural studies understandings of human activity to the design of technological systems in an effort that he calls "embodied interaction". He states that our body, considering its culture, social norms, and practices, influences technological embodiment and actively shapes our experiences rather than being passive receivers. For example, our physical actions, typing on a keyboard or swiping on a touch screen, determine how we interact with technology (Dourish, 2001).

In 2015, the interactive designer Jelle Stienstra published an article inviting us to re-think technology, which frequently reduces people to shared characteristics, diving into generalisations. He claims that user-model-inspired design strategies and products frequently tend to find the best solutions for most people rather than concentrating on their unique subjective experiences, embodied skills, physical characteristics, worldviews, and potential behaviours, adapted to the context's open and dynamic nature. So, he states the need for assessment strategies that promote phenomenology-inspired design thinking, reevaluating the discrete (objective) measures and metric systems and making them compatible with the nuanced (subjective) and always-evolving aspects of life (the continuous) to develop products that embrace diversity and a rich and complicated social environment (Stienstra, 2015).

Going back to Damasio's concept of homeostasis and its impact on affect and wellbeing, it is possible to suggest that design, like art, enables a range of emotions to be felt and communicated subtly without language and may have the power to express, regulate, and amplify emotions. Design, therefore, could be seen as an extension of ourselves, acting as a psychic stabiliser or destabiliser. In this case, the relationship between the user's personality, background, context, and mood may also, be more important than we thought in contributing to the enjoyment of a design Fig. 3. Soma-based design and Dourish and Stienstra's views were a great movement in that direction, but maybe mood and personality could still be considered in the design process.

In addition, understanding that ongoing physical and psychological homeostatic imbalances may also influence the perception and affective state of a design means that they can change at any time Fig. 4. So, the question might be whether it would be conceivable to create open-ended, homeostasis-based designs constantly informed by these changes to achieve wellbeing. If feelings influence emotions and, nowadays, emotions can be captured and measured to a certain extent with biodata measurements, Quantified Self practices, and AI, would that be possible? (Macruz et al., 2021).

Designers are increasingly adopting biofeedback systems during the design phases, using biometric data (heart rate, breathing patterns, and muscle tension), micro-facial expressions and AI, eye trackers, skin conductance response (SCR), and brain waves. However, they usually use those during the design proposal but rarely after the design is ready, embracing homeostatic changes and body states transformations. In addition, the implementation of enhanced cross-modal perception and information processing, involving information obtained from more than one modality, typically sensory and multisensory integration, especially between touch and vision, is little explored. So, how could designers use other body-state feedback besides biodata to produce more intelligent and performative spaces, products, and services?

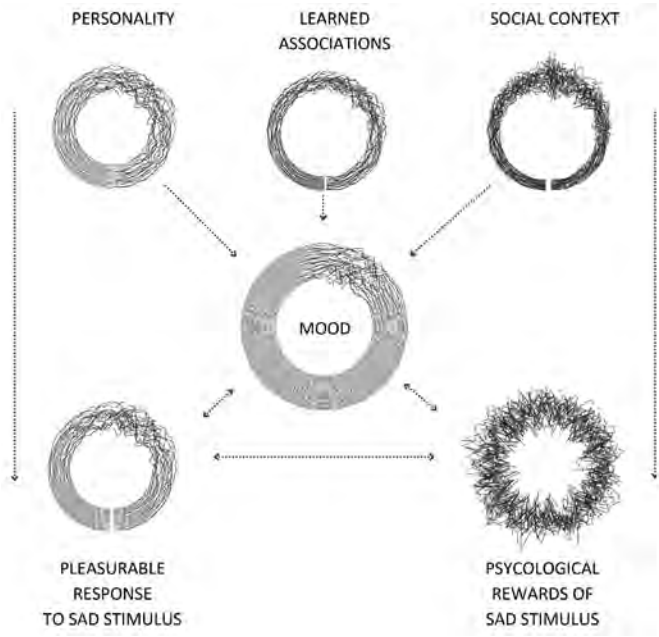

Fig. 3
How sad stimuli can become pleasurable, leading to positive feelings. Diagram adapted from Sachs, M. E., Damasio, A., & Habibi, A. (2015). The pleasures of sad music: a systematic review. *Frontiers in human neuroscience*, *9*, 404, 5.

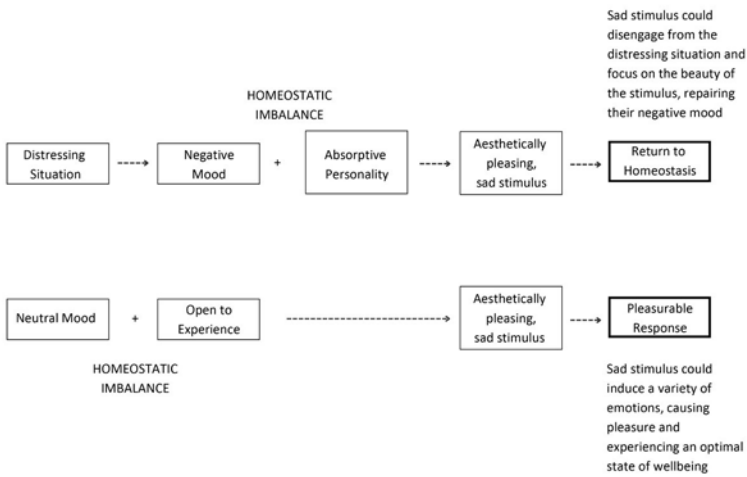

Fig. 4
Two examples of homeostatic imbalance resulting in pleasurable responses. Diagram adapted from Sachs, M. E., Damasio, A., & Habibi, A. (2015). The pleasures of sad music: a systematic review. *Frontiers in human neuroscience*, *9*, 404, 8.

diid No. 79 — 2023
Doi: 10.30682/diid7923j

Furthermore, it is important to consider that there are different thresholds to homeostatic feelings depending on the person and even for the same individual in different moments. Meditative practices and mindfulness, for instance, focus on the body, interoceptive senses, and homeostatic feelings. Through that, a person can influence these states, changing thresholds. The change in the interoceptive side drags on some changes in the exteroceptive one, modifying psychological states (Damasio, 2022, 1:18). For this reason, designers could pay more attention to internal stimuli, how they affect what we perceive and feel and consider whether there is a way for design to influence these states, changing thresholds to be more open to exteroceptive inputs, for example. Understanding homeostasis and how it works is crucial because it may influence the design process more deeply than we think.

Conclusions

Contemporary neuroscience and its rigorous methodologies support theories related to architecture and design. The paper discusses the role of homeostasis according to Antonio Damasio and its potential relation to design. It begins with the development of homeostasis across time, culminating with Damasio's homeostasis theory which calls attention to conscious homeostatic feelings, apart from the traditional unconscious mechanisms of physiological control. Next, it shows the importance of Damasio's homeostasis theory in perception, consciousness, affect, and wellbeing. Lastly, it discusses how it can inform the design discourse, specifically regarding emotions, embodiment, and environment.

The paper has potential as a line of inquiry since it discusses Damasio's theories, which are supported by an extensive body of scientifically proven research that can inform the design discourse. Although neuroscience is starting to demonstrate the significance of the body's homeostasis and emotions, the paper raises awareness of the need for designers to consider the implications of homeostasis theory in their daily work practices. How we feel may eventually serve as a homeostatic design guide.

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Inclusive Environments: Utopia or Reality? How to Create Inclusive Solutions Starting From People's Needs

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Abstract
Inclusive Design is an approach to design that aims to meet the needs of the widest possible audience, regardless of age and ability, through the realisation of products and services. This approach puts users at the centre of the design process, which means working with people rather than working for them. This article focuses on the application of Inclusive Design and Human-Centred Design approaches specifically aimed at Parkinson's disease. Through the analysis of a design case, the article describes the applied methodology aimed at solving the challenges posed by Parkinson's disease through the design of an inclusive home environment. The case study shows how the Inclusive Design mindset favours a holistic and creative approach, capable of bringing together different user groups throughout the various stages of the design process.

Keywords
Inclusive design
Human-Centred Design
Parkinson's disease
Design for disability

Introduction

The term *home environment* refers to the place where people live and it encompasses the economic, social and cultural dimensions that influence human health and well-being (Evans, 2003; Goldhagen, 2017).

Home environments can be defined as containers of content. McClure et al. (2011) argue that home environments are defined by seven domains of design, planning and management such as products, interiors, structures, landscapes, cities, regions and Earth.

Over the years, the domestic environment has evolved because it has been subject to social, cultural, work and technological changes of which human beings are an integral part.

Just as product and interior design influence human emotions, feelings, moods and behaviour within these environments (Norman, 2004; Pullin, 2009), the physical environments also have an impact on human health and well-being (Alfonsi et al., 2014; MacAllister et al., 2017). There is therefore a close connection between people and the home environment. People adapt to their environments in order to meet their needs and desires, and the built environment links human thoughts and integrity to their social, physical and cultural contexts.

We have all observed this during the COVID-19 pandemic. As a matter of fact, we have witnessed a paradigm shift at all levels: from work life to family life, the pandemic has fundamentally shifted the way in which people work and live. There has been a shift from working in the office to working from home, from physical activity performed in specialised environments to physical activity at home, and even some medical examinations conducted pre-pandemic in health care facilities have changed into remote or teleconsultations.

Home environments are designed and built in compliance with local building regulations and on the basis of the designers' convictions, thus reflecting human desires and spatial needs, but if we shift the focus towards the relationship between *ageing-home environments* and *disability-home environments*, then end-user satisfaction is not respected.

The Relationship Between Home Environment and Disability

The ageing of the global population is a success story achieved thanks to medical, social and technological developments. Nevertheless, there is also evidence for negative impact, as the ageing of the world population also means there is a greater risk of incurring disabilities or chronic diseases. One of these is Parkinson's Disease (PD).

As of 2021, approximately 1.3 billion people — about 16% of the global population — experience disability (WHO, 2022). Disability is part of the human condition (WHO, 2011), temporary or permanent, and can be experienced at any time of life. The quality of life is very often related to the quality of living spaces and objects of daily use.

PD is the most frequent neurological affliction in the elderly, along with dementia (Abbas et al., 2018). PD affects the initiation and execution of voluntary movements, leading to difficulty in performing basic daily activities of living and an impaired quality of life. Accord-

ing to the statistics, in 2040 14 million patients will suffer from PD globally (Pringsheim et al., 2014; GBD, 2016; Dorsey & Bloem, 2018).

Few studies can be found in the literature that deal with the relationship between Design and PD and between home environment and PD (Schwarz, 2006; Davis Phinney Foundation, 2019), rather, the field references deal with the relationship between disability in general and home environments. The scientific contributions from the field (Imrie & Hall, 2001; Imrie, 2006; Farella et al. 2010; Preiser & Smith, 2011; Lauria et al. 2019) point out that a large proportion of home environments are not equipped to be accessible, both in terms of space and as regards the objects/utilities employed within it.

There may be many reasons for this, including urban limitations, the size and shape of domestic spaces, designers' inadequate understanding or lack of knowledge regarding home accessibility, cultural beliefs, poor efficacy of objects and furniture, inadequate services, etc.

When health declines, environmental conditions often cease to match the individual's capabilities, causing numerous Personal-Environmental Fit (P-E fit) problems with negative health outcomes. The definition of P-E fit refers to the relationship between the environment and the person (Murrel & Norris, 1983; Bhidayasiri et al., 2015), understood as the correspondence or congruence between individuals and their environments, a key determinant of a person's well-being and safety (Kristof-Brown et al., 2005).

The objective, therefore, is to improve accessibility and usability in the home environment in relation to the performance of daily life activities, removing all barriers that may limit a person's autonomy and independence.

For these reasons, this article describes an action-research project which aimed to define the guidelines for the design of an inclusive and accessible environment for a Person with Parkinson (PWP), and which can also be extended to other physical discomforts experienced by people.

Accessibility, Versatility and Domestic Adaptability Over Time: Human-Centred Design and an Inclusive Design Approach for Parkinson's Disease

In order to carry out the research project two approaches were used jointly: Human-Centred Design (HCD) and Inclusive Design (ID).

The HCD approach can be defined as an "approach to systems design and development that aims to make interactive systems more usable by focusing on the use of the system and applying human factors/ergonomics and usability knowledge and techniques" (ISO 9241-210:2010; Giacomin, 2014).

ID began as a general approach to design, based on the main Design for All (DfA) and Universal Design (UD) approaches in which designers ensure that their products and services meet the needs of the widest possible audience, regardless of age or ability, without the need for special adaptations or specialised designs. ID is the inverse of the DfA and UD approaches, aimed at designing for disabled and elderly people as a subset of the population, but is part of a more recent international trend towards the integration of elderly and disabled people into society (Clarkson et al., 2003).

The concept of inclusion in the design and development of environments and products is not a question limited to disability design per se, but is, on the contrary, a matter of *equity* and *quality of life for all* (Imrie & Hall, 2001). This mindset leads to putting the users at the centre of the design processes rather than at their margins, and thus means working *with* people rather than working *for* them.

Involving users and listening to them means avoiding aprioristic approaches to design in favour of an anthropocentric approach.

To satisfy the requirements of home accessibility and adaptability, the starting point is to assume an attitude towards design that starts from the ability to pay attention to the *context of use* in which one is called upon to design, and in our specific case this consisted of Fig. 1:

- users (PWP, caregivers and health professionals);
- domestic activities;
- equipment (objects, aids, assistive technology);
- physical environment (indoor and outdoor);
- social environment (the services present near home);
- and finally, the heterogeneous and progressive chronic symptomatology of PD.

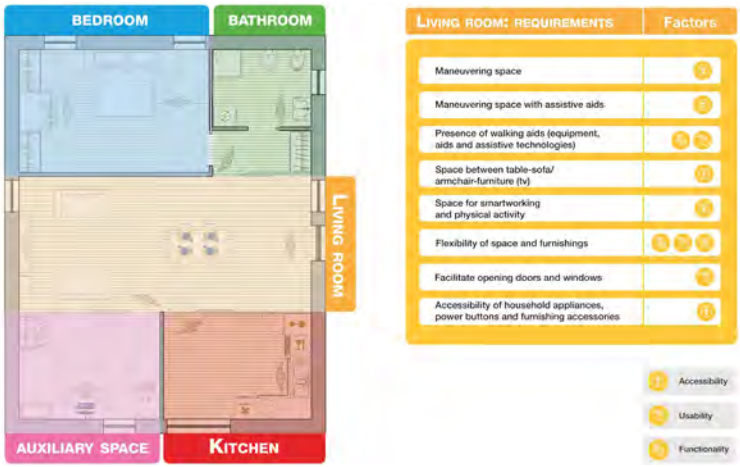

Fig. 1
Home and design requirements (factors).

In the specific case of people with PD, the projection of design solutions over time is realised in the adaptability of spaces, furnishings and equipment, in the possibility of guaranteeing adequate space for movement for wheelchairs and movement aids, and in the possibility of inserting walking aids and technological equipment (e.g. for environmental control, fall detection, etc.) with low-cost and easy-to-implement interventions, while maintaining the configuration of the home as unaltered as possible.

The specificity of the needs that arise with the different stages of the disease and the different consequent levels of autonomy, as well as the different needs for support and care, thus become basic references for the project and translate into the principle of *versatility* and *adaptability* over time, which can offer a plurality of options that may be planned for and easily adopted.

Lastly, the design solutions identified for the specific case of PWP can be used in numerous and diverse other contexts (ageing and other disabilities) in which the full accessibility and safety of the living environment, its full domesticity and friendliness and its adaptability over time can contribute to improving autonomy and quality of life.

Research-Action: Home Care Design for Parkinson's Disease

The research program *Home Care Design for Parkinson's Disease* (Tosi & Pistolesi, 2022), carried out in 2020-2021, involved different research groups belonging to university departments of the Università degli Studi di Firenze and Universidade Federal de Minas Gerais (Brazil) (Design area), Università degli Studi di Torino (Medical area) and Università Cattolica del Sacro Cuore (Milan) (Sociology area), as well as the participation of the Confederazione Parkinson Italia and Accademia Limpe-Dismov.

The *context* was analysed adopting two empirical methods: the interview, divided into two phases (phase 1, exploratory structured interview and phase 2, specific structured interview) and the virtual observation, carried out via Skype and via Whatsapp. It involved twenty-five PWP and sixteen informal/formal caregivers, all resident in Tuscany. The methodological setting of the study was defined by taking into account the limitations imposed by the COVID-19 pandemic.

The results underline how the home environments that create discomfort/problems are attributable to the size of the bathroom, the presence and size of stairs, and finally the presence of small spaces such as the closet Fig. 2. Data shows that 72% of the subjects wish for housing solutions with adequately sized bathrooms to ensure access and wheelchair rotation in addition to the space required to install grab bars and a shower seat. Furthermore, respondents (n=10) place great importance on stairs. Although they are aware that stairs, depending on the level of PD symptomatology, can be an incentive to reduce freezing, they prefer single-story housing solutions. Furthermore, 39% of the subjects stated that they would like to have more accessibility within the kitchen environment, even for those who are forced to sit in a wheelchair or use a walker.

The greatest problems arise from the house wall units and the kitchen base units, but also the appliances provided. 28% of the subjects ascribe great importance to adequate space in the rooms that make up the home, and finally, to home usability/accessibility for walkers and wheelchairs. Finally, 22% of the subjects interviewed declare their need for rooms that offer suitable size wheelchair access, open space solutions (at least to ensure this solution between the kitchen and the living room) and spaces inside the house where it is possible to perform physical activity. In conclusion, 89% of the subjects who took part in this study stated that flexibility and versatility could be a valid alternative to static walls, believing that a space that changes with the changing needs of the PWP and the caregiver is a valid idea (Pistolesi et al., 2022).

Home environment	Description of problems and areas of intervention
Vertical paths	- Some users complain about the presence of steps or staircase;
Horizontal paths	- Lack of large spaces to ensure the passage and rotation of the walker or wheelchair to ensure home accessibility and to limit freezing; - Lack of space or unsuitable spaces between the objects of use in the house, such as table-chair, chair-sofa, table-kitchen, etc.; - Lack of space to allow wheelchair rotation in some rooms of the house; - difficulty in passing through narrow doorways or tight spaces (e.g., corridors); - Difficulty in walking due to the presence of obstacles in horizontal pathways (sofa, chair, bed, furniture, etc.); - The presence of height differences in outdoor space (terrace, garden, etc.);
Rooms dimensions	- Useful space in the bathroom to allow access to the caregiver during PwP hygiene and cleaning; - Lack of sufficient space for physical activity, physical therapy and/or recreation activities;
Accesses	- Difficulty in opening and closing doors and windows;
Furniture, aids and assistive technologies	- Lack of grab bars and/or support elements in the most critical points of the house (corner where changing gears are expected) for fall prevention; - Lack of space to install grab bars in the bathroom; - Difficulty in reaching low furniture. Some users complain of difficulty in bending over to equip themselves with objects placed in the kitchen base units or in the lower cabinets; - Difficulty in getting out of bed or armchair (beds, armchairs and static sofas). Many PwPs support motorized beds, chairs and sofas; - Poor knowledge of aids or assistive technology for PD or other motor impairments.

Fig. 2
Global mapping of problems and needs.

The aforementioned results were subsequently used to create the guidelines.

The guidelines are a set of recommendations and/or operational indications, aimed at guiding actions, types of behaviour or a *modus operandi*, or at proposing a structured set of good practices and possible alternatives for the development of project solutions addressed to specific sectors.

The guidelines produced for this research project were intended both to respond to explicit needs and to interpret implicit ones, and should also respond to their possible evolution over time.

The guidelines are designed to address as broad and heterogeneous an audience as possible, comprising current and future designers, but also people directly affected by the disease, their families and healthcare professionals.

The sheets that make up the guidelines are composed of four parts, one dependent on the other, providing different graphic and descriptive levels, as follows Fig. 3:

- dimensioned 2D drawings with the minimum dimensions to be respected;
- description of the technical aspects to be taken into account;
- renderings;
- finally, indications regarding products, aids and assistive technologies available on the national and international market;

Fig. 3
Bedroom. The four parts that make up the guidelines.

Every single environment has been represented with its possible evolutions in relation to the evolution of the person's needs over time, demonstrating the fact that if PD changes, in severity and intensity, and in a different way from person to person, then the environment in which he or she lives may also change over time to meet the new needs of the PWP. For this reason, the environments are represented with three levels of evolution: mild, moderate and severe symptoms. The first, referring to the mild level of symptomatology, considers the PWP to still be able to perform all, or almost all, common household activities independently. The technical tables show the person without any aids or assistive technology. The second, referring to the moderate level of symptomatology, considers that the PWP suffers from postural instability but is still physically independent. The technical tables show the person using the walker, and grab bars are placed at strategic points in the room, such as corners, where the change of stride is expected to take place. Finally, the third, referring to the level of severe symptomatology, considers the PWP to have difficulty walking and performing

household activities independently. For the latter development, the technical tables show a person using the wheelchair, both grab bars and other aids for movement are present, and the presence of a full-time caregiver is envisaged Fig. 4.

Fig. 4
Bathroom and auxiliary space: the three levels of PD evolution (mild moderate and severe symptoms).

Conclusion: Opportunities for Designers

The paper explored the issue of the accessibility of home environments and the usability of objects and aids intended for the care of PWP, discussing the opportunity to overcome this gap through the use of HCD and ID approaches. The literature review emphasised how unsuitable current home environments are to accommodating individuals in need of care and assistance. The results confirm that a large proportion of the homes studied are not suitable or may not be suitable in the future to accommodate the PWP and their caregiver.

The paper focuses on the practice of design involving collaboration between research organisations, health-care professionals and end users. Cooperation between various research groups has been a determining factor in proposing solutions in line with end-user needs.

According to Giacomin (2014), design, if human-centred, can produce as a natural result disruptive as well as incremental innovation, making a concrete contribution in terms of product innovation and business competitiveness.

Designing inclusive solutions (products, environments and services) means responding to the needs and desires of the most disadvantaged sections of the population, but it also means responding to the widespread needs of broader sections of the population for whom the increased usability of products, environments and services will result in conditions of greater well-being, time and energy savings, and a general improvement in the quality of life.

Many solutions designed to meet the specific needs of equally specific user groups can be successfully addressed to a broader range of users.

Examples include the kitchenware produced by the OXO[1] company and the *No Spill Cup*[2] designed by designer Soneji, an inward-curved cup that allows the PWPs to drink without spilling the contents

inside. Most interesting are the formal experiments in the framework of the project *Rethought elderly furniture & accessories that support and empower life & lifestyle*[3], carried out by the design studio Lanzavecchia+Wai. The motivation that prompted the two designers was to generate enthusiasm, desirability and sense of ownership, through the design and introduction of new functions for some aids designed for the elderly the aesthetics of which are still too hospital-like today. While IKEA, through the *ThisAble*[4] project, allows anyone to download free 3D models of its products: through artificial intelligence and 3D printing, they may be implemented with additional solutions to enrich and enhance the lives of consumers, especially those with special needs. As for smart objects, of particular interest is Microsoft's *Emma* project[5], a wearable device that can compensate for upper limb tremor. To conclude, there are interesting floor concepts that create the illusion of a 3D staircase, such as *Staircase Illusion*[6], and the study conducted by Gál et al. (2019), which are useful for reducing freezing situations, or the *SensFloor*[7], a floor equipped with sensors that can monitor the direction and speed of movement and detect people's falls.

It can be argued that products immediately identifiable as *products for the disabled* can represent a possible source of frustration for the end users. Although necessary and potentially useful, these products can be experienced as the stigmatisation of the user's diversity in relation to other people, and they are often rejected by those who could, on the contrary, use them with unquestionable advantage because of their appearance and their incontrovertible difference with respect to *normal products*.

The objective of Design is the realisation of products and environments that, starting from the specific needs of people with reduced physical, perceptive or cognitive abilities, are easily usable and desirable by all people.

The design challenge is to consider in the design brief the stated and/or tacit needs and expectations of users, but also to anticipate their interaction with the proposed system. The relationship between users and designers is based on extreme trust. Whenever the former use products designed by a designer, they rely on the latter trusting that he has carried out his work in an ethical manner: it is therefore up to the designers to become aware of and respect this trust (Saffer, 2010). As Buchanan (2001) states, designers often forget the meaning and full force of the words *human-centred design* as a fundamental affirmation of human dignity, which gives design the responsibility to continuously search for what can be done to uphold and enhance the dignity of human beings as they lead their lives in various social, economic, political and cultural circumstances. On this basis, it is possible to state that the purpose of design is to communicate and rework not only the information but also the personal stories and experiences that contribute to generating complex human-product interaction: although influenced by extremely subjective factors and the personal experience of each individual user, it can be designed on the basis of universally shared patterns and characteristics.

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The Complexities of Political Engagement and Consumer Response to Woke Design

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Abstract
What happens when brands engage in activism and involve themselves in the socio-political lives of their consumers? The rise of social issues and political messages in brand design is an emerging topic for the Design discipline. Designers are asked to communicate more complex ideologies in products and advertising campaigns. Designing-in values, individuality and political stance is becoming more commonplace though the impact of such efforts on consumers is mixed. This study explores the complexity of political engagement to woke design. A series of case studies discussed in this paper show that when brands are involved in activism, it impacts their consumers, reputation, and products. The analysis of evidence extracted from case studies indicates that activism campaigns have polarizing effects on consumers, increasing the brands' reputation. Moreover, a visual model mapping the dynamics of activism in brand design is presented to allow an assessment of the phenomenon.

Keywords
Political engagement
Activism
Brand design
Woke design
Consumer response

Introduction

In an age where big business is seen by many as an "irresponsible steward" and consumers are demanding more authenticity and value alignment from brands, the rise of 'woke' design is apparent (Carroll & Brown, 2018). Consumers want to buy from brands that align with their identity and in so doing they signify to others what group they belong to. "Cool consumerism" is powered by a drive to avoid conformity and even express criticism of capitalism (Heath, 2001). Indeed, Heath argues that anti-consumerism shopping has now become the central ideology of the capitalist system (2001).

While ethical consumerism began with a focus on global inequalities and sustainability, it has more recently moved to embrace counterculture and political spheres in response to Gen Z's more radical outlook (Gutfreund, 2016). This positioning by companies within a political debate is termed brand activism and further research into this area has been called for (Mukherjee & Althuizen, 2020).

Designers are therefore required to communicate more complex ideologies within products, packaging, branding and advertising campaigns (Zajzon et al., 2017) in an effort to attract 'cool consumers' and avoid being cast on the wrong side of right vs wrong in an increasingly moralised arena. Designing-in values, individuality and even political stance is becoming more commonplace, though the impact of such efforts on consumers can be mixed (Mirzaei et al., 2022).

Consumer backlash in the form of boycotting or countercampaigns on social media is a risk of such activities, particularly where there is a perceived lack of authenticity (Carroll & Brown, 2018).

Aim and Methodology

This study reviews literature relating to woke design, brand activism and authenticity to examine the impact on the consumer-brand relationship. The analysis of works produced by notable scholars in the field of Design is used to provide consistency to the theories considered for this work. Four brand activism campaigns are later used to examine relevant patterns and designed elements including products, advertising campaigns and packaging, as well as criteria for design activism. Campaigns were selected based on the following five criteria:

- The brand must be western, and the campaign released within the past 15 years must be documented by the brand, for data comparison with Mukherjee and Althuizen (2020);
- The brand must produce clear evidence of design; or the impact of the brand campaign is implemented through a recognisable design output, such as communication design, new products, etc.;
- The goal of the Campaign must be pro-social and communicated through the brand's products/services;
- The main industry of each brand must be different, to broaden the findings of this study;
- The campaign must have been discussed by external authors, close to its release. These are used to gain a less biassed insight on the campaign's effect on the brands, consumers, and reputation.

In order to select the brand campaigns, the terms “brands and activism”, “brand activism campaigns” and “brand activism” were inputted into Google. From there, a list of campaigns was collected from the first two pages of the results of each term. The selected brands included outdoor clothing company Patagonia, Lush cosmetics, Starbucks coffee and Ben and Jerry’s ice cream. These case studies were analysed and presented under the themes of perceived authenticity, design decisions, level of controversy and consumer response.

The case study approach enabled us to examine the multi-faceted nature of brand-activism and the complex relationship between design, consumer brand relationships, activism and authenticity. The real-life nature of the campaigns provides a snapshot of a fast-evolving area of marketing, branding, and design. Findings are synthesised into a graphic proposing a model for interpreting the relationships within brand activism and design.

Literature Review

Branding and Design

Brands represent and promote individuals, products, and companies. The term “brand” encompasses any features (name, term, design, symbol etc.) that identify one seller’s goods or services as distinct from those of another (Slade-Brooking, 2016). Wheeler and Millman (2017) define brand identity as a tangible asset that “fuels recognition; amplifies differentiation; combines disparate elements into systems; appeals to the senses”. To motivate consumers to purchase its products/services, a brand needs to build upon its relationship with its targeted consumers (Slade-Brooking, 2016).

Consumer Brand Relationships

Literature on consumer-brand relationships has identified the diverse types of relationships consumers have with brands (Gómez-Suárez et al., 2017). Our purchase choices are not only influenced by our basic needs but by our social pressures, aspirations, and desires (Slade-Brooking, 2016). Thus, the products and services consumed are a representation of the consumer’s identities, thoughts, and feelings.

Consumer-Brand Identification (CBI) refers to the phenomenon that occurs when an individual relates to a brand because of its unique properties. Stokburger-Sauer et al. (2012) define CBI as a “consumer’s perceived state of oneness with a brand”.

Brand Activism/Woke Activism Branding

In Design, the concept of activism has been discussed by notable authors such as Carl DiSalvo, Harun Kaygan and Guy Julier in relation to the cultural transition toward social design.

Kaygan and Julier (2013) discuss the notion of design activism as an emerging design practice imagined and practised in worldwide localities that can shape entire design cultures; the idea discussed in the work of these authors is important because the concept of activism is linked to a new culture that must be embraced in order to transition toward more holistic designs, as well as to the need to influence the design community to develop social and economic change. The work of Kaygan and Julier shows similarities with thoseby Victor Papanek (1985) — design interventions for the weakest population — and by Ezio Manzini (2019) — design for social innovation. Conversely, DiSalvo (2010) proposes the concept of "agonistic pluralism" in relation to the wider idea of design for democracy, as a model of democracy grounded in productive conflict or contest. DiSalvo's work is important because it articulates the concept of social design from the perspective of democracy and political design: when designers adopt informed design practices to enrich the significance of a design intervention with political meanings and foster democratic conditions. Dissensus, provocation, and contestation as models of participation are collateral aspects discussed by Knutz and Markussen (2020) in relation to DiSalvo's work as applied to participatory design.

We use the term "woke design" to describe instances in which designerly skill has been applied to cultural and consumerist assets in a way that signifies or contributes to the "woke-ness" of a brand, product, or service. It is interesting to examine how woke design fits into the spheres of design activism, consumer cultures and political design because, particularly in the realm of brand activism, design skill is a key component. The drive of brands to align with gen Z's politically engaged outlook can be seen as a sales tactic or a method of change-making within a neoliberalist system. Either way the tools of design are central to the success of such actions.

The Oxford English Dictionary defines 'woke' as alert to racial or social discrimination and injustice. Woke design is more self-conscious and consumer-focused than the type of activist design described by Manzini (2019), and it could also be argued as suggested by Julier (2013), who defines design activism as spanning both a utilitarian and political action.

As Julier points out (2013), activist design is able to exploit the neoliberalist environment of consumer markets to "recycle and reprogram" in order to achieve change.

With regard to brand activism, in 2016 the Marketing Science Institute recognized the decision as to whether brands should court activism as an emerging critical issue (Mukherjee & Althuizen, 2020). A view reflected by the increase in brands such as Nike, Coca-Cola and Gillet taking stands on socio-political issues (Peters & Silverman, 2016). Activism has been defined as "an emerging marketing tactic for brands seeking to stand out in a fragmented marketplace by taking stances on social and political issues" (Vredenburg et al., 2020, p. 444).

Social Design

Social design intends to bring change to pursue collective and social ends. Armstrong et al. (2014, p. 15) assert that "social design highlights the concepts and activities enacted within participatory approaches to researching, generating and realising new ways to make change happen towards collective and social ends, rather than predominantly commercial objectives". Victor and Sylvia Margolin (2002) discuss the value of social design in allowing companies and designers to work with human welfare, and address how they can play a significant role in developing collaborative processes to make social interventions. The value of the social aspects is further reinforced by Margolin's work (2002) that links the value of a social-oriented design practice operated by designers that enable bottom-up interventions linking people, contexts, design artefacts; accordingly, designers are seen as informed facilitators of radical changes (through educational pathways). Therefore, social design is a design practice that includes other domains such as: social entrepreneurship, design activism and socially responsible design (Armstrong et al., 2014).

Researchers such as Chen et al., (2016) and Zajzon et al., (2017) acknowledge that social design stems from the writings of authors such as Victor Papanek (1985), Victor Margolin (2015) and Nigel Whiteley (1994). There is growing international interest from companies (IDEO, Think Public) and researchers (Markussen, 2013; Julier, 2013; Manzini, 2015; Chen et al., 2016).

A more literal example of design's capacity to bring social and political change can be seen from the Two-tailed Dog Party's (MKKP) billboard campaign Fig. 1. From 2015 to 2016, MKKP crowdfunded a billboard campaign against Viktor Orbán's anti-immigrant referendum on a mandatory resettlement quota which would have given Orbán the power to reject the European Union's refugee distribution plan (Zajzon et al., 2017; Nelson, 2018). As a result, this encouraged Hungarian residents to vote against Orbán.

Fig. 1
MKKP's billboard against Viktor Orbán's anti-immigration referendum (Karáth, 2016).

Trust is courted by brands as a desirable element of consumers' relationship with them. The perceived authenticity of a brand is becoming increasingly important in a market in which cynical consumers can voice their criticisms and call brands out on disingenuous campaigns. Indeed, consumers that trust a brand to do the 'right thing' in terms of social issues are more likely to advocate and defend that brand than if they trust it on product quality (Ries et al., 2019).

Mirzaei et. al.'s 2022 study investigated consumer responses to two woke branding campaigns from Gillette razors and Nike sportswear. They analysed online audience commentary and identified various reasons for a perception of inauthenticity. They propose a conceptual model for authenticity of woke branding based on six authenticity dimensions Fig. 2.

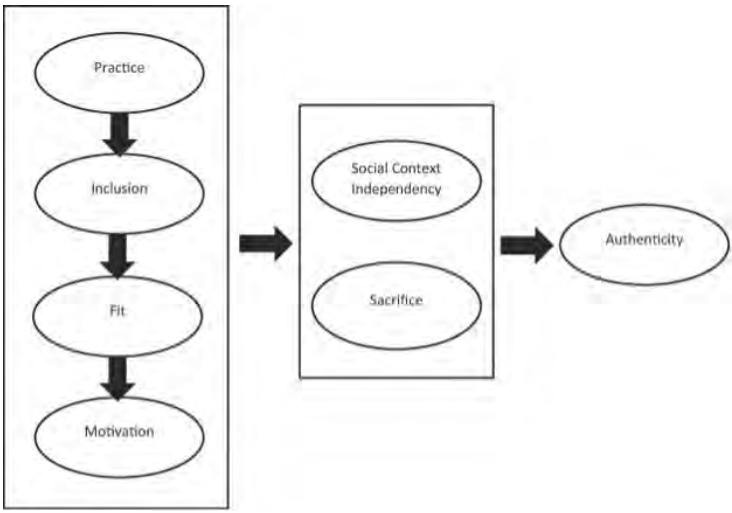

Fig. 2
Woke activism authenticity framework (WAAF), (Mirzaei et al., 2022).

Design plays an important role in the pursuit of successful, authentic-feeling woke branding. Socio-political products, ad campaigns and branding all attempt to convey, through design, that they represent a stance on a particular political issue and seek to persuade the audience to join them in that stance.

Graphic design and, one could argue, product design serve four purposes: to convey information, persuasion, decoration and "magic" (Barnard, 2005). The rise of woke brand campaigns by companies requires designers to tell more complex, value-driven stories and evoke a sense of outrage, comradery and counter-cultural energy.

In 1985 Buchanan viewed design as a commentator on social issues "Design is an art of thought directed to practical action through the persuasiveness of objects and, therefore, design involves the vivid expression of competing ideas about social life." (Buchanan, 1985). It seems unlikely that he could have imagined how far this function would develop forty years later.

Barnes (2017) examined the way that design can be used to mislead the consumer through inauthentic branding in her 2017 study of Tesco's redesign of their value food range. Tesco were widely criticised for deliberately giving the impression that their

ranges of meat, fruit and vegetables were coming from tangible farm locations. The packaging design strengthened this story through textures evocative of farmers' markets, copy writing that suggested a connection to single farm suppliers and logo elements with a 'rural country show' aesthetic. It is clear that skilful design is a powerful tool in conveying a clear, value-led message within woke branding.

Case Studies

Patagonia: Don't Buy This Jacket

Patagonia's 2011 *Don't Buy This Jacket* campaign detailed the company's socio-political stance on consumerism and its impact on the environment Fig. 3. The advertisement encouraged consumers to reconsider buying the R2 jacket due to its environmental impact, despite the use of recycled materials within it. It also aims to encourage consumers to use its Worn Wear platform, a repair service intended to extend the life of Patagonia's products (Patagonia, 2021). The design of the campaign mainly uses visual communication strategies to generate cultural and social frictions in consumers. While corporate attention is on the production of more durable products, the marketing and communication codes were designed to trigger unconscious reactions that stimulate the cultural side of the purchasing experience. In essence, the campaign juxtaposes contradictory aspects: the quality of the product and the antithetical message of not buying.

In terms of market results, this campaign produced a rise in Patagonia's revenue, reputation and CBI, and sales increased over 30%. Hwang et al. (2016) reported that the campaign lowered the purchasing intentions of consumers when compared to Patagonia's past advertisements, fortifying the effectiveness of the campaign itself.

The use of design methods resulted in the creation of new services, which incorporated activism within Patagonia's brand identity, as brand products and services are elements that contribute to its identity (Wheeler, 2013). Furthermore, the campaign also positively impacted the brand's reputation and relationship with consumers — pro-company effects.

Fig. 3
Patagonia's 'Don't Buy This Jacket' campaign (Patagonia, 2021).

Ben & Jerry's: Pecan Resist

The Ben & Jerry's 2018 *Pecan Resist* campaign aimed to combat Donald Trump's regressive policies on racial and gender equity, immigration, climate change and LGBTQ rights, issues the company declares to be at the core of their social mission (Ben & Jerry's, 2018). The campaign utilises both intangible messaging and tangible actions to achieve its goals. The tangible commitments are the donations made — over $100,000 towards NGOs — and the production of a limited-edition Pecan Resist flavour. By using intelligent graphical design strategies — i.e. the colour palette and graphical images to reflect Ben & Jerry's diverse base of consumers — the brand also recalled relevant social values such as inclusivity and democracy.

In terms of the effects on consumers and reputation, five days after the campaign was released a 4.74% increase in the brand's stock was reported (Knoebel, 2018) suggesting *Resist* had positively impacted the brand's reputation with consumers.

Pecan Resist uses engaging visual communication to evoke cultural feelings and visual links in consumers, such as tribalism, local values, cultural heritage, etc. The overall experience produced by the redesign of the packaging is clear proof of how the political message behind the campaign can produce a rebranding of packaging. In terms of design strategy, the work of Ben & Jerry abides by the core principles of social design and political design, due to its positions clearly antithetical to the top-down governmental positions. *Pecan Resist* is therefore a design activism campaign, because it voices its pro-social stance through design in a way that seeks to raise awareness of Ben & Jerry's pro-social mission against regressive policies. By donating to NGOs and designing a new product to proclaim its stance, *Resist* further built the brand's identity and activism. The campaign also affected the brand's relationship with consumers, due to the controversial topics it explored.

Lush: Spy Cops

In 2016, Lush launched an activism campaign entitled *Spy Cops* to bring awareness to the crimes committed by undercover police units when infiltrating activist groups [Fig. 4]. The campaign was inspired by a public enquiry initiated by Theresa May (Lush, 2018) and ran for several weeks until the company cancelled it due to threats against its employees.

Upon its release, mentions of the brand spiked by 2331% on Twitter; most were negative, because people perceived the campaign as an attack against all police officers due to the graphic image of a uniformed policeman used on the poster (Belam, 2018).

Although early mentions of the brand were negative, *Spy Cops* later received overwhelming support from its consumers, as they continuously voiced their support on social media. This surge is further supported by brand activism literature, which reports that backlash caused by brand activism cements and increases CBI among its supporters (Mukherjee & Althuizen, 2020).

Spy Cops voiced pro-social stances through design. By using a series of graphic elements to redecorate Lush's stores, it communicates a socio-political position: the main poster displayed

two images of an officer with provocative messaging including ‘paid to lie’. The campaign is a diligent example of how visual communication elements used to convey social issues have been able to produce higher cultural engagement in a brand’s message. In terms of activism, it evoked friction in the sense of perceived safety, beyond stereotypes and a political sense of justice — as evinced by Fig. 4 *Spy Cops* was therefore considered a value-driven advertising campaign that drew immediate backlash, and was then overwhelmed with positive support from consumers. By using elements that contribute to its brand identity to voice its stance, Lush further developed its brand identity: an activist brand.

Fig. 4
Lush’s *Spy Cops* advertisement displayed in a shop window (Belam, 2018).

Starbucks: Hiring Refugees

In 2017, Starbucks launched the *Hiring Refugees* campaign to help the integration of displaced refugees into “new societies” and hire over 10,000 refugees by 2022 in response to Trump’s executive order (Starbucks, 2021). The campaign sought to integrate refugees by working with pro-refugee NGOs to redesign their hiring process, as well as to create more supportive services that would make it easier for refugees to enter its workforce. This impacted the brand’s identity since employees also contribute to a brand’s value and identity (Wheeler, 2013).

Although the campaign mainly resulted in the adoption of strategic messages aimed at repositioning the vision of the brand itself — standing with the weakest, as a part of a political commitment — it is an excellent example of socially inclusive design-oriented strategy aimed at improving the social and economic lives of workers and enhance the company’s reputation. Accordingly, the design of the campaign directly and indirectly influenced the corporate responsibility toward marginalised workers. Following

its release Starbucks was subject to a mix of negative and positive views — calls for boycotting its products were contrasted with those in support of its stance.

Hiring Refugees is a design activism campaign due to its pro-social goal of improving the social and economic lives of refugees. Furthermore, the polarised responses received by the campaign also correlate with brand activism literature (Mukherjee & Althuizen, 2020).

Interpretative Model for Brand Activism and Design

Assessing the impact of activism in branding design is paramount to understand the quality of design strategies used by companies when approaching complex social issues. Both design strategies, design outcomes (i.e. new services), and impact on CBI help organisations to map the hidden and explicit actions needed to increase awareness of social topics. Here the number of mentions on Twitter is used to gauge awareness of the issue raised and the impact on design activism in terms of igniting debate.

An interpretative model is proposed to meet the above-mentioned needs Fig. 5 (Nyarambi, 2021). It was created to help designers and brand design strategists to map the basic information behind an activism campaign. By exploring the domains of branding, CBI, brand activism and design activism, it visually represents relevant links proposed by the literature to identify the impacts produced by activism actions on a brand's relationship with consumers, its reputation and brand identity. This also constitutes a link between brand activism and design activism, which depends on the campaigns' goal and communication methods.

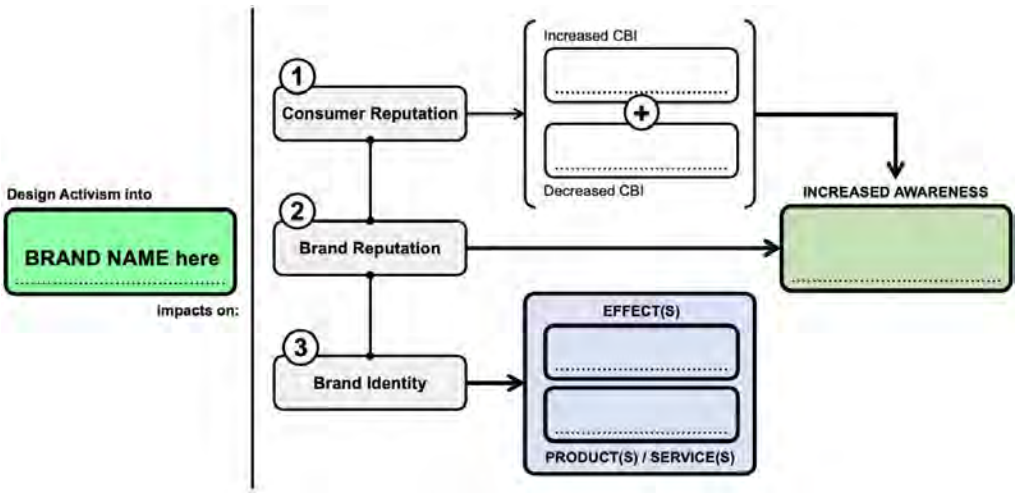

Fig. 5
Interpretative model for brand activism and design (Nyarambi, 2021).

The model was later tested experimentally in all case studies discussed in the previous section to identify relevant design impacts Fig. 6.

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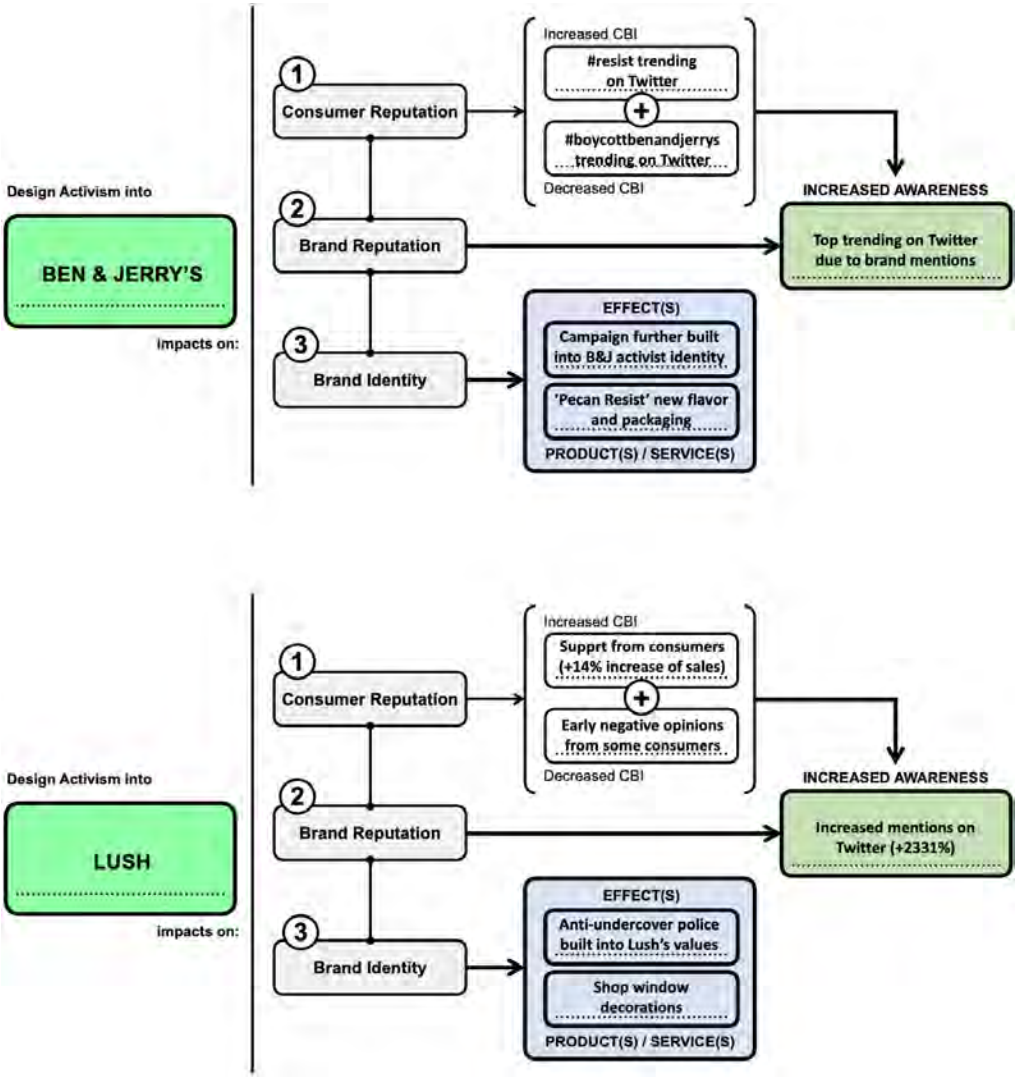

Fig. 6
Use of the interpretative model for some case studies (Nyarambi, 2021).

Conclusion

This paper explored the impact of political engagement on woke design. It demonstrates that international brands, even those considered to be leaders in their sectors, can take serious political stands to publicly support social causes, regardless of the potential impacts that may be generated against public opinion. Trends that emerged in the analysis of the literature and the case studies prove that brands pay great attention to this fast-growing phenomenon. Accordingly, it can be deduced that any brand can act as an 'agent for change' (indirectly deduced by Manzini, 2019) to support bottom-up issues, even those potentially aligned to support the weakest. This linkage is paramount because it reveals intriguing links between the perception of brands as money-makers and the visions

expressed by social design, which require forms of economic discontinuities to trigger pro-social interventions. Thus, discontinuities in the perception of brands can be produced when a pro-social campaign is implemented. In terms of design, such mutations are channelled by strategic design, which is an important means to implement activism. Visual design as a part of a strategic design intervention is also needed to coordinate the design efforts toward clear trajectories, and to avoid creating excessive anomalies in customers' feelings.

On the other hand, the analysis of literature and certain notable brand activism campaigns show that activism clearly impacts brand reputation, products and consumers. Moreover, the cultural theories and the design evidence discussed in this work further illustrate the complexity of an emerging social phenomenon that has a direct impact on design practices (Nyarambi, 2021). Woke design has clear connections with design theory, such as social design, design for democracy, political design, and marketing. From the point of view of design, there are clear indications that document how the marketing campaigns operated by different brands can generate pro-social stances while reinforcing the CBI and opening brands to take committed positions.

In terms of the impact on brand identity, early findings discussed in this work (see case studies) indicate that when brands communicate their socio-political stances, through products or services, they include activism in their brand identity: when the socio-political stance aligns with the brand's values, the campaigns inspire brand loyalty and advocacy, which are pro-company behaviours caused by high CBI (Stokburger-Sauer et al., 2012).

Design activism can have a polarising effect, eliciting strong responses from consumers due to the fact that they tackle socio-political issues that have not yet reached a consensus in society (Nalick et al., 2016). When brands were subject to backlash as a result of their campaigns, some consumers rallied to their support. Case studies have shown a stronger increase in CBI as consumers who agreed with the brand's stance exhibited pro-company behaviour.

Design activism, and woke design in general, is an effective method for raising awareness. Products and services are then effective tools to raise awareness and to voice brands' socio-political stances.

Finally, the proposed interpretative model helps to map the impact of activism on brand design. As documented in the paper, the model is innovative as it shows — or it requires the inclusion of — a set of elements useful for descriptive and inductive analyses. In terms of descriptive process, it clearly depicts the different aspects composing a brand activism campaign by asking researchers to indicate only those qualitative and quantitative aspects that are relevant to describe a brand activism campaign. In terms of the inductive process, it produces qualitative evidence that can help to generate quantitative effects (re CBI) resulting from activism; therefore, the model can show designers the possible nature of results in relation to the adoption of certain design strategies — what can be obtained from a given design-led action. Overall, the model shows activism entering the brand and influencing its brand

identity, reputation, and relationship with consumers, areas that are interconnected and contribute towards a brand (Wheeler, 2013). Furthermore, it simplifies the reading of relevant links.

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Communication Design as a Relational Mediation Approach for Territorial Networks

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Abstract
With regard to the idea of contemporary society as a system of relational networks, Communication Design for the Territory assumes a pivotal role as a facilitator for the exploration of territorial networks. The research takes on the perspective of "Apomediation", as it attempts to answer the question of how to design communication guidelines that improve accessibility and integration of the existing offer of services for health and well-being in urban spaces. Starting from the study of the social and health networks of Piacenza, the text defines the pivotal role of design with respect to the opportunity of guiding the citizen towards knowledge and participation in the services offered by territorial and digital networks. The goal is to give back to the community aggregated and inclusive information in the area, with the fundamental aim of enriching personal health culture in the daily practice of diverse lifestyles, while preserving the state of health in the event of an emergency.

Keywords
Mediation
Communication design
Relational approach
Digital networks
Territorial networks

The Territory as a Relational Network System

As a perceived, conceived, and lived space (Lefebvre, 1974), the territory suggests an image which is not unitary but rather highly stratified, determined by the plurality of physical elements, their functions, and the relationships they establish with the social environment and its community. Therefore, rather than investigating a social space from a quantitative point of view, the focus should be on a qualitative and relational investigation, with hypotheses of tools that enable people to collaborate at scale and share information.

Simmel (1908) stated that space is so only in its ability to structure relational interactions. As a sociologist, he conceived the territory as the dimension in which social relations found their spatial concretization.

At the same time, the theoretical foundation of Communication Design for Territory (due to its multidisciplinary nature) is partly found in the studies of Urban Sociology, which investigate the representation of space based on the social practices and the relationships between local people. A new Social Geography[1] perspective as "relational aesthetics" (Calabi, 2009).

As Bauman states, today's society is based on a reticular structure: its organic functioning is defined by interactive exchange and physical and digital connections (Bauman, 2003); this perspective has been previously investigated in *The Rise of Network Society* (Castells, 2010). The sociologist Castells was the first to suggest assimilating the idea of space into the network metaphor, describing the dynamism of modern society as no longer made up of physical infrastructures but of interactions between nodes. Many of these relationships appear intangible since they are not directly linked to spatial dimensions, but rather to functional and social, as well as digital interactions between the actors in the shared space. Another feature of the network is that it is an open structure: the points of intersection, the nodes, produce multiple interconnections and the multiplication of the networks themselves.

Territory, therefore, beyond its geographical and topological dimension, is a relational network system, which requires design to adopt a specific relational perspective, beyond simple representation, setting up a mediation process between physical and non-physical nodes in the network.

Within the social context described so far, the Communication Design process plays a key role. Indeed, according once again to Castells: "a central feature of the network society is the transformation of the realm of communication, including the media" (2010, p. 12).

Digital communication, based on information exchange and network connections, enables the increase of contacts, establishing links that overcome physical and temporal limits.

The designer must try to adapt to a renovated communicative perspective of digital colloquial interfaces (Anceschi, 1993), considering the multiplication of connection possibilities. At the same time, the designer cannot ignore current communication circumstances, as we live in a full-time connected reality in which social relationships intensify.

1
Simmel states that sociology studies the pure forms of relationship and represents the grammar and geometry of society (1908).

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The digital potential has allowed for *non-filtered* exchange, leading to phenomena of hyperconnection and unlimited access to knowledge and disintermediation[2], with an overload of worthless information.

2 Eysenbach (2007) writes that information and communication technologies empower consumers; they allow them to cut out the middleman to access the information directly.

Communication Design Matters: From Territorial to Digital Networks

The proliferation of digital connection has shortened communication distances and provided an alternative relational space to the physical one. It has also guaranteed free access to an ever-increasing amount of more or less reliable online information about different social topics and practices. For example, self-help and online communities have spread widely: through social networks, the active exchange between individuals sometimes overcomes the need for dialogue with experts as intermediaries. They are used less for self-expression and more for offering or seeking support, for sharing specific personal experiences.

A typical example are the phenomena of Online Health Communities and the evolution of Medicine 2.0. On the one hand, the rise of new digital communities provides several advantages in bringing together more people involved in the same health issue and creating actual support groups. On the other hand, however, they cannot be considered reliable sources of information. Nevertheless, even if users are aware of this, they benefit from the social support perceived through the relational exchange: "Online Health Communities is pivotal in facilitating social relationships" (Hajli et al., 2014, p. 238). This happens not only within communities, where trusting relationships are established between participants, but also in the more generic activities of web surfing and interacting with search platforms.

With reference to Medicine 2.0, recent pandemic circumstances have led to a tangible spread of digital intermediation systems, such as telemedicine, e-health, and patient monitoring systems. This phenomenon is more controlled, as it directly involves the experts who interface with the citizens. However, it does not directly involve the network system and is very effective on an individual level, but less widespread.

From a design point of view, the risk sometimes lies in considering digital not as a simple communication media but as a device in itself. Communication Design must develop devices that respond to a digital need, taking in account the territory, the network and the community healthcare space. In this specific case, the research enhances the role of mediation between networks, collaborating in the dissemination of information related to the activities carried out in urban areas not only by hospitals, but also by Third Sector Entities (TSOs) generally independent of public administration or private parties.

From Research To Framing: Designer as Network Mediator

"A system isn't just any old collection of things. A system is an interconnected set of elements that is coherently organized in a way that achieves something. If you look at that definition closely for a minute, you can see that a system must consist of three kinds of things: *elements*, *interconnections*, and a *function* or *purpose*" (Meadows, 2009, p. 11).

In accordance with the definition of territory as a relational system, both physical and virtual, and paraphrasing Donella H. Meadows, it may be stated that the urban context system is the result of the interconnections established between actors within the social environment in which they interact. Developing a design thought shaped on the systemic model[3] requires an in-depth study of the dynamics that determine and influence Communication Design actions.

As such, the designer's role can be described from a double point of view: on the one hand, naturally rooted in the physical territorial context, on the other, necessarily projected towards the integration of the latter with the digital space. It is no longer relevant to distinguish physical networks and digital networks, but to refer, rather, to hybrid systems[4], in which digital issues cannot ignore the territorial dimension. Therefore, the designer is called upon to assume the role of "mediator" (Castelli, 1996) as a relationship reorganizer and connector.

Mediation is understood here as a process that activates a filtered exchange, not at the content level but at the "device-level", in a communication apparatus that effectively translates the complexities of the relationships between the nodes. It considers the physical and virtual contact and access points, interpreting the actors' needs and promoting network awareness. A process of mediation between needs (Celaschi, 2008), focusing attention on the transmission and transparency of the system connections to promote individual empowerment[5] within the network and create an inter-institutional collaboration between organizations and citizens. This effective design approach projects itself beyond simple "intermediation", contact opportunity, and information exchange. It places the designer as a relational mediator, an "apo-mediator"[6], to ease connections and help access credible content.

As a "relationship mediator", the designer is not concerned with creating content but with creating reliable orientation and access points to information. Apo-mediation as a dialogic concept, redefining the designer's responsibility as a junction between the nodes of the relational network and potentially between networks themselves. The mediation project is at the service of the user, taking into account the existing offer and at the same time promoting new spaces and opportunities for interaction.

Design as a mediator "of relationships" and "for relationships" does not impose a central presence to translate and reformulate the message, but rather points out new ways of using and accessing reliable and credible content that is adaptable and scalable across the entire network. "It characterizes the 'third way' for users to identify trustworthy and credible information and services" (Eysenbach, 2008, p. 5).

3
In System Thinking: "We seek out a deeper understanding of how the world works, so that we can design parts that work better within it" (Acaroglu, 2017, p. 51).

4
The physical and digital elements belong to hybrid territories (Quaggiotto, 2017).

5
Rappaport (1987) defines "empowerment" as a process through which individuals, organizations, and communities acquire greater control over issues that are vital to them.

6
"Apomediation" means that there are agents, like people or tools, which "stand by" to guide a consumer to high quality information and services (Eysenbach, 2008).

diid No. 79 — 2023
Doi: 10.30682/diid7923m

Toward a Future Territorial Perspective: A Design Case Study on Healthcare Relationships

"Ecological models of health are based on the premise that an individual's behavior is shaped by a dynamic interaction with the social environment, which includes influences at the level of interpersonal, organizational, community and political networks" (Zazzera, 2021, p. 36).

The approach and reflections described so far represent the theoretical basis for the research Coltivare_Salute.com[7], a project centered on the Italian territorial health system, to promote disease prevention and share well-being. A distinctive feature of the Piacenza area, our specific case study, is the consolidated existence of Community Houses/CdC (or "health house" – Case della Salute/CdS). These facilities offer citizens a set of social and care services and promote a better health culture as wellbeing and prevention. The research aims to assign CdC a new role as a neighbourhood center of urban and social regeneration.

Communication Design enhances that role through the context of networks, which complete the offer of services to the community. The results are summarized below in terms of analysis and interface design experimentation, with the aim of subsequently defining a methodology: Communication Design guidelines.

Firstly, regarding the ecological model of HiAP (Health in All Policies[8]) an initial consideration focuses on the idea of well-being and health: they are relational concepts, as they are dependent on the continuous exchange between individuals and strongly determined by the social, cultural, and territorial context taken into analysis. In particular, the healthcare system in Piacenza is based on promoting health services within a dense network connecting social and health-care actors with citizen associations and the community. Secondly, even if at the functional and organizational level a well-structured network is evident, the same systemic organization cannot be found on a communicative level: the broadscale availability of the healthcare services does not correspond to an equally widespread and effective communication providing real access.

Therefore, starting from a focus on the general territorial availability of health services, the research investigated different design solutions focused on the transition from a fragmented to a scalable and relational communication model. As Villari (2012, p. 57) claims, "The comparison with the territorial dimension also requires Design to adopt a multidisciplinary approach, methods of scientific verification based on the reproducibility of models for an environment that, on the contrary, are not usually reproducible".

Therefore, in this perspective, the design effort consists in adopting mediation strategies between individuals and the system of structured networks present in the territory, offering citizens complete access to information and providing guidance tools towards wellness and health paths. Paths that can, for example, become true urban itineraries that can be extended to the entire community, managed by hospitals and TSOs for functional rehabilitation and prevention, but always suitable for shared sociability.

The first phase of the research involved the creation of interactive maps, a first digital representation of physical spatial

7
Polisocial Award 2020, *Coltivare_Salute.Com. Città e Case della Salute per Comunità resilienti. Le Case della Salute quali costruttori di urbanità e socialità diffusa nell'era post COVID-19*: nuove centralità periferiche in città salubri e integrate. The project focuses on territorial healthcare networks in Piacenza and involves four departments of the Politecnico di Milano: DABC, DAsTU, DESIGN, DIG. http://www.polisocial.polimi.it/it/progetti/

8
The Declaration of Helsinki on Health in All Policies (HiAP) is an approach to public policy in all sectors. It considers the implications of policy decisions to avoid harmful impacts on health.

relationships, to understand the leading actors in the district health system. Following the first collection of cartographic data related to the actors around the CdC (health centers, community associations and citizens' committees), the next step focused on shaping more accurate maps, through the selection of information and linked actors, considering the most useful elements to share and represent in order to empower the community awareness.

Fig. 1-3 show the survey conducted in collaboration with the Comitato Sportivo Italiano (CSI, Italian Sports Committee). The study focuses mainly on two key steps: from the geophysical dimension to the abstract data, designing targeted info-graphics to better understand the connection; from the abstract data visualization to the overlapping of links on the geographical dimension.

Fig. 1 shows the relational synthesis originated from the geolocation of the territorial actors and the loss of the topographical dimension into an abstract diagram of links between the nodes. Fig. 2 proposes data visualization focusing on the central role of the CdC within its healthcare and social network. While these first representations constituted an excellent starting point to improve citizens' perception and awareness of the territorial network, they were not suitable for inclusion in a systemic, dynamic, and widespread communication approach.

The next step focused on a hybrid communication system and its possible representation, which, in addition to providing an overview of the networks, effectively identifies the individual node as belonging to the system and as the hub of connected activities Fig. 3. More than a traditional cartographic device, the result is a dynamic map of the relationship between the actors within the network. The cartographic interface returns an interconnected, adaptable, and scalable representation of the "network territory", which provides selected information based on the specific observation point. Having verified the effectiveness of the methodology, it was possible to commence the final phase of the work, which culminated in the definition of the guidelines for the communication of territorial networks Fig. 4 and of some experimental map-based application hypotheses.

Communication Design Guidelines for Health Culture

The process described so far has pointed out the need for an alternative communication system, going above the geo-referred representation and traditional wayfinding systems, that can support the community in finding accessible information, in orienting itself within the network, and above all, in developing awareness of the specific health opportunities available in the territory it inhabits.

More specifically, the study of the healthcare in the Piacenza district highlighted certain values to be taken into account for the application of the guidelines: the central role of the CdCs as main actors to promote health culture; the idea that personal and community health are linked to and determined by the territorial context; the importance of the community's active participation in the network.

Regardless, the paradigmatic change of the role of the designer from direct mediator between community and territory to

diid No. 79 — 2023
Doi: 10.30682/diid7923m

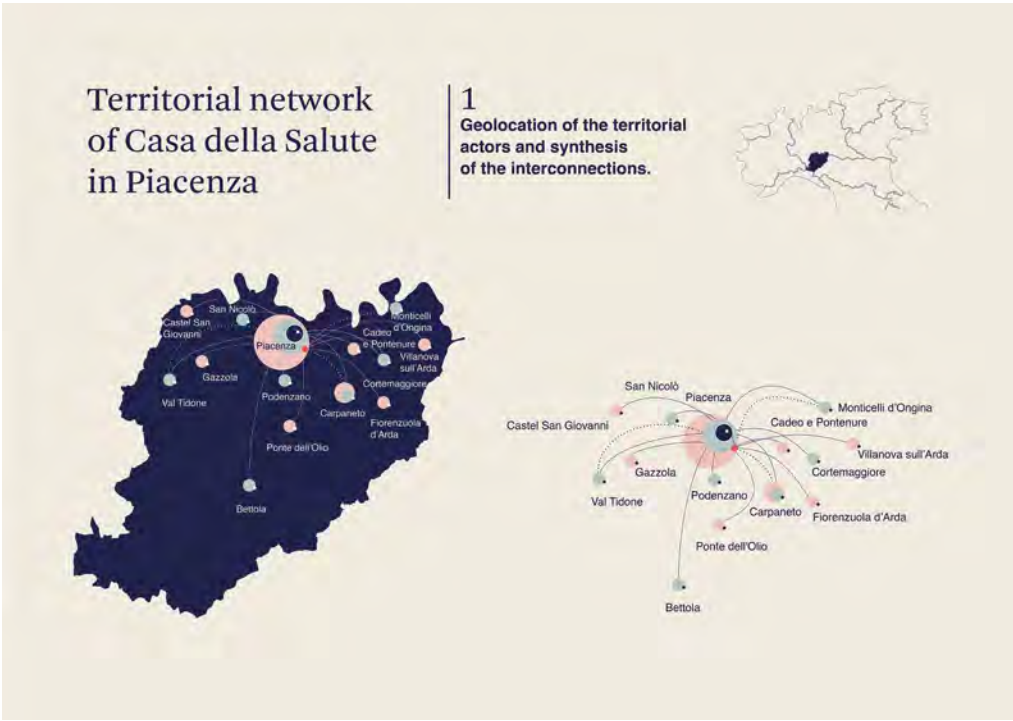


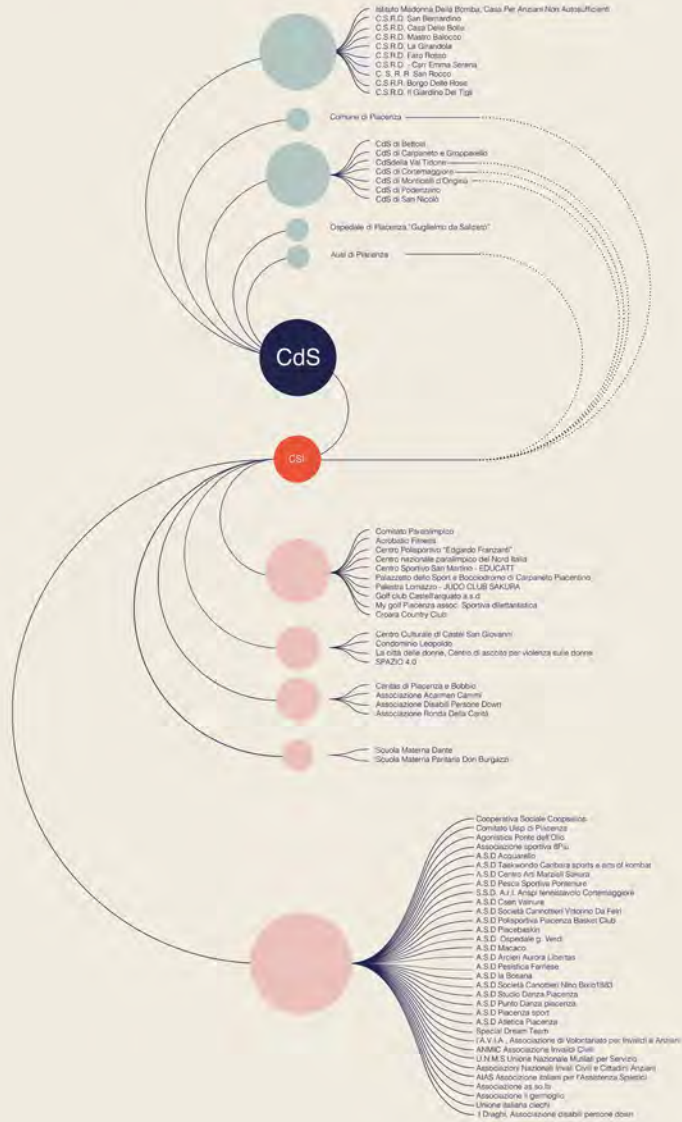
Fig. 1-2
Study visualization: from the geo-physical dimension to the abstract data by Daniela Anna Calabi and Alice Maturo.

relational mediator is crucial. A design approach which features a dynamic representation of network interconnections is required, through the integration of nodes within a hybrid territorial perspective, beyond static widespread territorial communication.

The purpose of developing a communication system that places the CdC within the network of relationships of which it is the central node in the territory, coherently summarizes the proposal for a system that makes information accessible and complete. At the same time, it is essential to simultaneously clarify the relationship between places, territory and the geolocation of services. With these aims, Communication Design Guidelines for Health Culture, articulated on three different levels, were developed: development of cartographic systems for orientation; information and content accessibility; empowerment of social media for the community. The current research project was followed by experimental application projects, based on the guidelines, with experts (specifically Marco Quaggiotto) and young interns and graduates in Communication Design, including Giada Zoncada and her master's thesis.

Territorial network of Casa della Salute in Piacenza

2
Arc diagram of relational links between the CdS and other sanitary and social actors

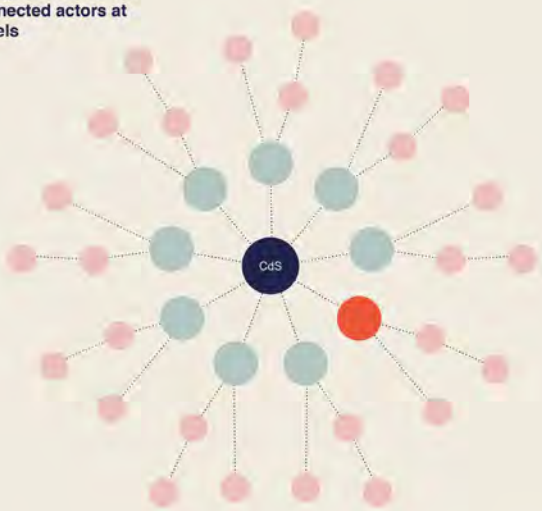


diid No. 79 — 2023
Doi: 10.30682/diid7923m

Territorial network of Casa della Salute in Piacenza

3
Data visualization graph showing the dynamic network of interconnected links

Abstract dyagram to describe the interconnected actors at different levels



Activities for people with motor disabilities

Children and gymnastic education

Interconnected graph system applied on the territorial network of Casa della Salute in Piacenza

The diagram shows the adaptability and dynamic scalability of the graph about the specific case study of Piacenza CdS, in collaboration with CSI. This visualization ensure accessible selected informations to the citizen, according to a specific topic.

Women's health

Activities for people with intellectual and social disabilities

Disability assistance

COMMUNICATION DESIGN SPECIFIC GOAL	GUIDELINES FOR GRAPHIC AND ORIENTATION SYSTEMS	
	DESIGN ACTIONS	DIGITAL TOOLS
SG 1 Ensure the recognition of *Case della Salute* in the context of the Health Culture Communication actions must ensure information and guidance	Provide geo-localization tools, easy identification of *CdS* and orientation within the network of actors in the territorial network	Use geo-localization tools on a cartographic basis (website with cartographic representation) for the identification of *CdS*. To ensure greater accessibility, a simplified representation of the territory is suggested, containing the data necessary for orientation, a symbology and an effective categorization of the elements, and and a scalability at different levels in-depth.
SG 2 Communicating the network of health actors, explaining the relationships on the territory Communication actions must be informative and guidance-based	Provide tools for geo-location and way-finding for orientation on a cartographic basis and in the territory	Geo-referencing and representing health actors and their territorial organization within the structured network between *CdS* and actors themselves.
SG 3 Promoting the Health Culture on the territory Communication actions must explain to the citizen the initiatives, mapping sports associations, training places, sports and rehabilitation paths	Provide geo-localization tools to identify actors, relationships and activities	Make visible on the cartographic representation elements for the identification of health routes and their territorial distribution within the network.

Fig. 3
Study visualization and prototypes: from the data visualization to the dynamic territorial mapping by Daniela Anna Calabi and Alice Maturo.

Fig. 4
Scheme: Communication Design Guidelines for Health Culture and Actions/Design Output by Daniela Anna Calabi and Alice Maturo.

Conclusions. Considerations on a Relational Communication Design Approach for Mediation

"Maps are fleeting, contingent, relational and context-dependent, emerging through transductive processes to solve relational problems" (Dodge & Kitchin, 2007, p. 331).

In conclusion, it is worth highlighting specific results and evidence. The metaphor of the interconnected graph offers a precise image of the territorial network system: it expresses the dynamic, organic, relational and open traits of social connection into an environment that changes and multiplies depending on the point of observation.

diid No. 79 — 2023
Doi: 10.30682/diid7923m

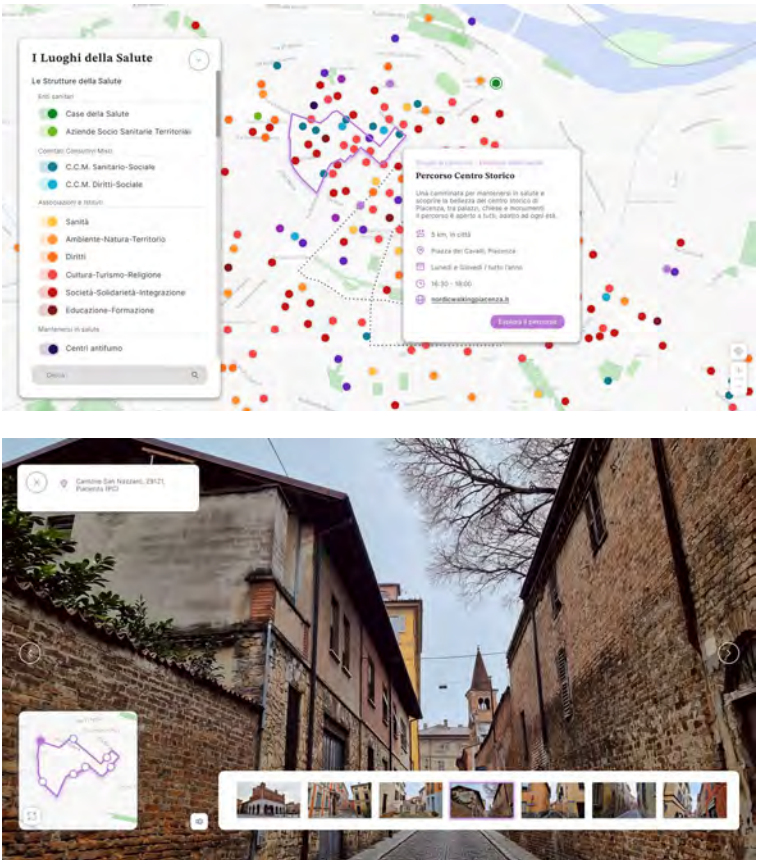


Fig. 5-6
Interfaces for the exploration of the Territorial Networks. Georeferencing and representation of the actors and their activities. Immersive visualization for orientation and involvement of people. By Giada Zoncada.

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At the same time, it is the key to a renewed community-centered service communicative approach. The use of digital tools to communicate the healthcare and wellbeing network is motivated by giving the user a clear image of the actual dynamics of onsite social exchanges, within a mediated communication apparatus. It is not a multiple virtual exchange tool, such as online community systems or e-health applications, but rather a systemic project of dynamic networks, showing a wide-scale perception of the entire system and providing data for citizen awareness and accurate information about each node's network, according to a selected topic. It is a project of relational mediation to foster the multiplication of social, healthcare, inter-institutional, hybrid networks: digital but anchored to the physical dimension of the territory. The training of young designers capable of taking on this new responsibility is another desirable outcome of this research.

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Forum and Reviews

Over the Mainstream

Edited by Andreas Sicklinger

Ph. Siti Marhainis binti Abu Mansor and Nur Syazana Osman.

Introducing Industrial Design to the Public

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The success of the nation's development is significantly influenced by industrial design. Recent changes in the local consumption landscape have highlighted the value of industrial design and how it transcends simple aesthetics. Industrial design, which may be divided into the three main categories of product design, automobile design, and furniture design, is a vital component that permeates the entire product manufacturing process. In a nutshell, industrial design underlies everything we use, from the chair we sit on, to the car we drive, and to the kettle we boil our water in. This vast scope reflects the national significance of industrial design, but the common mistake Malaysians make when industrial design is mentioned is that 'industrial' means factories and the works with regards to heavy industries. This misconception has resulted in unappreciated industrial designers, even if the products they designed are being used and enjoyed worldwide. The *Flipper Toothbrush Holder* invented by Goo Yock Tee, the *Automatic Egg Boiler* invented by Datuk Hew Ah Kow, the *Nehemiah Walls* invented by Dr. Nehemiah Lee, and the *Polyclone Rubber Stamp and Vision Touch Braille Phone* invented by Robest Yong are some of the products designed by Malaysians, but they did not become well-known as industrial or product designers.

Industrial designers in Malaysia have a respectable opportunity since we currently develop and manufacture products for other major overseas brands such as Original Design Manufacturing (ODM) and Malaysia is next moving towards Original Brand Manufacturing (OBM), where we hope to be able to create and produce our own line of goods. Therefore, in order for the aspiration to come true, we have to attain the wealth of skills and resources necessary for success in the industrial design field, providing assistance to the public so that they are more familiar with the field of industrial design and understand the value it can bring to a product or service as well as the quality of lives. This is where

diid No. 79 — 2023
Doi: 10.30682/diid7923n

academia may help, by educating the public on the correct definition of the industrial design, and its role and impact on people, communities and the society as a whole.

In order to educate the public, a number of initiatives have been undertaken in Malaysia. Design competitions, design talks and exhibitions have been conducted in order to promote design. Kuala Lumpur as the national capital of Malaysia, has conducted annual design events that aim to promote the importance of design to the public, consisting of activities and exhibitions by leading design associations of architecture, industrial design and visual communication. *Kuala Lumpur Design Week* (KLDW) is an annual event in Kuala Lumpur that features a wide range of design-related activities including exhibitions, talks, workshops, and competitions. The event is typically held in the month of September and aims to promote the city's design community and showcase the latest trends and developments in the field of design. It typically features a mix of local and international designers and design studios, as well as students and design schools. It also focuses on different themes each year such as sustainable design, urban design, technology and design and many more. In 2022, the annual design month was reintroduced into *Kuala Lumpur Design Festival* (KLDF), where in addition to promoting the importance of design to the public, the festival also consists of international trade and exhibitions akin to design. However, a large proportion of the participants in the events were from design associations and higher learning design schools, and the number of public participants was not very encouraging.

This is where an intervention featuring an awareness event for a target audience is needed. In addition to the earlier above-mentioned events, awareness programmes that educate the public about industrial design should begin in schools, where the majority of the public can be reached through the direct involvement of the school children, and indirectly through their parents and consequently to the community. The involvement of the school children in the industrial design process would be a firsthand experience for them to understand what industrial design is all about.

School plays a crucial role in nation-building, by educating and preparing future citizens to participate in and contribute to society. It provides individuals with the knowledge, skills and values needed to become productive members of the community and to make informed decisions that will shape the country's future. Through a well-rounded education, students learn about their rights and responsibilities as citizens, and they develop the critical thinking and problem-solving skills necessary to address complex social and economic issues. Furthermore, schools foster a sense of national identity and pride, promoting social cohesion and helping to build a strong, unified nation.

School children are typically between the ages of 5 and 18, and they are in the process of learning and developing academically, socially, and emotionally. They have a wide range of abilities, interests, and personalities, and they come from diverse cultural and socioeconomic backgrounds. They have varying levels of attention span, motivation, and engagement in learning. Additionally, school children tend to be very curious and eager to learn new things. This may therefore be seen as the best time to introduce industrial design. Another key benefit of introducing industrial design to school children is that it helps promote social cohesion and understanding. This is particularly important in today's increasingly diverse and globalised world. By raising awareness of the importance and role of industrial design in everyday lives, children are better equipped to understand and appreciate the perspectives of products and design ideas and development. This is essential for building a more tolerant, inclusive, and industrial design conscious society.

There are several different ways in which awareness can be raised among school children. One of the most effective methods is through the use of engaging interactive educational materials. For example, children can learn about different industries and economic sectors through the use of storybooks, videos, and other multimedia resources. These resources help children to understand and appreciate the perspectives of others in a way that is both fun and engaging. In addition to that, schools can also use more traditional approaches to raise awareness

Fig. 1
Industrial design exhibition at the *Kuala Lumpur Design Week 2018*.

diid No. 79 — 2023
Doi: 10.30682/diid7923n

Fig. 2
The involvement of design faculties in one of the events of the *Kuala Lumpur Design Festival 2022*.

among their students. For example, they can invite guest speakers to talk to the children about different topics. For example, a guest speaker from a local industrial design organisation can talk to children about the needs of an original design, while a guest speaker from a local manufacturing or production industry can talk to children about the future of product manufacturing.

Another effective method for raising awareness among school children is through the use of roleplaying and hands-on activities. For example, children can learn about the importance of industrial design for the economy by participating in a product design development activity. These activities help children to better understand and internalise the messages to which they are being introduced. Hands-on activities can also promote a deeper understanding of the product design process concepts, as children are able to engage with and manipulate materials related to the topic they are learning. Additionally, hands-on activities can be more engaging and enjoyable for children, which can increase their motivation and interest in industrial design.

This awareness plan for school children was tested with the design project given to Universiti Kuala Lumpur's undergraduate students, taking the course in product design. In this course, students will learn how to design and produce a product, beginning with the identification of user needs, through concept development and selection, taking into account ergonomics considerations.

At the beginning of the semester, these students were given a problem that they needed to solve through the design of a product. The product design method uses the Quality Functional Deployment, in that this method makes it easier to visualise the quantification of the correlation of needs with the developed products. The visible correlation also allows the users to easily relate their role as the source of the development of the product. Hence, this subject is the most fitting to involve the school children, who will be assigned the role of the end users of a product, and consequently will be aware of the role of industrial design and industrial designers in society.

In a particular semester, a group of product design students from Universiti Kuala Lumpur worked with a primary school in Kuala Lumpur, where a number of 10 and 11 year old students were selected to be involved in the product design process development. These product design students were given the task to redesign the traditional Malaysian games usually played by children. In Malaysia, Congkak, Gasing, Batu Seremban, and Baling Tin are among these traditional games. Congkak is a game played with a board and small shells or marbles, in which players take turns to move the shells or marbles around the board following specific rules. Gasing is a game played with a spinning top, which players spin using a string or cord. Batu Seremban on the other hand is a game played with small stones, in which players catch the stones thrown up in the air, while Baling Tin is a game similar to bowling, but played with empty cans and a rubber ball and involving running and catching players. These traditional games as the product subject are seen as suitable to involve the children as the end users in the product design process. The end user plays a crucial role by providing feedback and input on the design and functionality of a product. This feedback can help guide the design team in creating a product that meets the needs and desires of the target market. End users can also test prototypes and provide feedback on usability and user experience. This allows the design team to make adjustments and improvements before the final product is released. Overall, involving the end users in the product design process helps ensure that the final product is tailored to meet the needs of the target market and is more likely to be successful. Thus, with the inclusion of the school children as the end user in the product design process, not only do the school children receive the first-hand experience of the early stage of an industrial design, but the undergraduate product design students also gain knowledge, skills, and understanding about end user behaviour, through observation, interaction, or participation with the school children in the activity.

At the beginning, the school children were given a brief introduction about industrial design and an overview about the entire activity of design , and what their roles are in the design process. This was followed by

diid No. 79 — 2023
Doi: 10.30682/diid7923n

Fig. 3
School children playing the *Baling Tin* traditional Malaysian games together at school.

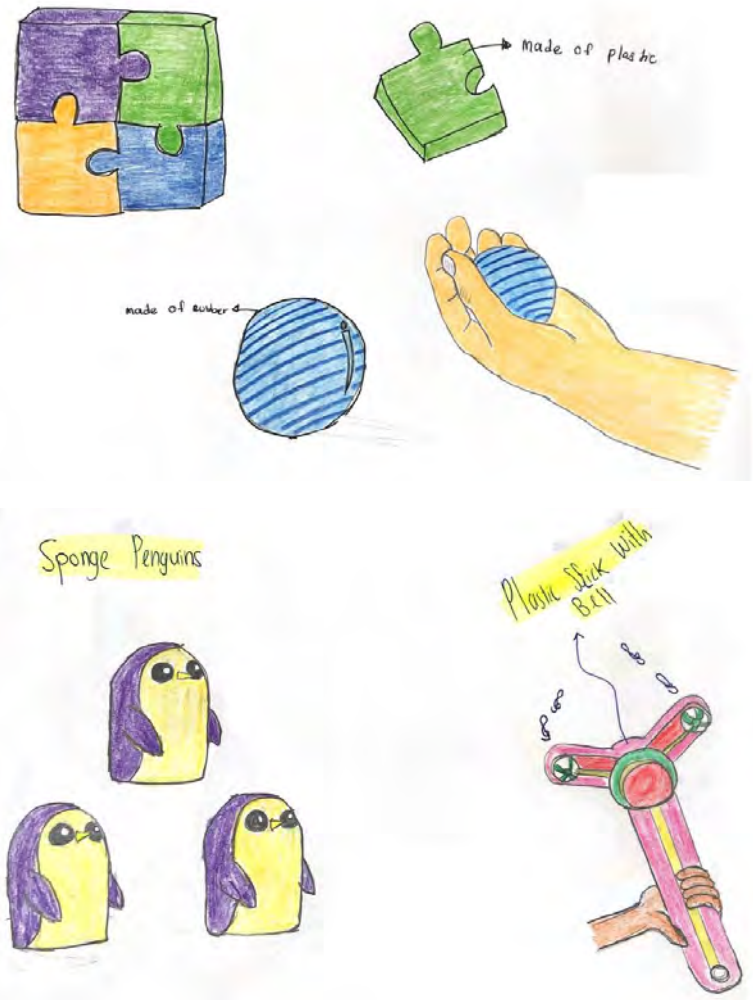

Fig. 4
Some of the concepts proposed by the school children for modernised traditional Malaysian games.

diid No. 79 — 2023
Doi: 10.30682/diid7923n

Fig. 5
Universiti Kuala Lumpur undergraduates in the Product Design programme with their concepts of modernised traditional Malaysian games.

focus group activities in which the school children were given the original traditional Malaysian games to play and experience themselves. This step is highly important in order to create users with sufficient knowledge of the products and a sense of belonging to the project. After the playing session, the school children were asked how they felt about the traditional games they played, how comfortable they were in playing them, what they liked best and if they had any complaints about the games. The school children were very enthusiastic in giving their opinions at this stage. They were also asked what they wanted to maintain, change or improve in the traditional games. At this point, the product design students also explained to the school children how their responses would affect the development of the product.

The school children were very excited as they began to understand the impact of their input on the designed product. At this stage, they seemed to have a clearer view about industrial design and especially about how people interact with products, in order to improve their safety, usability, and overall user experience.

The next steps in the product development processes were also explained to the school children, and they were informed that the final product would be designed and selected based on their input, and would be developed. Apart from the activities described above, the school children were also given the chance to design their own modernised traditional Malaysian games.

From the design activity conducted with the school children, it was found that active involvement in the design process reflected a great deal towards the understanding of the subject, which in this case was the industrial design. It is important that a tangible product be the subject of design, as well as the suitability of the product itself to the public so as to stimulate interest towards industrial design. Apart from the hands-on activity for school children, colleges and universities must also provide a platform for school children to foster their interest towards industrial design by hosting design competitions and exhibitions specifically for them. Competitions in particular can serve as an effective awareness programme by engaging individuals and groups in a shared goal or objective thereby providing a platform for showcasing and promoting different perspectives, ideas, and achievements. Design competitions in particular, which encourage participants to come up with creative and functional solutions to a particular problem or issue, would be educational and raise awareness about different fields of design and the impact of industrial design on society.

These efforts should be pursued tirelessly and continuously, to create consistency in educating the public about industrial design. A continuous effort is important because it helps to create a more informed and engaged public, leading to increased support for policies and programmes that address the issue at hand. It is also worth mentioning that a continuous effort in educating the public about industrial design can also help to break down stereotypes and misconceptions, and to promote greater understanding and hopefully involvement among different demographics of people. Furthermore, the inclusion of decision makers in the industrial design awareness efforts should be implemented robustly because they are the ones who have the power to influence the development and implementation of policies and strategies related to industrial design.

Decision makers who are aware of industrial design can make informed decisions about issues such as funding, intellectual property protection, and regulations that can impact the development of innovative, user-friendly products that can improve people's lives and contribute to economic growth. In addition, decision makers who understand the value of industrial design can further promote its importance to the public and encourage more people to pursue careers in this field, which will help create a more vibrant and dynamic design community. We aspire to the day when whoever you ask in Malaysia about industrial design, would relate industrial design to the consumer products they use, and be able to name some of the Malaysian industrial designers.

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Forum and Reviews

Cultural and Creative Industries

Edited by Elena Vai

Ph. Boris Meggiorin.

Creative Industries and Cross-Sectoral Innovation: A European Story Through Policy and Funding

From the Green Paper to the New European Bauhaus

Boris Meggiorin

A (Not So) Recent Beginning

Following the publication of the European Agenda for Culture[1] in 2007 and the Green Paper[2] on the potential of cultural and creative industries (CCIs) for economic growth in 2010, many European institutions and research centres have turned their attention to studying the impact of cultural and creative activities on the economy in general and on innovation in other industrial sectors.

Creative industries became a major focus of industrial policy throughout Europe. High expectations were placed on this sector as it was expected to contribute to the industrial renewal of the European economy.

However, both mapping operations and quantitative analyses were confronted with methodological questions[3] (Which subsector should be included in the CCIs?), political questions (Is it fair to measure the economic performance of public subsidies to the arts sector?), and cultural questions (Do gastron-

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The European Union's 2010 Green Paper on "Unlocking the potential of cultural and creative industries" was a policy document that aimed to identify the main challenges facing the cultural and creative industries in the EU and to outline a range of policy measures to support the growth and competitiveness of these industries. The paper recognized the significant economic and social contributions of the cultural and creative industries, which include sectors such as advertising, architecture, the arts, crafts, design, fashion, film, video, and photography, music, performing arts, publishing, software and video games, and television and radio. It also acknowledged that these industries are facing challenges such as digitalization and globalization, which are changing the way they operate and compete. The paper outlined a range of policy measures to support the growth and competitiveness of these industries, such as increasing access to finance, improving copyright and intellectual property protection, and fostering international cooperation.

diid No. 79 — 2023
Doi: 10.30682/diid7923o

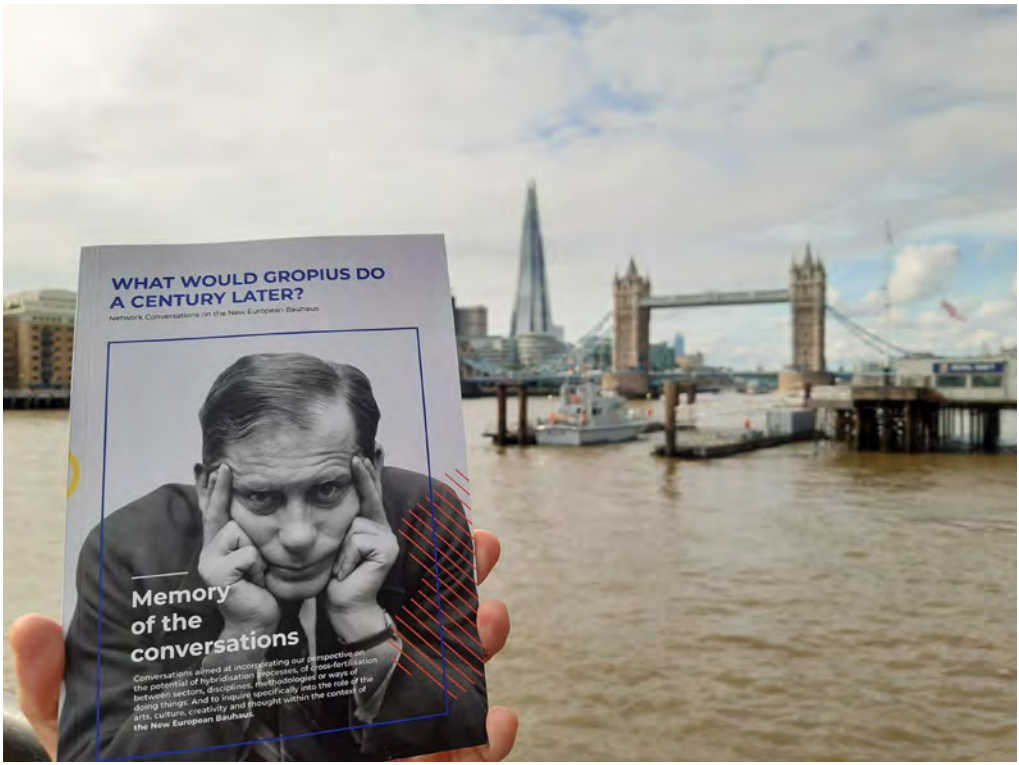

Fig. 1
Conexiones improbables, as official partner of the New European Bauhaus, launched a series of meetings titled *What would Gropius do a century later? Network conversations on the New European Bauhaus*, that seek to analyse, from different thematic areas, the role played by the arts, culture, creativity and thought in the processes of transformation and innovation of organisations and territories, as well as create a network of dialogue and reflection on the contribution of transdisciplinarity, hybridisation and cross-fertilisation between sectors and knowledge to developing Europe's future. Ph. Boris Meggiorin.

omy or tourism count as creative activities?).

In some countries, such as France, ethical questions also rose to public attention: isn't it risky to evaluate the economic impact of artistic expression? As recipients of public grants, why should we measure their impact in terms of economic value? Are we shifting from grants to investments? What about "L'art pour l'art"?[4]

Nevertheless, the banking and debt crisis in Europe in the early 2010s made the rhetoric of economic development inadequate (obsolete?). In the meantime, we witnessed the progressive introduction of environmental issues into national and European agendas. The European Union 2020 Agenda was replaced by a stricter net-zero strategy and the mitigation of climate change effects became an important field for the collaboration between CCI tools and ecological transition policies and circular economy.

At all these stages, interest in CCIs and their cross-cutting role in society and the economy has continued to grow, beyond their mere impact on employment and growth.

Joining the Dots

What used to be a set of local and isolated experiences in different European countries began to be placed under constant observation and framed by academia and policy makers. It meant reviewing organisations proposing the improvement of processes through artistic thinking, designers working on industrial projects since their early conception stages, spontaneous collectives of artists occupying abandoned urban areas following industrial transformation. Even if progress occurred at a different pace throughout European regions, the production of compelling academic research improved the availability of public funding at all levels of governance.

The recognition of the role of the arts and culture in society is nothing new. The pilgrims along the Via Francigena recognized a soothing function for body and spirit in the frescoes of Assisi , defining an intuitive link between art and health. In more recent times, industrial companies such as Italsider and Olivetti integrated artistic knowledge in different forms, both in production and in the well-being of the workers.

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"L'art pour l'art" is a French phrase that translates to "art for art's sake." It refers to the idea that art should be created and appreciated solely for its own sake, without any practical or moral purpose. This concept originated in the late 19th century and was associated with the Aesthetic Movement, which emphasized the beauty and form of art over its subject matter or meaning.

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Even if many aspects of Richard Florida's work have been refuted today, it was highly influential in the 2000s.

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The SAMOA Quartier de la Création Nantes with IIT Institut für Innovation und Technik Berlin, for ECIA European Creative Industries Alliance in 2014.

The contribution of creative industries to the broader economy became clearer in the early stages of globalisation and the digital shift at the turn of the millennium. Phenomena such as the collapse of the music industry or the development of the gaming industry, highlighted the global economic value of such sectors. The work of Richard Florida on the creative class[5] in the US and the aforementioned Agenda for Culture and the Green Paper in Europe promoted new policy windows.

Framing the Phenomenon

The next step was to identify what we mean by cross-sectoral innovation involving the culture or creative practices. Terms such as spill over, hybridisation, creative fertilisation... were popularised and came to define these types of operation.

A new wave of research made it possible to classify these types of collaborations, assessing their intensity and impact, on a spectrum ranging from low intensity, e.g. SMEs hiring a graphic designer for a new website, to the more radical high-intensity innovations promised by the artistic interventions in organisations[6], appearing in the form of residencies of artists interacting with a company's workers for one year.

European funding supported cross-sectoral local projects, even before national or

diid No. 79 — 2023
Doi: 10.30682/diid7923o

Fig. 2
Architecture as well as other disciplines is changing greatly thanks to new innovative approaches for public spaces. Ph. Boris Meggiorin.

Fig. 3
Mani Grandi a Venezia, by Lorenzo Quinn. La Biennale di Venezia 2017. New forms of collaboration try to overcome the effects of individualism when it comes to innovation. Ph. Boris Meggiorin. Ph. Boris Meggiorin.

diid No. 79 — 2023
Doi: 10.30682/diid7923o

regional funds. In fact, even if Treaties attributed no competence in cultural matters to the EU, they allowed a breach for action from an economic point of view.

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EU Funding Support to Cross-Sectoral Innovation

Some examples in this sense were several projects that I followed closely, such as Creative Clash[7], TAFI[8] – Training Artists for Innovation, both supported by the EU Culture Programme in 2010 and the ECIA[9] – European Creative Industries Alliance, co-financed in 2011 by the European Competitiveness and Innovation Programme (CIP).

These projects involved scholars, practitioners and industrial companies acting as recipients of artistic interventions in organisations. They fed regional and European authorities with results and impacts and raised awareness of the potential of brokering actions to manage the collaboration between the world of the arts and traditional economic sectors.

ECIA in particular was a policy learning platform funded by the EU with more than 20 partnering organisations. It studied ways to improve regional conditions for growth through the creative sector. For example, it analysed the integration of creative services, such as design, with traditional manufacturing sectors to add value and enhance the economic performance and robustness of European industry. Although there was agreement that the collaboration between creative industries and traditional industrial sectors resulted in cross-innovation of new products, services and processes, back in 2011 there was still little proper understanding of the mechanism behind it.

Particular emphasis was placed on the instruments that could be used by local and regional authorities to promote cross-innovation involving both creative industries and traditional industrial sectors. This was the case with the study of the VINCI innovation vouchers in the Upper Austria region[10], run through the joint effort of the cultural unit and the economic development service of the regional government.

All these efforts converged into the design of the "perfect framework" for the regional development of cross-sectoral innovation based on cultural and creative industries.

These and other initiatives by the most dynamic territories have enabled the European Commission to gather evidence to come up with new funding schemes integrated in Horizon 2020, Erasmus + and the COSME programmes, specifically addressing the promotion of cross-sectoral innovation throughout the continent. They were designed to support collaboration between the creative industries and other sectors.

However, these kinds of initiatives were slowed down by a number of obstacles, such as:

- the degree of awareness of local public administrators and economic operators of what cross-innovation is;
- the compartmentalisation of knowledge in educational systems and the existence of administrative silos in the distribution of political competencies, as well as the fiscal categorisation of private activities;
- the uncertain ownership of intellectual property and copyrights of creative products generated by these collaborations;
- the internal culture of companies in dealing with change;
- the lack of training for artists willing to interact with realities other than their own;
- the urgent need to obtain tangible products from collaborations, reducing the time and resources available for process analysis and experimentation not linked to artefacts.

The obstacles have been extensively studied and each impediment has led to a new wave of projects proposing solutions to overcome them.

The more industrially or politically mature regional territories found an ally in the Intelli-

Fig. 4
Hybrid event in the form of a pop-up radio, produced by the author for MateraHub as part of the Deus project on open design as a method for innovation.

diid No. 79 — 2023
Doi: 10.30682/diid7923o

gent Specialisation Strategy RIS3, promoted by the EU more than 15 years ago. Giving priority to a reduced number of economic sectors improved the possibility for reciprocal collaborations. And when Cultural and Creative Industries were listed in the RIS3, it was a good observation point for cross-sectoral innovation experiences steered by regional authorities. The construction of a favourable environment at the national level also led to the establishment of inter-ministerial strategies, e.g. by the governments of the Netherlands and Estonia.

Some branches of the creative industries, such as architecture and design, have shown a greater affinity for working with private companies. It should be emphasised, however, that the most daring solutions are generally those resulting from artists' collaborations with industry. Among the industrial sectors most receptive to this type of experience in Europe are textiles and automotive, transport, health and agribusiness, also driven by the ecological agenda and the subsequent crises.

Another new item in the agendas was citizens' need for democratic participation, pushed to counteract the populist agenda. Citizen participation platforms benefited from the brokering experiences such as those between creative and cultural industries and other sectors. To name only a few that I had the chance to study closely in Italy: the Theatre of Citizenship of the Teatro Stabile in Venice[11], the redevelopment of the old fire station in Ferrara by the architectural collective Spazio Grisù[12], the Open Design School of Matera European Capital of Culture 2019[13].

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Taking a Step to the Next Level

The EU has integrated all these practices into a new interdisciplinary platform accompanied by substantial project funding, called the New European Bauhaus.

The New European Bauhaus is an initiative proposed by the European Commission in 2020 as a way to promote sustainable and inclusive design in the built environment. The goal of the initiative is to bring together architects, designers, engineers and other experts to develop innovative solutions for housing, public spaces and infrastructure that are environmentally friendly, socially inclusive, and aesthetically pleasing. The initiative aims to promote a new vision for the built environment in Europe, one that is based on collaboration, experimentation, and creativity. It also aims to connect the creative sector with the construction and building industry and to promote a culture of circular economy.

The initiative, supported by several European universities, marks a new stage. Its motto, "Beautiful, sustainable, together", underlines the evolution in the methodology. Firstly, it shifts from the point to point relationship to the community-based initiative. Secondly it marks a partial emancipation from the problem-solving approach that we find in previous EU projects, allowing inspiration before solution.

Another rather new feature of the New European Bauhaus is the longer and deeper process of co-construction that took place in 2021. A first set of core partners have been selected based on their applications to define what the New European Bauhaus would have been, before deploying the funding scheme. I took part in this process as a member of Conexiones improbables, a Spanish company producing hybridisation and innovation projects. What was interesting was that the initiative generated both a Call for proposals from scratch, and the re-labelling of other calls for projects in existing EU funding programmes.

The Future of Cross-Sectoral Innovation

The elements formally introduced by the New European Bauhaus mean that cross-sectoral innovation isn't so special anymore. Sustainability resides in the collective dimension and in community-based projects. Specialisation has long been seen as the condition for innovation, but its consequences and the size of current challenges have pushed for a more flexible methodology.

Grassroots and peripheral ideas became projects and have been dignified by years of studies and practices. They have made it clear that solutions do not just come from well-funded technological research.

The low-tech movement also proposed an alternative agenda: why not fully exploit the technology we have instead of investing in continuously new hi-tech solutions?

The evolution of multidisciplinary and then interdisciplinary methods tends towards what insiders call transdisciplinarity, i.e. the creation of something new from previous disciplines (as might be the case with neuroscience within the field of the cognitive sciences)[14].

Hopefully it will mainstream what I have called cross-sectoral innovation so far, which has proven to be a flexible tool able to adapt to the policy trend of the moment.

14
Other experts already speak of "post-disciplinarity".

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79

This issue focuses attention on circularity and sustainability in the design process. It does so by casting light on the Packaging System that we have taken as a paradigm for the system of contemporary commodities because it is the sum total of everything that is designed around the commercial commodity in order to unleash its potential exploitable value. Tatjana Karpenja and Clara Giardina, who bring with them different backgrounds and sensibilities, accompany us through this journey with vertical investigations, highlighting the state of research at the various international, European and Italian national scales, where an alliance is being formed between all the most prestigious universities that have invested in these themes.

Meanwhile *diid*'s journey of evolution continues, expanding the number of colleagues who from around the world support us in our Scientific Board, seeking to grow together and to cultivate the scientific conscience of our contemporary design cultures.

Flaviano Celaschi

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