

DESIGN CULTURE(S)

Cumulus Conference Proceedings Roma 2021

Volume #2

ARTIFICIAL
LANGUAGES
LIFE
MAKING
NEW
MULTIPLICITY
PROXIMITY
RESILIENCE
REVOLUTION
THINKING

**Design Culture(s)
Cumulus Conference
Proceedings Roma 2021**

Volume #2

Editors

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Layout and Graphic Design

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Concept for Cumulus
Conference Proceedings
Series was developed in
2018 by Jani Pulkka

Cumulus conference

Design Culture(s)
hosted by
Sapienza University of Rome, Italy
on June 8-11, 2021.
Conference website:
www.cumulusroma2020.org

Published by Cumulus

Cumulus the Global Association of
Art and Design Education and
Research. Aalto University, School
of Arts, Design and Architecture
PO BOX 31000, FI-00076 Aalto
www.cumulusassociation.org

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ISBN 978-952-64-9004-5 (PDF)

ISSN 2490-046X

Cumulus Conference Proceedings
Series, N°7

**Cumulus Conference
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Cumulus Conference
Proceedings Series

Cumulus the Global Association
of Art and Design Education and Research

Rome 2021

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DESIGN CULTURE(S) | CUMULUS ROMA 2021
JUNE 08.09.10.11, SAPIENZA UNIVERSITY OF ROME

About the conference

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The theme

More than three years ago (it was 2018), when we presented our candidacy to host the Cumulus Conference in Sapienza, our first effort was to set up a Conference Theme. The duty was not simple since we wanted to avoid any naïve, fashionable or captivating topic. We were in search of a theme which is appropriate to the times, the context and moreover, to the Cumulus's community.

Our starting point was to consider what Cumulus meant and still means, not only for us, but within the worldwide design community. Looking back in the history of Cumulus, we found an interesting picture in its name: in fact, "cumulus" is the English name of a specific kind of clouds and comes from a Latin word that means "heap, pile, mass". Therefore, the word Cumulus is refereed, at the same time, to those big clouds that appear in the sky every time in different forms and always in constant change, as well as it is referred to a set of singular elements that make up a unit together. As a consequence, Cumulus efficiently describes the idea of a set of many singularities that meet, settle and become each time a new and different entity.

This picture helped us to set our goal: offering to such variegated, mutant, but nevertheless aggregated "cumulus", a conference theme where to recognize itself. This idea of big entity made of a huge number of singularities is connected to the idea of community, and then we had no doubt that this was the exact purpose of the founders of Cumulus when they decided its name.

Today the concept of community is increasingly complex, since it is crossing new social, technological, political and economic challenges and at the same time it is more global and multicultural than ever, more and more enriched by new hybrid languages and habits, due to the increasing flows of goods and people around the world. As a consequence, also a

Design Community, as Cumulus, is evolving as a wide-open field with many new practices and sometimes new principles.

In this regard, in order to figure out such complexity, we found a suitable answer in another word with Latin roots: the word "culture". Culture comes from the Latin word "colĕre" which means "cultivating the land to make grow" and, figuratively, also "taking care" of something, including knowledge, and therefore, "cultivation through education, improvement and refinement of the mind". This second meaning of "culture" is based on an insightful concept by the ancient Roman orator Cicero in his *Tusculanae Disputationes*: "cultura animi", which is the cultivation of the soul.

The resulting parallel between the culture of the land and the culture of the soul was fascinating and highly significant to us, since it is showing the challenge of growing something new, starting from the roots, from the soil, from the context and - as we know - depending on available soil, context and roots, we are growing different plants, obtaining different fruits and seeds, to plant again in a virtuous life-cycle. Thanks to this metaphor, we understood that diversity is a prime condition for the birth and the growth of culture, while it doesn't mean opposition but combination, arrangement and hybridization. Thanks to this metaphor, we got back to the initial concept of accumulation, and to the concept of Cumulus.

On another note, the Cambridge English Dictionary states that culture is also "the way of life, the customs and beliefs, of a particular group of people at a particular time". This could be an interesting stimulus but, when associating "Culture" with "Design", it was immediately clear that we cannot refer to one unique Culture, but we need to open to the concept of bio-diversity, where Design cannot be considered as the result of a single dominant, globalized, levelling thinking.

Finally, looking into design as an expression of Culture(s) and Culture(s) as the outcome of Design means to take into consideration not only what we are doing now, but what we are inheriting from the past and which should be granted for the benefit of future generations, so intertwining past and future, tangible and intangible, innovation and tradition.

Here is our conference theme: Design Culture(S)

Here, the suffix (S) is not only indicating the plural, the diversities, but it is also connected with the "saxon genitive", which is taking Design as subject, while connecting it to other different objects/meanings.

Following this concept, we found the ten keywords which we used to describe the tracks:

Artificial, Languages, Life, Making, Multiplicity, Proximity, Resilience, Revolution, Thinking and New Normal.

Each keyword was enriched with three additional keywords, to better explain the different directions and connotations, which are:

- Artificial is connected with Digital, Technology, Robotics
- Languages is connected with Aesthetics, Expression, Visual
- Life is connected with Nature, Biology, Human
- Making is connected with Process, Production, Post-Industry
- Multiplicity is connected with Gender, Pluralism, Diversity
- New Normal is connected with Health, Education, Work&Play
- Proximity is connected with Places, People, Economy
- Resilience is connected with Social Innovation, Circular Economy, Sustainability
- Revolution is connected with Critical Thinking, Interruption, Change
- Thinking is connected with Theory, History, Criticism

We obtained 40 wonderful words, full of possible meanings, ready to be interpreted and declined by the worldwide community of cumulus to figure out Design not as a singular specific voice but as a plural ecosystem of meanings.

After three years, during which our world is extremely changed, we can say that these words and this topic seems even more current and significant.

In the next pages of the Conference Proceedings, we are very enthusiast to offer a big picture of the biodiversity of Design Cultures and the multiverse of our Cumulus.

The experience

Cumulus Roma 2021 'Design Culture(S)' covered four days full of parallel sessions, working groups, poster sessions, exhibitions, social events, and more, but above all attending was a new form of experience than a conference.

While feeling the responsibility of filling a long void caused by the pandemic, we tried to re-design the whole experience to deliver a new form of conference which is keeping the in-presence through the online opportunities, so to bring you all to Rome and get the colors, the smell and the taste of the city, the architecture, the arts, the food, and the wine, always giving a cultural and a scientific perspective.

When facing the challenges, we wanted to deliver a new format to the whole Cumulus community, with the aim of innovating with technology, enhancing networking and the sociability of the experience, and keeping everyone on board to ensure the participation and democracy to our association from anywhere in the world, no matter of the time zone.

After four full days, we trust this conference at Sapienza University of Rome to be one of the longest Cumulus initiatives, counting with approximately 680 attendees, more than 350 papers and posters, 10 exhibitions, 10 tracks and 80 parallel sessions, 20 track keynotes and

four plenary keynotes, more than 50 schools exhibiting in the New Members Fair from everywhere in the world, and 18 schools participating in the Italian Members Fair.

Our aim was to develop a new form of hospitality to welcome and to make all of you feel at home in Rome but in a new virtual environment, while sharing design research and knowledge, along with the true spirit of Cumulus.

It is not enough to have a good project to gain good results, but it is necessary to get good responses. Your reaction was extraordinary, not only for the massive amount of registered participants, but for the involvement, the enthusiasm and not lastly the patience you have shown during the days of the conference. You joined in perfect Cumulus style from all over the world: from Oceania to the Americas, from Africa to Europe, to Asia, and you have actively followed the four days continuously, participating in a chat that often could not make your voices heard, but made us feel your presence very close.

Thank you for trusting us since the very beginning to the very end, while making this event possible. We will remember it for a long time for its extraordinary nature. We wish we will meet all together soon again without mask, and we will keep the memory of these days together among the best memories of this difficult period.

TUE 08 JUNE			WED 09 JUNE			THU 10 JUNE			FRI 11 JUNE		
9:30 CET DAILY PROGRAMME STARTS											
6 X ITALIAN MEMBERS FAIR			10 X TRACK SES SIONS	1 X WORK KING GROUP	6X NEW MEM BERS FAIR	10 X TRACK SES SIONS	1 X WORK KING GROUP	6X NEW MEM BERS FAIR	5 X WORK KING GRO UPS	POS TER SES SION	EX TRAS
6 X ITALIAN MEMBERS FAIR			10 X TRACK SES SIONS	1 X WORK KING GROUP	6X NEW MEM BERS FAIR	10 X TRACK SES SIONS	1 X WORK KING GROUP	6X NEW MEM BERS FAIR	5 X WORK KING GRO UPS	POS TER SES SION	DESIS EVENT
6 X ITALIAN MEMBERS FAIR			10 X TRACK SES SIONS + ROUND TABLE	1 X WORK KING GROUP	6X NEW MEM BERS FAIR	10 X TRACK SES SIONS + ROUND TABLE	1 X WORK KING GROUP	6X NEW MEM BERS FAIR	5 X WORK KING GRO UPS	POS TER SES SION	DESIS EVENT
12:50-14:30 CET LUNCH BREAK DESIGN CULTURE(S) OF ROME: FOOD EXPERIENCE											
OPENING PLENARY			10 X TRACK SES SIONS	1 X WORK KING GROUP	6X NEW MEM BERS FAIR	10 X TRACK SES SIONS	POS TER SES SION	EX HIBITION SES SI ON	CLOSING KEYNOTE SPEECHES		
KEYNOTE SPEECHES			10 X TRACK SES SIONS	1 X WORK KING GROUP	6X NEW MEM BERS FAIR	10 X TRACK SES SIONS	POS TER SES SION	GE NE RAL AS SEM BLY	FREE BREAKOUT SESSIONS 1:1 SPEED NETWORKING		
17:30 CET DAILY SESSIONS ENDING 18:30 EVENING EVENTS START											
EXHIBITION OPENING			DC(S) OF ROME: WINE DESIGN & TASTING			DC(S) OF ROME: MODERN ART EXPERIENCE			CLOSING REMARKS, CUMULUS GREEN		

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DISRUPTION
CHANGE

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HISTORY
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Roberto Marchesini

Roberto Marchesini is Director of the Center for the Study of Posthumanist Philosophy, as well as the School of Human-Animal Interactions, both based in Bologna, Italy. His studies focus on philosophical ethology, bioethics, zooanthropology, and posthumanism in an effort to better comprehend human-animal interactions. The cornerstone of his philosophical proposal is the unmasking of a perspective error that places humans at the center and at the measure of his predicates. One of his last books reinterprets the union between human beings and technology as a partnership that emerged from the phylogenetic set of the Sapiens species, highlighting the hybridizing and shaping potential of technology. From this perspective, every invention, every discovery, has an epiphanic effect; that is, it opens up a new dimension of the unexpected and of opportunities that change the boundaries and the perception of what we define human.



Salvatore Iaconesi and Oriana Persico

Salvatore Iaconesi is a robotic engineer, designer and artist; Oriana Persico is a cyber-ecologist, autobiographer and expert in digital inclusion. Living and working together since 2006 under the brand [AOS – Art is Open Source], they created artworks and performances of global interest united by the exploration and observation of contemporary technological human beings and societies – and their continuous mutation. Promoting a possibilistic vision of the world in which art is the glue between science, politics, anthropology and economics, they are the founders of Nuovo Abitare and HER, the two research centers they use to study the psychological and social implications of data and computation in human societies. Together they wrote *Digital Urban Acupuncture* (Springer, 2016), *La Cura* (Codice Editore, 2016), *Read/Write Reality* (FakePress Publishing, 2011), *Romaeuropa FakeFactory* (DeriveApprodi, 2010) e *Angel_F: diario di vita di un'intelligenza artificiale* (Castelvecchi, 2009).



Pier Luigi Capucci

Pier Luigi Capucci has been concerned since the '80s with the studies on communication, the new media and the new art forms, and with the relationships among arts, sciences and technologies. His theoretical activity is concerned with technologies of representation and communication, with technoscience-based art forms and with the media archaeology studies. He published more than 350 texts in books, magazines and conference papers in Italy and abroad. Founder of the first online magazine in Italy NetMagazine / MagNet; president of Noema, journal on the relationships between forms of expression, technologies, sciences and society; member of the International Advisory Board in many editions of Ars Electronica. Recently he founded art*science, a three-year research project on art and climate change and he serves as a consultant to the European Commission on the relationships between scientific disciplines and technologies (in particular Artificial Intelligence and Big Data) and humanities.



Chiara Luzzana

Chiara Luzzana is an Award-winning Sound Designer. She pairs a broad range of leadership in Sound Design, Music Composition, Sound Branding, Soundtrack and Audio Installation collaborating with companies and agencies all over the world. Noted among others for her project "The sound of city", she explores and listens in awe to the artifacts of the urban environment, the products of the industrial cultures all around the world. Eclectic Artist, she wanted to break the rules imposed by notation, working only with noise. Former student at Berklee College, she investigated how the brain reacts to sounds, experimenting with everything from the neurobiology of musical cognition, to the construction of microphones and sound sculptures. Her projects and talks take us to a journey starting from listening to our life, up to listening to ourselves turning life into a "soundtrack".



About Sapienza University of Rome

Faculty of Architecture and School of Industrial Design

The conference took place at Sapienza University of Rome, Faculty of Architecture. Sapienza University of Rome was founded in 1303 by Pope Boniface VIII and it is one of the oldest universities in the world. At the moment, Sapienza is hosting about 115,000 students and 4.000 professors and researchers, and it is a top performer in international university rankings, thanks to the 63 Departments organized in 11 Faculties driving high levels of excellence in several fields.

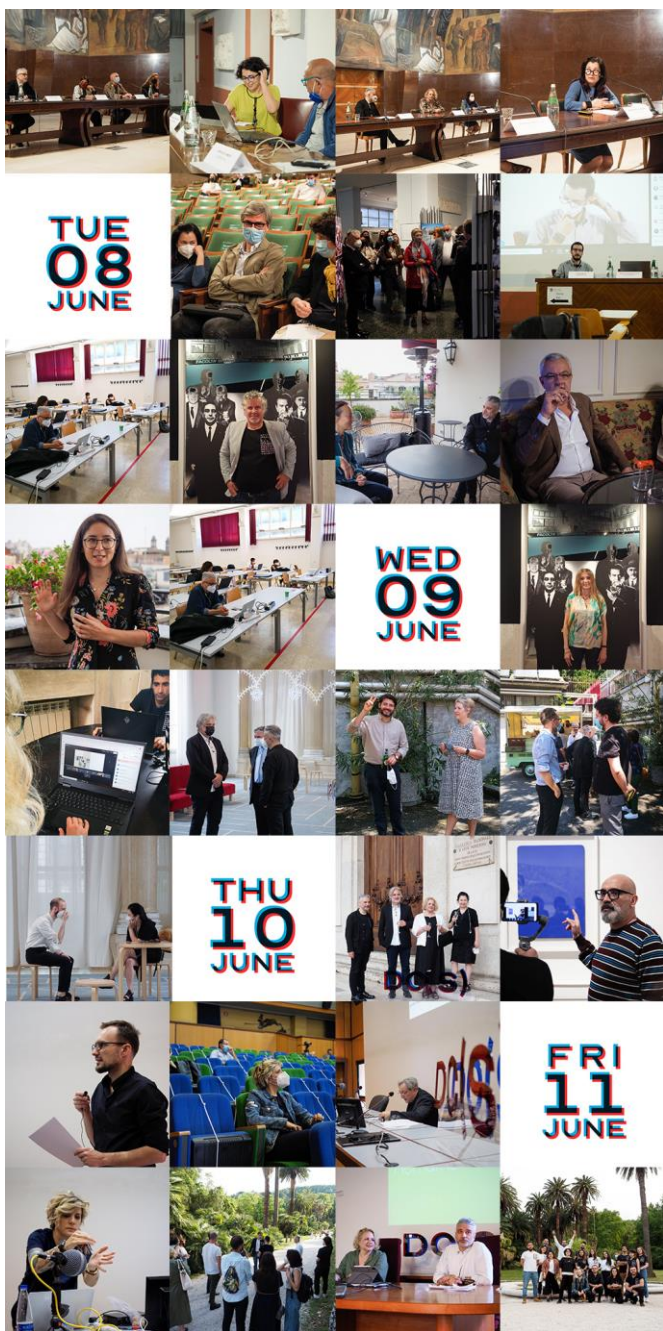
The Degrees of Design are part of the Faculty of Architecture, which was founded in 1920 and it happens to be the first modern Faculty of Architecture in Italy. At the core of its mission is the commitment to innovation, technology, urban living, while serving a fast changing society.

Its programs and curricula are divided between scientific research, studies in the humanities and experimentation with old and new technology. All this is leading to the education of the modern designer, which can be considered the synthesis of a scientist and a humanist who is both an artist and a technologist at the same time.

After the Degrees in Design, the Faculty is also offering programs in architecture, city planning, landscape, interior architecture and design management. Its high-calibre graduates are equipped with the skills which are necessary to design and to manage sustainable products, systems, services and environments, leading to innovation, technology, visual communication and design.

The Design Degrees in Sapienza are the following:

- A Bachelor Degree in Design;
- An International Master of Science in Product and Service Design (in English);
- A Master in Design and Visual and Multimedia Communication;
- An Interdisciplinary PhD Program in 'Planning, Design, Technology of architecture'.





DESIGN CULTURE(S) | CUMULUS ROMA 2021
JUNE 08.09.10.11, SAPIENZA UNIVERSITY OF ROME

Digital Creativity Tools Framework

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Abstract | The objective of this study is to define a framework for clustering and analysing digital tools that facilitate the Design Thinking process. The framework, based on an extensive literature review, is developed as part of a more articulated and complex ongoing research aiming at identifying the most crucial factors that influence creativity in the digital era. The purpose of our model is to map and classify digital tools in order to support designers to face the digital transition. This study outlines the way in which we produce new ideas and different forms of knowledge through a creative design process by adopting digital technologies.

KEYWORDS | DIGITAL TOOLS, DIGITAL CREATIVITY, DESIGN THINKING, CREATIVE PROCESS

1. Introduction and aims

In the last years, the integration of new digital technologies has been used not only to innovate products and services, but also to support and foster the creative design process.

Increasingly, the digital era and its technologies are having a profound influence on the digitally enhanced generation (Prensky, 2009) who need to develop new competencies and skills among which human creativity is the most important one. It is, therefore, becoming essential for the design research to understand how digital technologies are influencing the creative process and creativity abilities to develop appropriate tools and models for the next digital generation of designers representing the actors of a near future. Indeed, designers are facing a digital revolution which required them to be prepared to work in an interactive digital world in which everybody does design (Manzini, 2015) in order to address new technological challenges achieving large-scale innovation.

The digital transition is also affecting the tools that designers adopt to follow the different steps of the design process such as gathering and sorting different information or generating project opportunities and identifying new directions. There is some confusion as to which tools and techniques to use, when, and for what purpose. Therefore, we are proposing a framework to help organize the proliferation of tools, techniques and methods in hopes that the design community will benefit by discussing relevant applications and identifying potential areas for further exploration. The framework that deconstructs the design process into phases and tasks and defines the taxonomy criteria for clustering the tools that could potentially play a role in all stages of the design process.

Starting from our expertise and knowledge about the Design Thinking approach (Meinel & Leifer, 2015, Canina et al., 2020) we analysed for each phase of the design process which digital tools could be applied to facilitate design activities. All the tools identified during the research could enhance designer and non-designer's creativity in different terms, some of them are more design phase-specific and others are more collaborative or linked with the entire design process.

To identify the methodology with which to structure the framework it is essential to consider the several forms of support that facilitate or improve designers' activities:

- design methods to facilitate the process of product development (Araujo, 1996; Schneider & Lindemann, 2005) or to help designers better understand users' expectations and needs (Wharton et al., 1994);
- ergonomic principles or recommendations (e.g., Norman, 1993) and ergonomic criteria (Scapin & Bastien, 1997) to help designers create products or objects that are more adapted to users;
- computational systems that aim at supporting designers at several stages of their activities (Fischer et al., 2005; Maher, Kim & Bonnardel, 2010).

The framework will deliver a repository of digital tools, as computational systems, based on the steps of the design thinking process could support designers during the stages of their activities, empowering creativity in different contexts, improving products and services on a holistic level.

2. Digital Creativity

Creativity has a fundamental role in the design process, is not the domain of a few called “creatives”. Every creator throughout the design process should be guided by creativity in order to enrich his project with new insights and innovation opportunities.

By the coming of digital technologies, designers started to adopt the new potentialities offered by the latter. They recognise certain possibilities allowed by the digital, but also emphasise that there may be certain kinds of limits that get left out when engaging with digital technologies.

This belief was born when platform and digital tools began to appear, which is the same moment the definition of Digital Creativity was coined. Lee and Chen, (2015) describe it as: “All forms of creativity driven by digital technologies. In other words, digital creativity occurs when digital devices are used for various creative activities”.

Digital Creativity is the result of a creative process implemented by a computer aided technology. Every time we employ tools or platform for supporting our creative thinking, the digital technology dynamics and mechanics influence creativity principles, that are motivational, cognitive, and attitudinal constituents of the design process. (Corazza & Agnoli, 2015).

Digitally supported creativity encompasses the study of how creativity can be supported and enhanced by digital technologies. Digital creativity technologies support many different kinds of artwork in digital representation (text, layout, image, sound, 3D object, moving image, etc.) as well as new form of art such as the generative art. The technologies also enable us to capture, store, manipulate and output these representations to produce media forms we can experience.

Within the computer science field and the HCI domain digital creativity is studied from a technological perspective testing and studying the application and potentialities of specific digital technologies for creative achievement. By approaching the HCI field, emerged that one of the main recognized research works has been done by Ben Shneiderman (2000, 2002, 2007) that has always undertaken study on “Creativity Support Tools” (CST) intended as user interfaces or software supporting creativity across domain, empowering users to be more productive, and more innovative. As he states (2000)

“the goal of designing creativity support tools is to make more people more creative more often, enabling them to successfully cope with a wider variety of challenges and even straddle domains”.

In 2005 he organized the workshop, “Creativity Support Tools” sponsored by the National Science Foundation, with the main aim of accelerating research on this topic and defining guidelines for the design and development of these tools. According with the result obtained (Shneiderman et al. 2005), a CST should enable more effective searching of intellectual resources, improve team collaboration and speed up the discovery processes. They should also provide support in hypothesis formation, speedier evaluation of alternatives, improved understanding through visualization, and better dissemination of results. HCI apply digital technology to develop tools that could enhance and support some aspect of the creative process that allow individual or a team of individual working together in reaching high performance. From the workshop are emerged several concepts, types of practices, and aspects of human cognition as important ingredients for research on tools for supporting creativity. For our research is useful to acquire the outlined roles of tools for supporting creativity, positioned in terms of three dimensions (Nakakoji, 2005) in order to analyse in deep the hypothesised taxonomy for the framework.

The first dimension includes tools to train people to develop creativity, or skills of creative thinking. Such tools aim at helping people to develop skills to engage in creative ways of looking at problems and framing solutions by using these tools.

The second dimension includes tools to support people's creative process while engaging in a creation task.

The third dimension includes tools to enable people to have new kinds of experiences that they would not be able to have without using these tools allow people to engage in completely new experiences of producing expressions.

These three dimensions, in particular the first and the second one, are the lenses adopted to scout the digital tools to be included in the framework since they are well connected with the design process structures behind the framework.

2. Methodology

The construction of the framework followed three main steps:

- The definition of the design process structure that was mainly based on one side on the authors expertise and knowledge.
- A literature investigation to identify and select the criteria on which based the framework and the scouting of design tools.
- A scouting of web-based design tools and their positioning within the framework.

An extensive body of literature have examined and discussed - within the digital creativity domain - the characteristic and design principles to guide designers in building efficient digital design tools.

Within the review we decided to focus on three main contribution provided by Shneiderman (2002, 2007) (Shneiderman et al., 2005) that clearly highlight design principles for building creativity support tools. Modern creativity support tools enable new forms of expression for individuals, and they are especially potent in supporting group collaboration and social creativity.

“Creativity support tools extend users’ capability to make discoveries or inventions from early stages of gathering information, hypothesis generation, and initial production, through the later stages of refinement, validation, and dissemination.” (Schneiderman, 2007, p. 22)

The guidelines for designing these tools address the design process and the creative principles within the design process.

From the analysis of this contribution 12 design principles that highlight the relation between digital tools and the creative design process have been extrapolated (Figure 1).



Fig. 1. List of the selected design principles for building digital creativity support tools.

The identified principles have been analysed, elaborated and clustered in order to support the construction of the framework. The 12 principles have been indeed transformed into three main elements:

- *Design process activities*: this represent the most relevant activities that can be supported by a digital design tool. The activities have been defined within each process phase and are relevant for building the framework structure.

- *Tool's selection criteria*: these criteria are relevant for determine which tool can be selected and included in the framework
- *Tool's cross characteristics*: these criteria are fundamental to analyse and identify the different traits of the design tool collected. Digital design tools that are classified within the same design phase and that support the same design activity, can have different cross characteristic.

These three elements contribute to define the framework and the taxonomy with which select, analyse and classify the digital design tools.

3. The framework

The evolution of Design Thinking has been continuous, and the original paradigm has changed frequently and has acquired new names and facets.

In line with the evolution of the paradigm also the processes of Design Thinking changed, despite this in the last decade, four are the ones most used by the organizations. All these methodologies divided the Design Thinking process into many different phases, someone prefers to use a more linear path others adopt an iterative loop process. The names of the steps are different by the approach and the criteria behind these processes are the same (Figure 2)

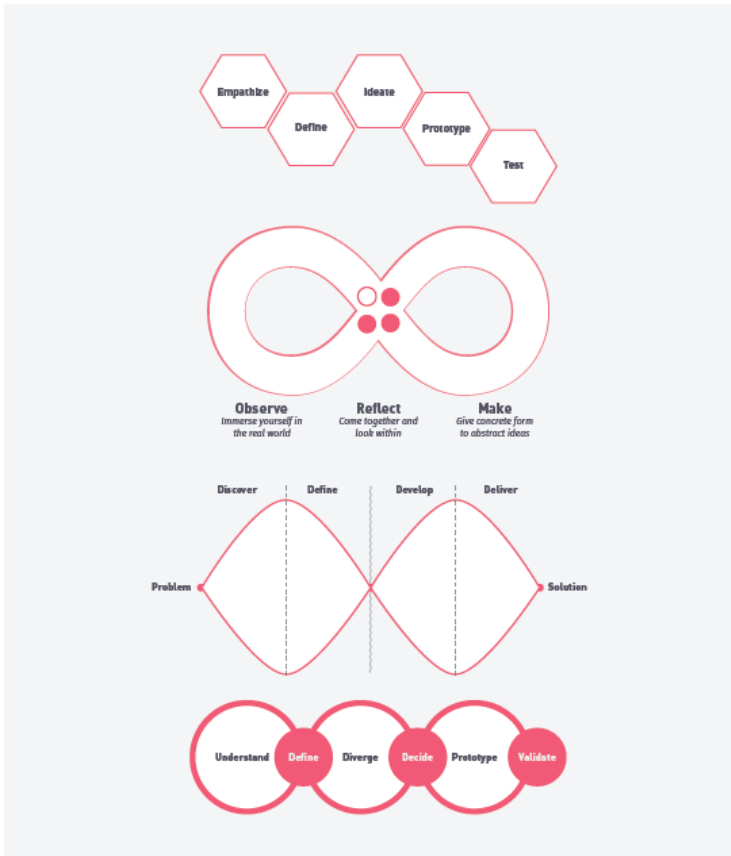


Fig 3. From top to bottom: D.School framework, IBM Loop, British Council Double Diamond and Google Design Sprint.

The design process model adopted for building the framework, comes from the experience and background of the authors on the topic. Indeed, we adopted the IDEActivity process as the specific Design Thinking approach (Canina et al., 2020).

Using the study of various most significant existing models as a springboard - the 3I model (Brown and Wyatt, 2010), the Double diamond model by the British Design Council, the Service Design Thinking proposed by Stickdorn and Schneider (2010) and a key reading in Human Centred Design (HCD, IDEO 2011) - the IDEActivity process model was developed and the user is recognised as having significant creative potential. IDEActivity process model adopt a stage configuration based on the two main moment of the design process called Explore and Generate. For the two main stage of exploration and generation, it includes

different steps, from Clarify Goal and Define Opportunities in Explore, to Ideate and Prototype in Generate (IDEActivity Toolkit, 2017). Each stage is always constituted by a first phase of divergence, which is followed by a classification, and finally convergence to arrive at the definition of the problem or a solution. The Creative Diamond (Tassoul and Buijs, 2007) is characterised by a diamond shape and its phases have specific rules.

In order to build the basic structure of the framework, have been extrapolated from this model the 2 main stages, and the steps to be carried out during the process that represented the four cluster within which we placed all the digital tools.

3.1 Design process structure and activities

The Digital Creativity Tools Framework is based on a simplified yet exhaustive version of the human-centred creative design process that, using the potential of creativity and the approach of design thinking, support individuals from different backgrounds to actively experience the development of ideas or strategies.

The process focuses on two main consequent stages, Explore and Generate, and a total of four explicit process steps, each one with specific objectives, and each one characterized by specific activities. The activities have been determined and integrated thanks to the literature investigation of design principles for creativity support tools.

The first stage, Explore, allows the creation of a basis from which a significant and potentially viable goal can be defined its possible development in relation to a given context. Within this stage an understanding of needs, hopes, and aspirations is crucial, and an analytical process of information interpretation is fundamental to identify opportunities.

Explore is divided in two main steps: Clarify goal whose aim is to bring the goal clearly into focus and Define Opportunities whose is to transform the information collected in design opportunities.

The activities emerged from the literature analysis and integrated within these two steps are: Searching, Empathising, Clustering/Visualizing, Open possibilities, Prospecting

The second stage, Generate, aims at the generation of suitable concepts in line with the given context and the prototyping of innovative ideas.

Generate is divided in two main steps: Ideate whose aim is to generate one or more novel ideas which is meaningful for the design challenge framed, and Prototype whose aim is to enrich and refine the idea, through the development of tangible artefacts

The activities integrated within these two steps are: Inspiring, Conceiving, Selecting, Making, Reflecting (Figure 3).

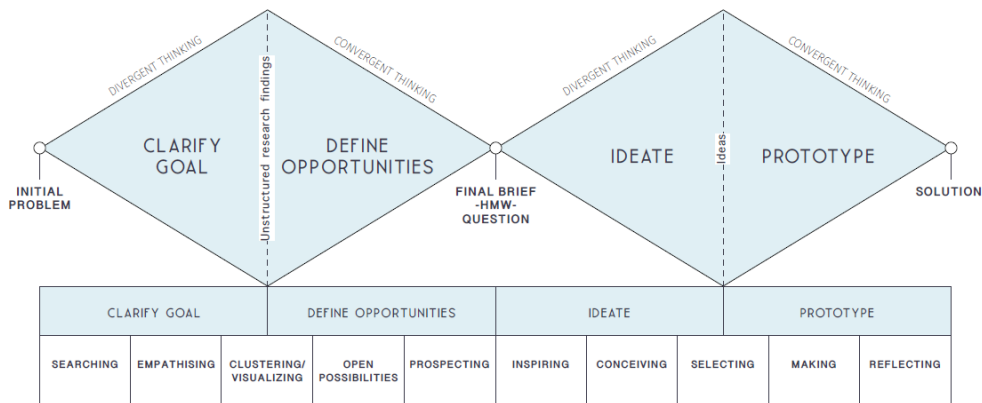


Fig. 3. Design process structure and activities.

Table 1. Summary of the design process structure and activities

PROCESS STEPS	ACTIVITIES	DESCRIPTION
CLARIFY GOAL	Searching	Accelerating the collections of information. A task which people undertake to find or retrieve specific data and resources.
	Empathising	Analysing user behaviours and creating harmonious relationships with him, to collect information about actions, feeling and emotions of others.
CLARIFY GOAL / DEFINE OPPORTUNITIES	Clustering/Visualizing	Grouping the large amount of data gathered and having a better visualisation of them, helps designers to organize their knowledge, see relationships, and possibly spot what is missing.
DEFINE OPPORTUNITIES	Open possibilities	Tools that show you all the possible implications of decisions. Enhancing the conception of which possible scenario might be done or might happen.

	Prospecting	Converging all the possibilities in a specific scenario or future event
IDEATE	Inspiring	Being mentally stimulated to do or feel something, especially fostering creativity. Collecting and combining immediately your ideas in order to get new inspirations.
	Conceiving	Inspirations bring you to a list of ideas that have to be simulated in all their possible implications of decisions.
IDEATE/ PROTOTYPE	Selecting	Making a decision on the strongest and most impacting ideas.
PROTOTYPE	Making	Building and composing artifacts, prototypes and performances. In order to test all the possible implications of the product/service
	Reflecting	Disseminating the final solution to all the stakeholders involved, in order to gather feedbacks to play with, to experiment with, to talk about.

3.2 Tools scouting and analysis

The inquiry that has been conducted, started with an analysis of the basic design tools for Design Thinking. Both for illustrating the state of art of analog tools and to give an exemplification of what kinds of techniques design currently offers. Secondly, we determined to go deeper in terms of specificity and to cluster a series of digital tools who could enhance the creative approach for each phases of the design process.

Two main general criteria have been identified for the selection of the digital tools:

- META-DESIGN. Creativity needs the “synergy of many” (Benkler, 2006) and this kind of synergy can be facilitated by meta-design. Meta-design is a socio-technical approach that characterizes objectives, techniques, and processes that allow users to act as designers and be creative in personally meaningful activities (Giaccardi & Fischer, 2008).
- LOW THRESHOLDS / HIGH CEILING. Tools should be easy for novices to begin using, they should not be intimidating, and should give users immediate confidence that they can succeed. At the same time, the interfaces should be

possible for experts to work on increasingly sophisticated projects
(Shneiderman et al., 2005)

The two specific criteria used for selecting the tools are related to two dimensions mentioned earlier:

- Tools enabling creative thinking in the different step of the creative process.
- Tools supporting the steps and activities of the creative process.

Each collected tool has been analysed firstly to identify which step of the process and which activity can support. Secondly, it has been analysing according to 4 criteria that allow to specify some characteristic of the tool that are transversal to all the steps and phases of the process. These are:

- **COLLABORATION:** The tool enables a sharing system and a safe environment that allow team members to contribute and work on their own parts in parallel, supporting the integration and iteration, building trust.
- **RICH HISTORY KEEPING:** the tool allows to record the process history and which alternatives the users of the tool have tried. The tool allows them replaying session histories, comparing the many outcomes and going back to earlier ideas to make modifications.
- **CO-CREATION:** the tool allows an expert facilitator to plan, modify and adjust co-design activities in which different parties work together and jointly produce a mutually valued outcome.
- **RELATE AND INTERACT:** the tool utilizes any form of communication for consulting with peers, experts and mentors for clarify requests and intellectual and emotional support.

From the collection emerged that some of the tools are mainly used by a design facilitator for training and co-design sessions with a larger audience (i.e Stormz) and others can enhance real-world interaction, discovery, exploration, and imagination through Augmented or Virtual Reality (Zünd et al, 2015).

Some of them are phase-specific digital design tools that are online platforms or tools repository with a high level of specificity, which support one specific phase of the process. Here we can find for example tools characterised by computer-mediated brainstorming, tools that allows to capture plans and ideas in a web-based virtual whiteboard (i.e. Miro), or others only for testing and evaluating already existing prototypes (i.e. Proto.io).

Others are considered as multi-phase design tools that are all those platforms that could keep track of the entire process. They are totally cloud tools that allow the collaboration between team members to develop new projects, from ideation and envisioning to gathering feedback directly from users. (e.g. Shape by IDEO)

3.2 Digital design tool positioning: Shape

For each tool analysed a card has been designed, indicating the Name of the tool, the Cross characteristics it answers, a description of how it supports the activity/activities of the process, and a link (Figure 4). Each card is then visually located in correspondence with the process activities he supports or empower. In this paragraph an example is described.

Shape (IDEO)¹ is a visual and collaborative environment for building, testing, and refining ideas. With respect to the design process, the web-based tool allows to *engage and guide a team of people through all the steps of the design process* also providing template to let people get quick access to convert the ideas. It allows to gather inspiration and ideas creating visual spaces to brainstorm a new idea or share design inspiration across a team.

Among the cross characteristics is possible to identify that Shape it is a platform designed to guide and *support collaboration* at multiple scales, from small teams to large organizations and global communities. Shape allows to guide, document and manage the creative process of a team of people who is solving a challenge, in a transparent way. It has been designed for simplify *communication* between the designer and its customer, allowing the latter to enter in the process, understand the main steps and contribute, and to easily *relate and interact* for request feedback directly within the platform. The visual support facilitates evidence-based decisions and allow to *keep track* of the best practice analysed, the idea shared allowing people in going back and iterate on the process done.

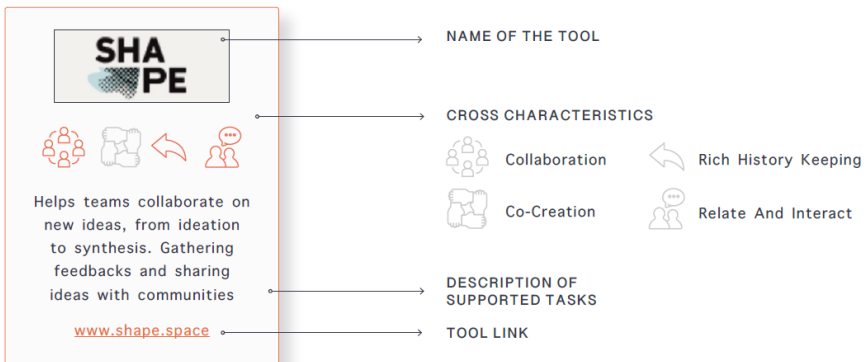


Fig. 4. Shape tool analysis card.

¹ www.shape.space

4. Conclusion

The research and the development of the taxonomy and the framework wished to identify some of the characteristics of the digital tools that nowadays designers can use in order to expand their minds and visions. As Literat and Glaveanu (2018) affirm, this new typology of tools emphasises individuals and individual minds. In fact, it is exactly the emergence and growth of digital technologies that contributed to new, systemic ways of thinking and talking about creativity.

The developed taxonomy highlights tools intended for a wide variety of uses and varying in complexity, from a simple tool with one specific function to multiple function tools or an entire suite of tools. The framework allowed us to characterise every tool with its own phase of intervention in the design process, and to identify areas in which nowadays there is an absence of supporting tools. We can, therefore, assume that the generated framework will benefit several contexts and open opportunities for other future researches. For example, it could support companies aiming to adopt digital creativity tools for exploring and anticipate design opportunities and needs. In the design field, it could shape new digital creativity tools to support designers at all stages of the design process and to diverge their thinking and get carried by lateral thinking.

This research is at an early stage and does not have the ambition to map all the existing digital tools that can support the creative design process. Only web-based digital design tools have been considered in this first scouting of tools.

The speeds with which these tools and digital technologies are emerging and developing would make the research never complete. The main aim is to identify in the different steps of the process the relation between the tools, the activities and the creative factors of the step itself, to facilitate the achievement of a more novel and useful result. Future directions aim at testing some of those tools in a real design setting, in combination or in comparison with other analog tools, to verify and understand what features can better meet the designers of the digital era works.

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