Meanings of Design in the Next Era

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4D is an international conference aimed to discuss the role of Design in developing value for social entities, technological advancement, and business creation and revamping. This conference is the second in the series of the 4D Conference since 2017. The first conference was organized in Kaunas, Lithuania.

Modern and nascent economies indeed are adopting design as a competitive lever to embed continuous and discontinuous technology in new product language as to propose new entrepreneurial ventures. Moreover design has become a strategic lever for social entities to run fund-raising, to create new user engaging logic’s, to combine social and economic value.

Specifically 4D conference embraces both perspectives:

“designing development”
where design is the main input to create feasible conditions to enhance social values, to diffuse new technology paradigms and to create new ventures.

“developing design”
where design is the “output” of the inter-playing of social, economic and technological supporting forces.
The conference is organized within 3 tracks:

TRACK 1: Meanings of Design in Social Development
Topic 1.1: Design for the Future Craftsmanship
Topic 1.2: Design for Third Sector and Social Innovation

TRACK 2: Meanings of Design in Technological Development
Topic 2.1: Design for New Paradigms in Production
Topic 2.2: The Role of Design in Humanizing Technologies

TRACK 3: Meanings of Design in Business Development
Topic 3.1: Designing Tradition in Global Markets
Topic 3.2: Design for Business in the Post-human Era
One of the motives for deciding to host the second 4D Conference in Japan was the strong connection I felt to the background stories of the first conference in Lithuania started by Prof Rūta Valušytė.

The historical transition of Lithuania made Prof Valušytė think about how value is by no means determined by anyone in particular, but by one’s inner self. Subsequently, the value lies in her activities that are rooted in the concept of design in society and increasing design education for (re-)establishment of the Lithuanian national identity.

On the other hand, today’s Japanese society has been facing stagnation for the past few decades; losing sight of the next destination, the way forward and future progress. It immediately occurred to me that Japan can, and should, learn from the case of Lithuania. I therefore thought it necessary for the country to have the chance to discuss how international design knowledge has the potential to help us in the social challenges we face today from a global perspective. It is my hope that the lessons learnt from Japan and Lithuania will be passed on to other global citizens – with this in mind, we decided to name the conference “Meanings of Design in the Next Era”.

General Chairs and Reflections

Kazaru Yaegashi

Professor of Design Management and director of Design Management Lab at Ritsumeikan University, Japan; Visiting Scholar at Politecnico di Milano.
It was an absolute pleasure and honour to see all the intense and insightful discussions taking place at the conference this year, and I hope that they may shape the meaning of design in the future. The discussions in the context of business in particular convinced me that the definition of design has tacitly but clearly shifted from simple problem-solving, to that of meaning-creation for the future. The discussions indicated the need to revise business models and objectives, and to consider the best ways of performing “design capability”.

The past decades have brought to light a diverse range of interpretations of what design is. The world has been rapidly changing, and we should never stop asking ourselves how our academic and practical expertise in design can impact the world of tomorrow, rather than merely observing and interpreting what is already there. Amidst perspectives from other academic fields, design is unique in its “forward-looking” scope, and its practice of analysing not only the present and past, but of also discussing and (co-)creating what the future should be. Hopefully, by developing the academic study of design, we will contribute to the larger scale, future development of all academic disciplines – this is what I believe is design’s purpose, and the role the scholars in design research.

See you soon again at the next conference.
Today we are increasingly confronted with complex, interconnected environmental and social problems so-called wicked problems. This is our new world. The complexity and wickedness of these problems make it impossible for any single discipline to plan and implement solutions. These wicked problems require the ability to think in systems work across disciplines and develop new alien skills enabling us to live among the unpredicted situations.

The 4th Industrial Revolution represents a fundamental change in the way people live, work, even – love. Furthermore, it is more than just technology-driven change; the lines between the physical, digital, and biological spheres are blurring. The main difference between the 4th industrial revolution and the previous ones is that now the technology merges directly with human lives. We have entered a post-human era, which is based on the new rules ever learned before; moreover, the technological changes happen faster than ever and effects our lives faster than ever. It is said that humanity will change more than in the next 20 years than in the previous 300 years.

The post-human world challenges us human beings. The blurring lines between physical, digital, biological spheres call for integration between technology, humans, and nature. However, a significant ‘cultural diversity’ exists between these three dimensions: technology is ‘exponential,’ humans are ‘linear,’ nature is ‘cyclical.’ Nor technology nor nature can manage the integration. Only humans are gifted with this ability. In this new world, we – humans are facing the need to manage the exponential technology and the cyclical nature; deal within unknown challenges, unpredicted situations, and generate new, uncertain solutions. Here the linear way of thinking becomes our main challenge. Typically, we are used to take a predictable path, or in other words - keep business as usual; keep us safe; remain in the comfort zone. That is why we are used to choose the options we already know, and which are already tested. However, the comfort zone does not exist anymore. As Georges Amar, an engineer, writer, and artist, mention in his book ‘Homo Mobilis’ (2010) – we are living a ‘mobile life,’ which can be compared to surfing on the wave – the wave...
is moving, and we, the surfers, are moving too. So we need some ‘surfing skills’ – a mental shift from linear and predictable to the bold and spontaneous.

There are different ways of how design can take action within this scene and sustainable future development – from small design projects, providing creative solutions which transform the human (user) habits; circular design projects which increase the integrity of products and replicate the principles of nature through biomimicry; or sharing the design culture and the ways of thinking among non-designers. The later becomes essential while challenging the linear way of thinking. Design thinking is characterized by one main feature – the combination of creative and rational thinking also called as ‘divergent and convergent thinking’ or ‘abductive thinking’ - the ability to be at the same time emphatic and analytical, rational and emotional, oriented by plans and constraints, but spontaneous. This kind of ‘dualistic’ reasoning is used among designers, and it differs from the rational deductive and inductive reasoning, which relies on past data. As philosopher Charles Sander Pierce (author of the term) defended - no new idea could be produced by deduction or induction using past data. Therefore, abductive reasoning is the way of thinking in new and different perspectives and about future possibilities, which do not fit into the existing models. Here feelings and emotions are just as important as rationality. This way of thinking enables us to question the status quo and overcome the linear way of thinking.

This is the main reason why design, culture, and creativity incorporated with fast-developing technologies has never been more critical. Design considers at the same time human needs and new visions of living well, technologies and the constraints, and opportunities for business. Therefore, it is described as the central factor of innovative humanization of technologies and cultural and economic exchange; It is also said that the role of design transforms continuously in response to what is happening around. While everything is changing so fast, the role of design changes accordingly, therefore it is to be redefined continually and not only among the designers and design discipline.
The 4D conference aims to reach places that represent a different relation to design and allows researchers from different fields to meet and share their thoughts about the transforming roles of design.
The second 4d conference took place in Osaka, shortly after the arrival of typhoon Hagibis over Japan. A natural catastrophe that, apart from having had consequences on world air traffic, has caused the death of dozens of people and significant damage to the entire country. The typhoon was predicted by the very sophisticated software that is used today by meteorologists, yet it has left a devastated territory and losses. Certainly, the complete surprise would have been an even greater disaster and there are areas of the world far less prepared to handle this type of event, but in reality no one is ever sufficiently prepared for disaster.

Design does not help to prevent disasters, but sometimes it can help people who face them. In general, design should help people "live better", otherwise it makes no sense.

The concept "live better", although universally clear on an intuitive level, can definitely take on very different practical variations depending on very different boundary conditions. In any case, whether it is to make relief efforts more effective after a natural disaster, or to work for small portions of a more comfortable daily life, an approach that involves listening and empathy cannot be considered secondary or less urgent than the mere technical-performance solution.

Design as a practice, in its sense of "making sense", has always accompanied the history of human beings and technology. During this long history as part of our evolution, from a careful reading of the artifacts belonging to different cultures and societies, it often emerges how technological evolutions have often been used
as a new support for the production and communication of meaning, often with repercussions, or at least afferents, with respect to important questions of the society of the period.

Design as a discipline is instead a relatively recent phenomenon, and is probably one of the few disciplines that is giving shape to itself. A "form" whose substance, whose focus is emerging to be the production of meaning for people, the implementation of new scenarios for a better existence.

The results of the design action do not fully fall within the domain of technology, as there are disciplines characterized by wider knowledge for this. Thus the realm of pure theoretical speculation is historically related to other fields of knowledge. The nature of Design lies in the tension between these two areas. So the results of his action fall into a "middle ground", where the knowledge relevant to the domains of technique and culture are intertwined, developing scenarios of a "possible present".

A possible present that represents the best stage for the fears, loves, weaknesses and energies with which our existences face wonders and disasters.
Hiroyuki Anzai

Director of De-Tales ltd, London based design consultancy; Owner of Mobile Crews Corporation.

During a financial crisis, people are likely to say “economy is too important to leave an economist”. It means that people are not interested in the (macro level) economy at a financial stable period however people change their attitude suddenly when they feel uncomfortable. Then an economist is claimed badly (people do not understand fully how to care of economy but are convinced of that a capability of economist is not enough). You may recall such an example happened in 2008.

Ezio Manzini, an Italian design thinker and social innovator, names the current-constant-change-world as “design mode” and he refers to a Polish sociologist, Zygmunt Bauman’s expression, by which our postmodern era is “liquid” instead of “solid” in the past. Nevertheless, as far as I remember, I have never heard a phrase such as “design is too important to leave a designer”, at the least, out of creative industry. Design has been introduced not just for styling of products but also for business strategy, community consensus building and others in more than decades, yet people have not expected design so much (perhaps because design have not be considered so important or live intentionally in hidden places).

Obviously there are many kinds of approaches for both problem solving and sense making in the world; design is just one of them for both of them. However I do not suppose that we need to demonstrate as if design is “the biggest figure” in order to get an attention from people, since design itself must be humble. Without being humble, we can not observe things as they are, and we may have a big difficulty to be observed as we want to be.

In my opinion, four keynote speakers at Plenary sessions of 4D Conference, Unni, Keiji, Elena and Mauro, confirmed what the main stream of design must be, while having mentioned about it by a modest way. They were very passionate to talk about design, at the same time, expressed and treated it as very delicate one.
One example; Elena picked up words “a beautiful big wall” (to be built between USA and Mexico) as unrecommendable use of aesthetic value. Ruta, one of our general chairs, said personally after the conference “we are not able to call design if it is planned for the purpose of political propaganda”. Ruta mentioned it in a different context she referred to the design of Lithuania under the control of ex-Soviet Union. Although an aesthetic value is one of fundamental factors within design, we have to use it with careful way (because of its character, an aesthetic factor has been often overestimated or ignored in the design process specially for problem solving instead).

It was my great pleasure to see/hear various discussions as to how a “humble” approach is creating a new direction for the new era. We must be happy to accept the fact; people do not claim “design is too important to leave a designer”. Do my comments appear to be ironical?
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THE ROLE OF DESIGN & INNOVATION IN TRANSFORMING HUMANITARIAN ASSISTANCE

Unni Kaunakara

The Shinhan Distinguished Visiting Professor, Yonsei University / Visiting Faculty & Leader in Residence at Schwarzman College, Tsinghua University / Assistant Clinical Professor of Public Health, Yale School of Public Health

Dr Kaunakara’s session brought us to the heart of humanitarian action through his introduction to the diverse range of activities carried out by Médecins Sans Frontières. May it be conflict, displacements, disasters, epidemics or neglect, doctors face challenging situations and must constantly diagnose creative solutions. Dr Kaunakara thus brought the two disciplines of design and medicine together to highlight the ways in which innovation in humanitarian activities may be facilitated through design thinking.

A fundamental step is understanding the ‘Wicked Problem’, of effectively framing the issue, managing different world-views, sustaining political and social will, recognising complexity and understanding that there are no solutions, only consequences. Design principles are essential. For example, the design must be needs-driven, patient-centred, field-adapted, accessible, scalable, realistic, respectful of the individuals concerned. As with product design, humanitarian solutions must be centred on the people. Nurturing solidarity prevents invisibility and indifference. The session took us through some fascinating examples of this theory in practice, from the Women are heroes project, to the nudges used in malaria pill design.

Date: Monday, October 21, 9:00 – 10:00
Mr Ashizawa’s presentation explored the role of design and innovation specific to the Japanese context. As an architect he has been involved in helping with disaster relief efforts in Ishinomaki in the Tohoku region after the Great East Japan Earthquake. Seeing as volunteers are only a temporary solution, integrating sustainable thinking into the design process is key. Through his personal projects in the region he demonstrated how important the role of community building was as part of the disaster relief endeavour. Merely making a space for fostering creativity is not the solution, the relationships and community spirit must lead the creative process for it to be truly sustainable.

By incentivising each community member to want to contribute and help their community, creativity will naturally emerge. Rather than creating a final product, it is a fluid process of working directly with the people affected throughout the conceptualisation process. The main task of the designer is therefore to support and build the infrastructural tools that will nurture grass root innovation as opposed to commanding it.

Date: Monday, October 21, 10:00 – 11:00
A DESIGN JOURNEY (IN THE BUSINESS WORLD)

Mauro Porcini
Senior Vice President and Chief Design Officer at PepsiCo

Mr Porcini’s presentation took us on a vibrant exploration of the design journey in the business world. He began by introducing the cultural journey of design at Pepsi, and outlined the vision that got him to the position of chief design officer.

Five main stages were put forward as the steps that allow for the pursuit of innovation: denial, hidden rejection, the leap of faith, the quest for confidence and holistic awareness. This must be advanced through both a bottom-up and top-down approach. New design know-how functions as a disruptive agent, and by identifying and leveraging strong internal sponsors, a corporate structure that supports innovation is materialised. External endorsement is important in terms of recognition, and quick wins as proof prints indicate progress.

To ensure sustainable business success, the key is to balance long term vision and short term projects. In a fast changing world, design has a new role. Pepsi harnesses this potential by developing holistic solutions that aren’t mere products but offer meaningful experiences to the consumer.

Date: Tuesday, October 22, 9:00 – 10:30
Dr. Pacenti took us on a theoretical exploration of the notion of design. What does it actually mean? Has its meaning become redundant in today’s world? How can it be utilised to effectuate concrete forms of innovation? Design is being democratised as an activity that anyone can take part in, and this universality requires a reconsideration of how we approach design today.

Dr Pacenti proposed a new direction for design, that of ‘pro-ject-ing’, of using the critical and practical senses to turn thinking into things, problems into opportunities and thereby creating concrete visions and concepts. It allows for a leap into the future that moves beyond the present. Rather than mere problem solving, the focus is on a continuous process of envisioning, sense making and opportunity creation. Design is not only knowledge based understanding, but of dynamic interpretation, and of putting people at the centre of the process.

Date: Tuesday, October 22, 11:00 – 12:30
Workshops

KANSEI (Affective) design

Date: Monday, October 21, 14:00 – 15:30
Participants: 6
Sponsor: DML (Design Management Lab), Ritsumeikan University.
Academic Speaker/Workshop instructor: Mitsuo, Nagamachi, Hiroshima University, Hiroshima, Japan; Yuuki Shigemoto, Toyama University of International Studies, Toyama, Japan

This workshop aimed for 1) a better understanding of the methodology of product development by Kansei Engineering, 2) discussing what conditions are needed to make the established methodology maximise its utility, and 3) what implications can be brought from Kansei Engineering for our design research and practice.

Prof Nagamachi gave an introductory presentation regarding his previous product development projects. One participant said that the following phrase from Prof Nagamachi was particularly awakening; “I have conducted a lot of experiments around psychology and neuroscience in the past few decades. These experiments have told me that brain waves don’t tell anything regarding what consumers are truly seeking for”. He then continued, “We need to consider consumers, look at them, listen to what they say. All of their words, actions, behaviour and attitude tell us what their inner selves seek for. My role is to interpret their unrecognised desire for future life, and statistical analyses link their desire with appropriate design elements such as materials, shape, colour, smells, size, and so forth that form an epochal product”.

The subsequent discussion amongst the participants reached one conclusion that Prof Nagamachi’s design attitude enables the Kansei Methodology to be best utilised to develop a strong emotional bond between a product and consumers, meanwhile many other researchers and business experts have applied the same methodology (the same procedures of product development) but faced quite a few unsuccessful products in the market and society. The absolute principle of the Kansei Methodology is questioning what meanings new products bring to consumers’ lives that are tacitly sensed by consumers but they cannot denote. In this sense, there are still spaces for tracing user-centred approach but the solutions for their needs should be driven from consumers’ Kansei (sensing for unrecognisably desired meanings of future life) and cristalised by the logic of science.
In abductive reasoning, a designer finds inspiration on experiences through the past projects and justifies the idea created from the inspiration. The novel idea requires to carefully and precisely build a logic to persuade someone to accept because it is the result of ‘best guess’ leap. Therefore design-oriented innovation can be described as the process of inspiration and justification.

However, engineers have a barrier to take advantage of this process. They tend to use deductive reasoning that starts from evidences have already cleared. The routine to think with the deductive reasoning discourage them from starting from inspiration, in other words they fail to create novel ideas using design thinking. Thus, the workshop aims at exploring the two research questions: (1) How do you find inspiration? What kind of IT tools are useful? (2) How do you justify your idea? What kind of IT tools are useful?

As a result, the participants claimed that analog tools are useful to find inspiration and justification. For example, some of participants use a lot of photographs attached on the wall because it is easy to move, rip, and throw away them. What is important in this process is to categorize photographs into meaningful group. The participants emphasize that this is the sensemaking and resource of creativity. This result is the challenge for the IT tools. To record and trace the data is IT tool’s strong area. We think that this speciality contributes to justification because it depends on the knowledge obtained in the past. However, the categorization of the knowledge into meaningful groups should be carried out by human because this is the sensemaking. Current artificial intelligence can categorize big data into groups. However, the group does not always have to be meaningful for human. Thus, IT system for design thinking must contribute to supporting human sensemaking in an indirect way.
What is the design capability necessary for the leadership of business people in the next era?

Date: Tuesday, October 22, 16:00 – 17:30
Participants: 15
Sponsor: Human Quest Co.,Ltd.
Academic Speaker/Workshop instructor: Mitsuru Onishi, Human Quest Co., Ltd, Tokyo, Japan; Kazaru Yaegashi, Ritsumeikan University, Osaka, Japan.

Recently, every corporation has faced an unpredictable situation called “VUCA (Volatility, Uncertainty, Complexity, Ambiguity) World” with the development of the global market. In this kind of situation, it is necessary for business people to explore a new style of leadership adapting to that.

The leadership in business has been recognised as the ability to lead the organisation of a person who takes an authoritative position thus far. From now on, however, it is required the new leadership which has a role to raise the motivation of stakeholders, show their direction, and create the future, regardless of the position or the authority.
We think design capability would play an important role in such leadership. However, what kind of elements in design capability could be helpful for that has not been examined enough yet.

Therefore this workshop aimed to explore the role of design capability in the new styles of leadership in the next era while referring to some cases of current human resource development programs in Japanese companies from the various viewpoints of participants who have the experience of the design expert.
In order to achieve the objectives of this workshop, the following activities have been conducted.
- Presentation from the facilitator on some cases related to current human resource development programs in Japanese companies.
- Discussion among participants to uncover the systematic issues on the leadership in the business context.
- Discussion among participants to uncover the role of design capability in the new styles of leadership.
- Collection of feedbacks, presentations, suggestions from the participants.
TRACK 1: Meanings of Design in Social Development

Topic 1.1: Design for the Future Craftsmanship
Why Are They Able to ‘Design Thinking?’: Framing A Designer’s Practical Intelligence Linked to Their Thinking, Acting and Attitude

Takuo Ando¹ and Satoru Goto²
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Abstract: This study aims at exploring the theoretical foundation of design thinking, especially from the perspective of a designer’s practical intelligence linked to their thinking, acting, and attitude. From the middle of the 2000’s, many efforts to apply design thinking to businesses have been made. The reason why design thinking is useful for business is that some of its aspects are considered to promote innovation. While rising such a business side movement, design researchers have tried to deconstruct design thinking for a long time (e.g. Rowe, 1987; Cross, 2011). The ‘designerly thinking’ discourse revealed that the core of this kind of thinking lies in the ‘abductive reasoning’, relying on a complex cognitive activity called, ‘reframing’ (Dorst, 2011). Reframing is, ‘shifting semantic perspective in order to see things in a new way’, (Kolko, 2010: p.17). It requires a unique mindset that constantly updates not only the knowledge and skills, but also its own ‘being’ (Adams et al., 2011). While understanding design thinking is important, creating or discovering a framework that guides the designers’ practical intelligence (Strenberg & Wagner, 1992) including their situated action, learning style and attitude, to understand, ‘why they are able to indulge in such a thinking’, is more crucial. In this study, we attempted to create a theoretical framework that links their thinking, acting, and attitude, through a literature review.

Introduction

From the middle of the 2000’s, there have been many efforts to apply design thinking (DT) to businesses. DT is, ‘bringing designers’ principles, approaches, methods, and tools to problem solving’, (Brown, 2008). The reason why it has been introduced to business so aggressively is the demand for new ways of thinking that is unbiased towards a convergent approach (Boland & Collopy, 2004; Martin, 2009). In the field of management, there is a need to build ambidextrous organisations that realise not only efficient management, but also innovation (O’Reilly & Tushman, 2008). Some scholars have adopted this unique aspect and developed it as a business building tool (Brown, 2009; Liedtka & Ogilvie, 2011), and others have attempted to apply that to management-related education (Boland & Collopy, 2004). Design thinking is now considered as the new way of thinking that will lead the current stagnant situation to an ideal sustainable future.

On the other hand, some scholars criticise the lack of clarity about what DT ‘is’, and the discussion of DT in management discourses has no theoretical foundation (Carlsgren, Rauth & Elmquist, 2016; Johansson-Sköberg, Woodilla & Çetinkaya, 2013; Kimbell, 2011). Indeed, most researchers define it
from their own original perspectives (e.g. ‘integrative thinking’ (Martin, 2007; 2009), ‘human-centeredness’ (Brown, 2009), ‘thinking out of the box’ (Kolko, 2011)), with no references to the academic design discourse.

While rising such a business side movement, design researchers have tried to unpack ‘designerly thinking’ for a long time (e.g. Rowe, 1987; Cross, 2011). In this designerly thinking discourse, it was revealed that the core of this thinking is, ‘abductive reasoning’, relying on ‘reframing’, which is a complex cognitive activity (Dorst, 2011). Reframing is the act of ‘shifting semantic perspective in order to see things in a new way’, (Kolko, 2010: p.17) requiring a unique mindset that constantly updates not only knowledge and skills but also its own ‘being (Adams et al., 2011)’.

In this study, we take the challenge to create a theoretical framework that links their thinking, acting and attitude, through a literature review.

**Literature Review**

*The literature of ‘Designing’*

Adams et al. (2011) emphasised that ‘the idea of “design thinking” has typically represented what designers understand about design and how they go about the act of designing based on this understanding’ (Adams et al., 2011: p.588). To frame the concept of a designer’s practical intelligence, we first need to focus on the act of ‘designing’.

In Design studies, many scholars pointed out that one of its unique aspects is its process of ‘problem-solving’ (Simon, 1969; Buchanan, 1992; Hatchuel, 2001). While traditional rational problem-solving has a high determinacy for the problem itself and a one-way nature of running from a problem to a solution (Simon, 1969), the problems dealt with in design, are open-ended and highly indeterminate. Some call them ‘ill-structured’ (Simon, 1973) problems, and others term them, ‘wicked’ (Rittel, 1972; Buchanan, 1992) problems.

The so-called ‘design problem’ (Dorst, 2006) has a unique aspect that has not been discussed from the rational problem-solving perspective. For example, Hatchuel (2001) argued that the problems dealt with, in the real design situation have an ‘extended rationality’, compared to Simon’s ‘bounded rationality’ (Hatchuel, 2001). He pictured the difference in the two types of problem-solving from the usual activities on a Saturday night, wherein one group of people search for ‘a good movie’ in town and another group plans ‘a nice party’. The former, deals with a well-defined concept (‘a movie’) and could choose from alternatives already provided. The latter, needs to not only choose, but also create the concept itself owing to the lack of a dominant notion of, ‘what a party should be like’.

Dorst (2006) termed this nature of such design-related problems that are hard to identify as, ‘paradox’. A paradox is a complex statement that consists of two or more conflicting statements (Dorst, 2006: 14). In a real design situation thus, creating a solution also includes redefining a problematic situation.

**Two types of knowledge of designing**

To solve a design problem, what should designers do?

Cross (2006) described a designer’s unique problem-solving approach as the, ‘designerly ways of knowing’. This phrase indicates that the designer’s way of tackling problems especially follows a
solution-focused mode of problem-solving. Through a continuous interaction with the practical situation, designers build their knowledge with direct reference to the experience and make decisions for the newly encountered design context (Cross, 2006). Some scholars explain this knowledge using the metaphor of a ‘gambit’ (Lawson, 2006). In a chess game, a gambit is the opening move to gain an advantage by sacrificing pieces. In the case of design, this is not the beginning of the whole process, but rather the starting point of the thought process of which aspects of the design need to be highlighted (Lawson, 2006: 176). Design is like chess with endless moves where, unlike chess, design neither has a fixed board size nor a limited number of pieces (Lawson & Dorst, 2009: 180). Through the process of ‘learning-while-doing’, designers constantly change and adjust their ways of acquiring information, which significantly impacts the future design decisions (Cross, 2011).

Many studies have shown that designers do not work on their own design problems in a ‘tabula rasa’ manner, but draw knowledge from their experiences (Darke, 1979; Rowe, 1987; Lawson, 2006). This kind of knowledge is called the ‘guiding principle’ (Lawson, 2006), which is an underpinning theory of design, based on some kind of moral certainty. This also includes the strong intellectual programmes behind their work including their own motivations, reasons for wanting to design, sets of beliefs, values and attitude (Lawson, 2006: 159). The content of the guiding principle is as diverse as the individual designers and varies according to their acquired experiences.

Some other scholars echo this notion as the ‘primary generator’ (Darke, 1979) or the ‘organizing principle’ (Rowe, 1984). The designer forms the first idea or interpretation at the beginning of a design problem. A primary generator is a principle that is applied at the starting point of a design activity and indicates the ability to justify design decisions from a rational perspective (Darke, 1979). In contrast, organisng principles leave a vast scope for creating numerous ideas in the later design process (Rowe, 1984). Thus, the designers accumulate principles from their professional experience, called ‘working principles’ (Dorst, 2010).

These two types of knowledge are essential in dealing with highly uncertain problem situations, and this shows that design is difficult only with the doctrinaire approach.

**The literature of ‘Designerly thinking’**

As mentioned above, in a designer's practice, two types of knowledge are employed: (1) designerly ways of knowing, and (2) working principle. By applying these, they could deal with complex problems. This is called ‘synthesis’ in design studies, which is a process combining market needs, technology trends, and client needs in an organised form (Kolko, 2010).

How do designers think while utilising the process of synthesis? Several studies have described this as ‘reasoning’ (Roozenburg, 1995; Martin, 2009; Dorst, 2010; Kolko, 2010), and especially in the form called ‘abduction’. Generally, there are three inference types: ‘deduction’, ‘induction’, and ‘abduction’. Deduction is, deriving specific knowledge from a general principle or a universal knowledge. For example, the so-called ‘trilogy’. In contrast, induction implies deriving common hypotheses by listing certain observable facts. Abduction is a logical form of inference or, ‘best guess’ leaps (Kolko, 2010). Peirce simply explains abduction using the following example:

*This was a hypothesis. Fossils are found; say, remains like those of fishes, but far in the interior of the country. To explain the phenomenon, we suppose the sea once washed over this land. This is another hypothesis (Peirce, 1970:155)*.

In addition, Dorst (2011) pointed out that there are two forms of abduction reasoning in design thinking. One form reflects the ‘problem-solving’ aspect of the design. In this case, the designers know both, the working principle (How) and the value that should be obtained (the connection between
these two is called ‘frame’, in design research (Dorst, 2010: 132)). Therefore, the frame is applied to the problem to find the most suitable solution by trial and error (abduction 1).

The other is the reasoning that is applied when only the value that should be obtained, is clear. In this case, what needs to be created and the working principles generating the value, are unclear. Under such circumstances, abduction 1 and the creation of a working principle must be applied at the same time (abduction 2). Thus, design practice is done by the ‘co-evolution’ of both, the problem space and the solution space (Maher & Poon, 1996; Cross, 1997; Dorst & Cross, 2001). This dual creation is considered as being unique to designerly thinking.

In addition, the core process in this second form of abduction is, ‘re-framing’ (Dorst, 2010; 2011). According to Kolko (2010), ‘re-framing is a method of shifting semantic perspective in order to see things in a new way’, where, ‘the new frame “re-embeds” a product, system, or service in a new (and not necessarily logical) context, allowing the designer to explore associations and hidden links to and from the centre of focus’ (Kolko, 2010: 23). As Schön (1984) states that the, ‘hypothesis depends on a normative framing of the situation, a setting of some problem to be solved’ (Schön, 1984: 132), the key to designerly thinking lies in the creation of a new frame to capture the problem situations properly (Figure 1).

![Designerly thinking process from the previous research](image)

**Where is the problem?**

*Why are they able to ‘Design Thinking?’*

Summarising the above discussion, in design practice, designers apply two types of knowledge: (1) designerly ways of knowing, and (2) working principle. By using these two types of knowledge, designers can deal with complex problem situations. In addition, the set of a working principle and a value is applied in thinking, forming a hypothesis from abduction reasoning and the examination of that by deduction, would be performed. If the problem is similar to what the designers have already experienced, they could apply the frames immediately. Otherwise, the second form of abduction would work. Kolko (2010) states that the, ‘design synthesis is fundamentally a way to apply abductive
logic within the confines of a design problem’ (Kolko, 2010: 20), and this ‘synthesis is an abductive sensemaking process’ (Kolko, 2010: 17).

The question here is, ‘why are the designers able to think like that?’ Especially, in the process of abduction 2 mentioned above (only the value should be obtained is clear), they generate a working principle that does not exist in the process of reframing (Figure 2). However, while the process and mechanism of design thinking is clear, the factors enabling their thinking are not.

The Clue: Theory of Practical Intelligence

Why are the designers able to reframe when they encounter new problems? The key to this lies in the understanding of not only the designer’s thinking but also the working synthesis (Duncan & Hmelo-Silver, 2009; Adams et al., 2011), such as their ‘practical intelligence’ (Strenberg & Wanger, 1992).

Figure 2: Designerly thinking process of abduction2 (Dorst, 2010)

In cognitive psychology, knowledge is usually divided into declarative knowledge and procedural knowledge (Anderson, 1983). Declarative knowledge is the knowledge about facts. Procedural knowledge is the knowledge that is difficult to express verbally, such as know-how or skill (for example, the knowledge that ‘the bicycle is a vehicle for moving’ corresponds to the former, ‘how to ride a bicycle’ corresponds to the latter). Ryle (1949) explained this difference using the phrases, ‘knowing that’, and ‘knowing how’. He pointed out that ‘knowing that’ is acquired only after critical review practices; hence ‘knowing how’ to act appropriately in practice is a more essential intelligence in humans (Ryle, 1949). The practical intelligence referred to here, is not an ability that an individual originally possesses, but is acquired through practice and learning (Christiaans & Dorst, 1992; Ericsson, 1996; 2001; Lawson, 1979). The concept of practical intelligence perceives knowledge as being in the body.

In addition, according to Ryle (1949), those who are skilled in the way of practice have the same ‘disposition’. Disposition is the intellectual attribute of a human being that enables the repeated performance of appropriate actions in a given situation. The embodied disposition enables unconsciously keeping the rules aside for proper practice and doing the logical reasoning responds to varying situations (Ryle, 1949). A similar concept is seen in Bourdieu’s work about the ‘habitus’ (Bourdieu, 1979). The habitus is a set of individualised dispositions, a collection of ideas, ways of feeling,
and the modes and styles that have been shared among social groups. According to Bourdieu, the norms such as rules, faith or conviction do not generate the practice, but the schemas inscribed in the body, do. These embodied schemas that accumulate within an individual through past experiences of a certain group or class, shapes their way of thinking, perception, and action unconsciously like a ‘sense of games’ (Bourdieu, 1979).

Thus, the disposition or habitus associated with practical intelligence are embodied in the individuals, and in the designers. Indeed, many aspects of a designer’s practice depend on their practical intelligence. Larson (2006) explains this point using the example of an architect.

‘The artist is not someone who designs in order to prove his or her theory, and certainly not to suit an ideology... any building that tries merely to express a theory or any building that starts with a theory and works very deductively is very dry, so we say that we work inductively (Lawson, 2006: p.163)’.

We consider these embodied dispositions to be one of the working principles that constantly generates improvisation in an individual, while being regulated by structures and rigid constraints. Moreover, these aspects enable designers to update themselves continuously and maintain their creative loop. This on-going openness (McDonnell, 2011) or unique mindset that constantly updates not only the knowledge and skills, but also the designer’s own ‘being’ (Adams et al., 2011) are important factors enabling design thinking. However, this embodied disposition or intellectual system is not easy to understand because it not only includes clear knowledge such as, about objectives, factual information, but also the motivations, beliefs, values, and attitudes (Lawson, 2006).

**The idea of Design attitude**

How could we theorise the designer’s practical intelligence? To filling the above theoretical gap, we focus on ‘Design attitude’. According to Boland & Collopy (2004), who first proposed the concept, Design attitude is, ‘the expectation and orientation one brings to design project (Boland and Collopy, 2004: 9)’ and the effective attitude and behavioural characteristics relating to solving ill-structured problems.

In addition, according to Michlewski (2008; 2015), the design attitude is the culture, values, beliefs, and the mental models shared by design professionals. In addition, he states that the culture and beliefs that the designers possess are shared by professionals, entering various companies and taking the form of one subculture. In Michlewski’s research, he proposed five elements of design attitude: (1) embracing uncertainty and ambiguity; (2) engaging deep empathy; (3) embracing the power of the five senses; (4) playfully bringing things to life; (5) creating new meaning from complexity (Michlewski, 2008; 2015). Table 1 summarizes the concept and the items of design attitude from the previous literature (Table 1).

According to Amatullo (2015), the important theoretical influence on the use of the word ‘attitude’ in the conceptualisation of design attitude is related to Bourdieu’s ideas of the practice theory and habitus (Amatullo, 2015: p. 114). These conceptualisations not only imply an introspective position on design (Simon, 1969; Schön, 1983), but also the flow of important research on the issues of design agency, identity, and morals (Buchanan, 1992, 1998; Margolin & Buchanan, 1995).

Research on the concept of attitude has different perspectives, lacking a unified view except that it is an implicit personal characteristic (Banaji et al., 2001). However, the practice generated from the disposition lies somewhere between the unconventional embodied acts and the acts without thought.
Table 1: The several concept of design attitude

<table>
<thead>
<tr>
<th>Literature</th>
<th>Concept and Definition</th>
<th>Attribute</th>
<th>Items of design attitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boland and Collopy (2004)</td>
<td>“Expectations and orientations one brings to a design project”</td>
<td>Design attitude for Managing</td>
<td>1) Invention of new alternative</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2) Questioning of assumption</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3) Resolve to contribute to human betterment</td>
</tr>
<tr>
<td>Michlewski (2015)</td>
<td>“Character of a professional culture shaped by designers”</td>
<td>Design attitude for Organizational Learning</td>
<td>1) Embracing Uncertainty and Ambiguity</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3) Embracing the Power of the Five Senses</td>
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<td></td>
<td></td>
<td></td>
<td>4) Playfully Bringing Things to Life</td>
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<td></td>
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<td></td>
<td>5) Creating New Meanings from Complexity</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1) Connecting Multiple Perspective</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2) Creativity</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3) Empathy</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4) Engagement with Aesthetics</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5) Ambiguity Tolerance</td>
</tr>
</tbody>
</table>

**Discussion: The Theoretical Framework of a Designer’s Practical Intelligence**

This is a theoretical framework of a designer’s practical intelligence derived from the above discussion (Figure 3). This model connected the perspectives on design thinking and disposition, especially from the discussion about design attitude. As aforementioned, in the design thinking process of abduction 2 (Dorst, 2010), the designers should find a working principle by reframing. The skilled designer is able to carry out this highly complicated thinking, continuously with an ongoing openness (McDonnell, 2011) or unique mindset that constantly updates its own ‘being’ (Adams et al., 2011). Without this mindset, the designer’s unique thinking is not triggered.

The discussion on design attitude brings several elements to light. For example, ‘ambiguity tolerance’, is an attitude that reflects the designer’s ‘optimism’ (Brown, 2009). Designers realise that creating something novel does not guarantee success. A truly creative process is not continuous, but rather complex and cumbersome. They feel comfortable getting through multifaceted and complex realities without relying on the process and framework that is seemingly perfect. This attitude enables them to gain new knowledge and confidence.

One of the other features of design attitude is, ‘engaging deep empathy’. Designers challenge to redefine the framework of users, clients, and the society by confronting the phenomenon with humility. Through the interaction with various stakeholders, they define the problem. They don’t pretend to know all the answers about users and rely on tools. Instead, they rely on their intuition to sympathise with people as deeply as possible. This attitude makes it possible to identify the value they should aim for (Michlewski, 2015).

‘Connecting multiple perspectives’, reflects a designer’s approach to complexity. Designers harmonise diverse contradictory viewpoints and information, leading to a completely novel perspective on things.
This attitude helps the designer in finding connections to different things at different levels and generate a valuable new network (Michlewski, 2015).

Figure 3: The model of designer’s practical intelligence

Thus, a designer’s practice is supported by not only their thinking, but also their attitude. Normally, it is considered that repeating such a creative loop is accompanied by difficulties due to the biases and tendencies shaped by routine work. For example, ‘anchoring’ and ‘confirmation bias’ have an influence on ‘analogy reasoning’, which is proximate to abduction reasoning (Gavetti & Rivkin, 2005). Anchoring indicates that it is difficult to wipe out fixed ideas in human thinking. This bias creates the possibility to retrieve the problem source that corresponds to their fixed ideas, without trying to gain a deep empathy towards new problem situations. Confirmation bias indicates the tendency to seek only that information which affirms one’s own ideas. It also has been pointed out that the tendency to collect favourable evidence and hide the inconvenient evidence affects the success of analogy reasoning (Gavetti & Rivkin, 2005).

This is close to the argument of double loop learning in Argyris and Schön (1978). Single-loop learning is a learning behaviour that modifies actions within a range of basic assumptions when the result of an action does not match the expected one. Double-loop learning, on the other hand, is a learning behaviour that modifies not only the behaviour, but also basic values (Argyris & Schön, 1978).

It is also close to the argument of the ‘technical rationality’ model criticised by Schön (Schön, 1983). The technical rationality model emphasises on the rationality of technical knowledge generated by a specific professional occupation. Schön (1983) criticised that, in highly specialised groups, while standardised knowledge constructed by hierarchising its expertise and learning had been emphasised on, the knowledge of the ‘defining problem’ had been ignored. He also argued that hierarchising cultivated the wrong attitude which tries to solve a problem by applying standardised knowledge to a situation (Schön, 1983).

In any case, this creative loop being generated from a designer’s practical intelligence supported by the embodied disposition (or attitude), greatly influenced design thinking.
Conclusion

This study explored the theoretical foundation of design thinking, especially from the perspective of the ‘practical intelligence’ linked to the designer’s thinking, acting, and attitude. The literature review shaped the discussion about the designing and designerly thinking. In design practice, the designers apply two types of knowledge: designerly ways of knowing and working principle. By using these two types of knowledge, the designers can deal with complex problems.

On the thinking front, the combination of a working principle and a value is applied, forming a hypothesis from abduction reasoning and the examination of that through deduction would be performed. In addition to the above discussion, we introduced another perspective on practical intelligence by including the discussion of disposition, habitus and design attitude.

Finally, we proposed an integrated model that explains a designer’s entire practical intelligence model, connecting design thinking and attitude.

Thus, this study provides a framework to understand a designer’s practice, better. However, it is not clear how each element of design attitude (e.g. ‘ambiguity tolerance’, ‘engaging deep empathy’, ‘connecting multiple perspective’) influences their thinking process in entirety or in parts.

In addition, there is a need to clarify the relationship between design thinking and other elements (e.g. ‘embracing the power of the five senses’, ‘engagement with aesthetics’).

John Dewey, an early twentieth century philosopher and educator once stated, that if one chooses either of the two namely, ‘having the right attitude to reasoning’ and ‘knowing the way of reasoning’, one should choose the former. However, Dewey also emphasised that good thinking people usually possess a balance between attitude and knowledge. In our future work, we will be focusing on how the designers acquire and update these two factors.

Acknowledgement

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References


Darke, J. 1979. The primary generator and the design process. Design Studies, 1(1), 36-44.


Measuring Design Trends Using Design Rights: A Citation Analysis Approach to Identify Influential Product Categories in Design Development

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Abstract: A product design, an appearance or shape of a product, often follows trends in the market. Trends is not always independent by product categories, and instead, it often interdependent with each other. Some products changes designs of other categories of products (i.e., iPod’s aluminum body design influenced to laptop computers, mobile phones, and even stationaries). A phenomenon of convergence potentially increases such cross-product category similarities. Particularly, multi-function products (e.g., smart ICT products) seem to be an influential actor in the era of convergence. We have been recognized the design trend by a qualitative analysis; however, its time-consuming procedure is fundamental limitations in design studies. This paper addresses a methodology to operationalize a product category level design similarity, which measures how products in the specific category affect designs in other categories. On an analogy of the technology trend examination, we analyzed citations of design patents. This approach is not completely new. Some papers already adopted this method to identify chains of designs; however, they do not cover a wide range of categories and long-time period. This paper analyzed design patents filed between 1999 and 2018 to Japan Patent Office, where professional examiners allocate detailed classifications of product categories and cite similar design right registrations. Applying a social network analysis method, we illustrate a transition of influential product, specifically increasing the impact of information and communication equipment. These products show higher centrality than others; in other words, many products other than ICT equipment frequently cited some ICT products. We also find some interactions between designs of automobiles and designs of consumer electronics. Our method displays inter-categorical design interactions and provides evidence of aesthetical convergence.

Keywords: convergence, design trend, citation analysis, network analysis
Playful Prototyping as A Didactic Method for Exploring User Experiences and Interactions

Magnus Feil and Milagros Zingoni

Abstract: This paper reflects on the collaboration between the city of Scottsdale Public Arts and the Design School at the Arizona State University in envisioning interactive installations for the 2018 Scottsdale Canal Convergence (CC) event. This annual festival located along a stretch of the Arizona canal, attracts artists from all over the world to exhibit installations featuring light, sound, and engagement with visitors. For the first time in the history of CC, an invitation was extended to students in industrial design and interior architecture to participate in a trans-disciplinary collaboration with a local Title 1 middle school to enable and transform the voices of the community into interactive art installations for the CC festival.

While navigating the design process, designers traditionally deploy various forms of 2d (sketching) and 3d visualization methods (mock-ups, models) to advance concepts from an early initial idea towards the anticipated final outcome. These static visualizations often serve the only purpose of visualizing the form and appearance, but don’t inform about user interactions and behaviors. This paper highlights various forms of storytelling methods used by the designers to visualize and test emerging concepts. With the help of low-tech props (like cardboard), the participants of this workshop will be challenged to treat the prototyping process as a playful form of storytelling. By creating low-fidelity artifacts, combined with the re-enactment of user-interactions, the stage was set for documenting scenarios on video.

With the help of basic post-production editing, the participants of the workshop were able to quickly generate and share pieces of storytelling to evaluate and share emerging concepts.

This project served as a model to fundamentally re-envision a process-driven design studio classroom experience centered around gathering crowd-sourced research, playful and explorative prototyping, form development, and ultimately the creation of full-scale interactive installations.

During the event’s 10 days duration, a record number of 208.000 visitors have been recorded by the organizers. This trans-disciplinary collaboration has offered the students not only the unique opportunity of showcasing their work to a broad audience, but also demonstrated the critical importance and learning experience of deploying playful prototyping methods throughout the creative process to envision impactful user-interactions of emerging concepts and artifacts.

Keywords: Design Education, Playful Prototyping, Designing Interactions, Industrial Design
TRACK 1: Meanings of Design in Social Development

Topic 1.2: Design for Third Sector and Social Innovation
The Importance of Identity for The Affirmation of Social Innovation Projects

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Abstract: The relevance of an identity system to support the image of projects in the scope of social innovation, can be measured through their visibility and degree of complicity between public and projects.
If we take as a reference the big brands or corporations, their identity systems guarantee recognition to the public with whom they contact, and their visibility is greater the more their identity is disclosed. This serves not only for the institution to be recognized, but also as a guarantee of quality, increasing the degree of confidence in the consumers for which they are intended, since they guarantee that the offer is made by that entity.
Hence the option that institutions of a differentiated character, less vocational for sale or profit, began to adopt this path to achieve greater notoriety and, consequently, to add value and differentiation to their offer. With the gradual widening of the influence areas of the brand, the size of those who use them has also changed: it is no longer just the great institutions that use it to communicate, noticing more and more the need for small organizations, events or individuals, affirm their presence through identifying signs, in order to be recognized and differentiated from competitors.
One of the areas where this need for affirmation is pressing is that of social entrepreneurship, increasingly asking for visual identity to approximate the one used in corporate systems, even if differentiated by its social aspect. The formula, frequently applied in the corporate fields, now extends to new areas of a social and sustainable nature, replacing the focus of financial gains for social welfare, in order to broaden the visibility of its projects, increase the area of influence and gain visibility, both among the public and the financing entities.
As a way of demonstrating the strength that the brand can add to the identity, it is intended to present a set of identities of international Social Innovation projects, developed following the Double Diamond methodology, whose formal coherence and visibility surpasses the exercise of logo construction, acquiring a strategy based on brand value, either in each project or in a set of projects already existing or to be created, in the area of social innovation.

Keywords: Identity system, Social Innovation projects, brand, visibility.

Introduction
A brand is more than a visual identity: the name, logo, and graphic design used by an organization. The crucial point is to take branding far beyond the logo, either in the business field or within social organizations.
Nowadays, many institutions, realizing the advantages that graphic identity can bring to their visibility - in spite of differentiated character or more or less vocation for sale or profit, have chosen to adopt
brand and identity systems to achieve greater notoriety and, consequently, to add value to their offer. It is considered a tool for managing the perceptions about an organization and constitutes support for the departments dealing with communications and marketing.

A distinct paradigm emerged where brand acquires a broader and more strategic role in any organization’s external activities, but also having a role in expressing internal purposes, methods, and values.

According to Olins (2004), many nations initially tested this strategy, using generalist concepts such as "made in" - ensuring that what used this denomination had intrinsic a certain standard of quality. Quickly this brand concept was extended to other territorial dimensions such as cities and / or regions and other areas of social dimension, such as charity, sports, culture and education.

The areas of intervention of the brand / graphic identity have gradually widened, but the size of those who try to apply them has also changed: no longer are just the for-profit organizations using the brand to communicate. In fact, international non-profits have been creating branding strategies for a long time and are some of the most widely recognized brands in the world, more trusted by the public than the best-known for-profit brands (Edelman, 2019). In fact, trust in NGOs increased in 21 of 26 markets in relation to previous years barometers.

In present days, small organizations, events or individuals are also trying to affirm their presence through identifying brands, in order to be recognized and differentiated from those who compete with them, also creating core value for internal purposes.

**Reinforcement of identity and recognition of credibility**

The need for affirmation in the social entrepreneurship field requires that the branding approaches to the one used in corporate systems, although being differentiated by its social nature. The formula usually applied until a few years ago, in business or corporate fields, widens now to new areas of social and sustainable nature, replacing the focus from the financial gains towards the social welfare (Holland, 2006).

Until the 90’s of last century, it did not make sense to associate social projects with the concept of branding. Exceptions can be made for institutions such as the Red Cross (figure 1) or others of the same nature and similar impact, like the United Nations – UN (figure 2), the World Wildlife Fund - WWF or Greenpeace (figure 3), but always with the perception that they should only resort to their brand for identification purposes and never to try to obtain profit with it.

In a war scenario, the visualization of a uniform or vehicle with a red cross on a white background is a way of identifying neutrality. The blue helmets of the UN are synonymous with peacekeeping forces and are, in principle, protected by their own identification. Even in the case of Greenpeace, a non-governmental environmental organization based in Amsterdam that does not seek neutrality, the brand provided extra protection because of its coherence and visibility, ensuring impact of their actions and public support for their causes.
Despite these examples, generally the concept of brand was associated with financial valuation, reserved only for institutions whose purpose was to obtain profit. For this reason, the majority of social innovation projects, not aware of the gains they could obtain with a strong visual identity, where inevitably limited to small audiences, being unable to reach the wider public.

However, with the increasing number of projects and respective financing, the need for visibility has become more evident, both to reach the target audience and to identify their investors. Audience, as Costa says, “(...) can only differentiate between those who have a unique personality and maintain their discourse (...) leaving to corporate identity the differentiation factor” (2003:138). Hence, funding needs to be recognized by broader audiences than the original recipients. This necessity led to a proliferation of identifiers of institutions, countries or governments, according to predetermined norms, so that their participation is explicitly visible (EACEA, 2013).

In the case described in this paper, the funding institution is the European Union through EACEA agency, that has established a series of formats to be considered about their brand placement and association with each funded project dissemination.

Framework of project development

The project proposals we present are integrated in the development of European Union’s ERASMUS+ funded projects related to innovation and social entrepreneurship.

Recognizing the importance and need to communicate with a consistent image, the project’s proponent and coordinator, Glasgow Caledonian University (GCU) initially requested the brand design for the Strategy for Change project, which was developed between 2016 and 2018. Considering that the result obtained was according to the brief launched, GCU eventually solicited the brands for other projects subsequently approved: SEASIN (2017-2019), SIKE (2018-2020).

After this request, given the awareness of the strategic importance of a brand in the communication with its public and considering the relevance it can have to establish bonds of trust, we considered essential to create a coherent identity system, not only capable of giving visibility to each of the projects but also enhancing the perception that all those projects had a common conceptualization and design development.

These projects involved some of the same institutional partners and intended to reach the same type of audience: scientific community, stakeholders of the social innovation ecosystem, decision-makers, policy-makers and the general public, with an international reach of European, Asian or even Latin American recipients.
This emphasized the importance of creating a coherent system of identity, differentiated but recognized and recognizable, that helped to establish a common language base, which can be read as a consistent and coordinated whole.

**Methodological Approach**

Regarding the methodological approach, we assume the difficulty of talking about methodologies in Design, due to the discipline’s nature. It is expected in a designer’s practice to question and reinvent methods already established. Depending on the expected outcomes or available time and resources, most tools and methods can be adapted by altering the level of detail, from a quick sketch to a deep development.

The Double Diamond model, proposed by the English Design Council in 2005, emerged as a strong proposal of schematization that “(...) maps the divergent and convergent stages of the design process, showing the different modes of thinking that designers use, allowing to divide the design process into four distinct phases, Discover, Define, Develop and Deliver, each associated with moments of divergence or convergence of ideas, that is, generating the highest number of working hypotheses or sorting the ones that fit the best” (Design Council, 2015).

**Design principles and formal coherence**

As a way of demonstrating the impact of a brand in strengthening identification, we will present a set of identities developed for **Social Innovation projects**, whose formal coherence and visibility goes beyond the logo building exercise to acquire a strategy based on brand value, either in the already existing projects, or in a set of projects to be created in the near future.

The Double Diamond model constituted a guideline for the development either of the strategy for the overall visual coherence of the brands presented, but also for the analysis of the necessities of each brand, given the specificity of the project they referred to.

In the cases developed by the design team (Strategy for Change, SEASIN, SIKE), we highlight the formal coherence that was sought, but also the attempt to connect with a brand that was previously developed by another design team under a first project related to social innovation networks. This project: LASIN – Latin American Social Innovation Network (figure 4) was active during 2015-2018, and we tried to preserve and enhance this visual identity considering it was the first project of this social innovation network.

![LASIN Logo](image)

**Figure 4:** Logo for LASIN, Latin American Social Innovation Network (2015).

The main points of contact between the different projects described are related to two common base factors:
- the use of formally related typography, understood as contemporary and neutral, assuming a strong institutional character; and,
- the set of luminous and contrasting colors, compatible with the gray neutrality that is predominant in the descriptions of the projects.

Considering these factors, we used only one typeface - Alright Sans - for its great versatility: it is composed of a series of different weights and dynamics but, at the same time, it is very laconic, in contrast to the one used in the LASIN brand.

In spite of this, the use of different typographies didn’t affect the formal coherence, since the characteristics capable of making the connection between the new and the pre-existing identities have been preserved. A sign of this is the use of different font weights, which can be seen in the composition with the light version and the bold version of the font, as well as the colour tones used.

**Cases Presentation: Strategy for Change, SEASIN and SIKE**

The first identity of this sequence was developed in 2016 for the Strategy for Change project (figure 5).

![Figure 5: Logo of the Strategy for Change project and a selection of brand applications.](image)

There was an attempted to portray the concept of change through the visual representation. Although initially this project used the acronym S4C, the substitution of "for" by "4" was quickly abandoned, to emphasize a more graphic solution, capable of representing the change through the use of a grey line. This line inclination points not only to the idea of dynamism but, at the same time, to the concept of junction point. Although the most used version applied the colour set between cyan and magenta, it was possible to use other combinations within the same tonalities but with a similar degree of contrast.

The same logic was applied in the design of the graphic identity for SEASIN Project - Southeast Asia Social Innovation Network (figure 6), created in 2017. However, in this case a pictogram was added: it was composed of two arrows that touched forming a star of six arms. The way of perceiving the arrows is accentuated by the use of two colours similar to those applied in the Strategy for Change project. However, they represent, by contrast, the North / South and Europe / Southeast Asia.
Due to the specific characteristics of the project implementation in such a diverse geographic area, this brand generated sub-brands, such as the identity of the SISUs and the Social Innovation Live Asia events in Kuala Lumpur and Bangkok, represented by six different colored arrows arranged in the shape of circle, representing the inputs of different geographical origins.

Finally, we present the graphic identity of the SIKE project, Social Innovation Through Knowledge Exchange, developed in 2017 (figure 7).
In this visual representation, the letters "i" and "k" were merged to give shape to an arrow, a sign of dynamism and acceleration. The orange colour was used to contrast with the neutrality of the grey typography.

In addition to the cases previously presented, we also highlight the identity developed in 2018 for SSI, Students for Social Innovation (figure 8).

This is an online peer-to-peer platform, which objective is to support and promote social innovation. The group was formed in 2018 to build a bridge between LASIN, SEASIN and Strategy for Change projects student participants and to provide a platform for driven people focusing on innovation, sustainability and social entrepreneurship.

The design itself intends to demonstrate this union between the different projects, and the colours applied can vary in order to take on the colours of the projects associated to the platform, either those already finished, or those to be developed in the future.

For each visual identity development, another important issue to take into account was the difficulty of controlling the application of the different brands in the various institutional and cultural contexts resulting from the geographical diversity of each project (figure 9).

As a way of preventing this constraint and avoid misplacement, basic identification systems were created in order to condition the brand application in different formats, taking into account the promoters' obligations to the European Union as the financing entity, as well as promoting the correct application of each brand. These systems consisted in books of graphic standards distributed within the partners of all the different consortia. These also included rules for integration of the funding entity brand and disclaimer, also in an attempt to prevent errors or identification failures.
Final considerations

Recent investigation in the area of non-profit branding focuses not on how to raise money but on how to leverage non-profits brands in the cause of greater public discourse and social impact (Kylander & Stone, 2012). In fact, a growing number of non-profits are developing a broader and more strategic approach, managing their brands to create greater social impact and tighter organizational cohesion.

In this paper we present a set of identity systems created for international projects financed by the European Union and coordinated by the Glasgow Caledonian University, whose implementation is spread by various parts of the world.

After a process of visual development and strategy establishment, a set of brands are correlated and can work independently or within a network. Although referring to different consortiums, it is possible to perceive that in addition to the theme of social innovation, they have common identity traits, whether in terms of naming, design, typography and even the colour palette. The aim was that any of the projects presented - LASIN, SEASIN, SFC, SIKE - could contribute to the strengthening of a network of partners in the areas of social innovation.

References

Reminiscence and Nostalgia
-The Role of Design in the Development of Feasible Solutions for Dementia Care

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Abstract: GRACE_Lab is an interdisciplinary laboratory involving researchers, designers and therapists (from GENERA Onlus), established in a day-care centre for dementia in Milan. This paper describes an on-going study carried out inside GRACE_Lab and focused on the development of environmental solutions for Reminiscence Therapy in dementia care. Accordingly, inside the framework of Non Pharmacological Therapies for Alzheimer’s disease, the environment is widely considered as an important support in the care process, as it can lessen behavioural disturbances typical of this disease. Moreover, Reminiscence Therapy in care home design proved to be effective in helping residents to feel more familiar with the environment they are living in. Nostalgia is defined as “a longing for things, persons or situations that are not present or a longing for a perceived utopian past”. Even though reminiscence and nostalgia are strongly related, there is one relevant distinctness: on one hand, reminiscing past events is connected with the act of “remembering” but can be dissociated from evoking any feeling; on the other hand nostalgic remembrance is deeply associated with feelings, adding a sentimental component, through which an increased self-esteem can be triggered. Therefore, the recreation of nostalgic feelings and memories has deep psychological implications for human beings. In fact, research has shown that an increased self-esteem, social cohesion and connectedness can be triggered by nostalgic memories. Applying this approach to dementia care may enable us to reframe the use of memories to generate new methods of intervening on/in the interiors, suggesting a therapeutic use of nostalgia in the development of environmental solutions for dementia care units. Moreover, a wide variety of external stimuli (such as objects, sounds, images) can trigger nostalgic recollection due to their affective intrinsic qualities, widening the horizon to different innovative ways of engaging with people with dementia. Thus, there are strong evidences that led us to consider nostalgia, and archetypical elements, as the active component of therapeutic success in Reminiscence Therapy in dementia care home design.

Keywords: Dementia, Nostalgia, Interior Design, Non-Pharmacological Therapies

Introduction

Ageing and global impact of dementia
Currently, the world’s older population nearly reaches 900 million people. Due to medical
achievements, improvements towards better lifestyles and better care methods, life expectancy is projected to increase worldwide in the next decades. This will imply a prevalence of chronic diseases (Prince et al., 2016). Nowadays, among them over 46.8 million people live with dementia worldwide. This number will reach 74.7 million in 2030, and 131.5 million in 2050 (Prince, 2015). Dementia has an impact not only on the person diagnosed, but also on his/her family, the community and even the whole society. Its greater impact is represented by the decrease of personal well-being and quality of life, not only for the individual with dementia, but also for the caregivers. Nowadays, Italians with dementia are 1,241,000, and the new cases in 2015 have so far 269,000 (Censis, 2015). Of these, 600,000 have Alzheimer's disease (AD) and due to the aging of population they will continue to increase (Italian population has the highest life expectancy in Europe, with 13.4 million that are over-60s - 22% of the population). Thus, in 2030 1,609,000 individuals will have AD, reaching 2,272,000 in 2050. Considering the increasing prevalence of dementia, growing attention has been given to psychosocial and cognitive interventions aimed at enhancing the quality of life of those individuals and at the same time relieve the burden on caregivers.

**Brain-activating interventions for dementia**

People with dementia encounter great difficulties in remembering recent events, as well as to orient themselves to time and place. However, past memories remain preserved; the same happens to rituals and past habits. Brain-activating interventions encompass reminiscence actions, and they are aimed at activating the remaining cognitive abilities, positively affecting motivation to live through engaging activities that stimulate social roles and social connectedness. A well-known example of brain-activating intervention is ‘reminiscence using old-style tools’. This therapy activity recalls old memories through the use of old-style tools familiar to the patients involved. In particular, this intervention activates a ‘role-reversal’ mechanism as elderly with dementia can teach the therapists (younger then them) how to use tools, in which they are experienced. Through this process, elderly people recover their sense of social function in a natural role, which is the teaching of knowledge from the elderly to the young (Yamagami et al., 2007). Aim of this paper is to present an on-going study carried out inside a daily care centre for dementia in Milan, focused on the development of environmental solutions for Reminiscence Therapy Activities in dementia care. Previous studies have shown that increased self-esteem, social cohesion and connectedness can be triggered by nostalgic memories. Applying this approach to dementia care we suggest a therapeutic use of nostalgia, in the form of archetypical elements, for the development of environmental solutions in dementia care units.

**Reminiscence & Nostalgia**

Reminiscence is a psychosocial intervention extensively used for people with dementia (Wang, 2007). Reminiscence process can be defined as ‘the recalling of personally relevant memories from the past’ (Cappeliez, Guindon, & Robitaille, 2008, p. 266), or more specifically ‘a selective process in which memories are evoked and reconstructed’ (Cohen & Taylor, 1998, p. 601). The first studies on Reminiscence Therapy were carried out starting from 1980s, and showed improvements in cognitive capabilities, enhancement of the quality of life, mood and well-being of people with dementia (Dempsey et al., 2014). Woods et al. (2005, p.1) describe in details the various processes encompassed in reminiscence activities: ‘reminiscence therapy involves the discussion of past activities, events and experiences with another person or group of people, usually with the aid of prompts such as photographs, household and other familiar items from the past, music and archive sound recordings’ thus drawing on the person’s preserved abilities rather than focusing on their levels of impairment (Gibson, 2006; Schweitzer & Bruce, 2008). Therapists and caregivers play a key role in reminiscence practises, as they can help the patients to recollect autobiographical early memories, or trigger them through certain objects or actions (Moos & Bjorn, 2006). Reminiscence interventions are characterized by three main attributes: (1) Reminiscence implies a recollection of
memories following consequent stages. The process starts with the recollection of a memory, followed by an immersion into it and a gradual withdrawal from the experience. (2) Reminiscence is an interaction which implies the recollection of early events, memories or experiences which may occur without a specific purpose. Triggers used to stimulate the recollection with people with dementia may be familiar objects, multisensory tools, visual images, or sounds associated with work-life, schooldays, childhood, etc. Linking the past into the present in this way creates a sense of continuity and restores a sense of personal identity. (3) Reminiscence is an interaction between two or more individuals. Past experiences which are recalled are meaningful to the person and the memory may have an emotional aspect. The personal interaction between the individual and the nurse or caregiver or with the reminiscence group may provide a means of precluding social isolation as well as improving psychological well-being and communication skills of these individuals. Nostalgia is defined as ‘a longing for things, persons or situations that are not present or a longing for a perceived utopian past’ (Batcho, 1998). What makes certain memories nostalgic, is the sentimental component associated with them. In fact, nostalgic memories are those recognized as “affective relevant” by the person recalling them (Wildschut et al., 2006). More positive emotions than negative ones are associated to nostalgic memories; they are characterized by desirable features, positive mood and great intensity. People remembering nostalgic past memories often feel a sense of joy and relieve coupled with a bittersweet sense of longing for a past the could not come back. Those memories are connected to significant life events (birth of a child, marriage, graduations, etc.) extremely pleasant situations and places and desirable situations. Personal nostalgia serves as an ‘anchor of continuity and identity’ especially for the elderly when life circumstances are changing (Ismail, 2017). Nostalgia strengthens social connectedness and cohesion. Nostalgic past relationships are relived through nostalgic recollection becoming once again part of the present life of the person. Thus, individuals can develop a sense of attachment from these past relationships (Sedikides et al., 2015). Certainly, nostalgia helps to afford a meaning in life intensifying an individual’s sense of belonging with those cultural beliefs he/she adheres to. Recollecting those nostalgic memories, individuals with common worldviews can feel a mutual sense of belonging, enhancing new relationships based on common beliefs and cultural identity (Ismail, 2017). Thus, reminiscence and nostalgia have similar origins and applications. In particular, reminiscence studies emanates from gerontology literature, meanwhile nostalgia studies are closer to social psychology literature. Both reminiscence and nostalgia involve remembering past memories in order to produce a positive outcome for the individual recalling them. However, nostalgia is different from reminiscence, in particular in the case of vicarious nostalgia (individual feeling and emotional attachment to events or situation occurred outside his/her lifespan, or towards memories that aren’t personal, but shared among different people). Vicarious nostalgia can be evoked longing for a time period that an individual did not live through but that feels emotionally relevant (Merchant & Rose, 2013).

Nostalgic environment

Inside the framework of Non Pharmacological Therapies for Alzheimer’s disease, the environment is widely considered as an important support in the care process, as it can lessen behavioural disturbances typical of this disease. The environment, in terms of interior spaces, if properly designed can support people with dementia’s residual capabilities, and act as a prosthesis enhance their orientation, well-being, cognitive responses and interactions (Zeisel & Raia, 2000). Chalfont & Rodie (2005) argue that it is time to move beyond designing only for safety control and decrease of behavioural symptoms, and take into consideration the understanding of “how environments actively encourage pleasurable and satisfying behaviour, for everyone who lives or works within or near them”; a design approach that encourages curiosity and action, rather than focusing on decreasing symptoms.
Interior features can act as triggers for reminiscence activities, enabling elderly with dementia to recall past memories connected to a specific ambiance or style, or linked to specific objects found in the interior environment. Different studies have been carried out reproducing environments based on 1950s, 60s or 70s ambiance and aesthetic features. Their purpose is to enhance a feeling of connectedness and identity with the spaces, fostering a mutual recognition and identification between patients and care spaces. Reminiscing is a wonderful way for elderly people to feel a sense of purpose, especially those living with dementia. Experts in the field of aging say that as we age, reminiscing takes on a greater significance. Among people with dementia, nostalgic memories, compared to non-nostalgic ones, increase social cohesion, self-esteem, meaning in life, self-continuity and positive affect (Sedikides et al., 2015). In our study, more than reproducing an entire “in-style” environment (room or entire space) we developed a system of nostalgic archetypical elements as an attempt to design a system of artefacts that in a seamless and simple way can trigger personal memories of past events both individually and in groups.

Archetypes are defined as “the original model or a perfect example of something”. Many studies are focused on the creation of typologies of contemporary interior design practices and artefacts that are derived from reiterative historical designs that span time and style and cross cultural boundaries (Jennings, 2007). By definition, typology is concerned with those aspects of human production that can be classified because of some inherent characteristics that make them similar. Within architecture, the two most common classifications have been by use and by morphology. An interior archetype “represents an ideal example of a historical and culturally determined practice of design or artefact from which similar models are derived or reiterated” (Jennings, 2007). For example, the sofa, the armchair, the carpet, the sideboard, the table and the chandelier, have been considered as the basic and characteristic archetypes of domestic comfort. In the same way, in our study archetypical elements are defined as objects or pieces of furniture that characterize and identify certain domestic spaces. Those archetypes act as triggers for people with dementia to recall past memories and experiences.

Grace Living Room

At the beginning of 2018, our research group, together with Genera Onlus – an organization active in the care of elderly with dementia, founded an experimental living lab. for the development of environmental solutions for dementia care, named GRACE_Lab. GRACE_Lab is located in Figino, a peripheral neighbourhood of Milan, inside the spaces of GRACE, a day care centre for dementia. GRACE hosts and takes care of 30 elderly with dementia, providing them daily care assistance 6 days a week. GRACE_Lab is an experimental lab. involving designers/researchers, therapists, medical professionals and caregivers. The on-going study described in this paper is carried out inside GRACE_Lab and focused on the development of an environmental system for Reminiscence Therapy in dementia care named Grace Living Room.

Methods

First part of the method was aimed at identifying the archetypical elements of three different spaces: sleeping room, living room and kitchen. This phase involved the use of cultural probes. Cultural probes consist of material which is used to provoke different and inspiring responses from the participants. The probes were carried out in collaboration with the therapists, whom introduced them, in different moments, to the patients inside the living spaces of the day care centre. It should be noted that the use of cultural probes were not aimed at finding problems which could be solved. It was instead to get inspiration for unexpected ideas. Our cultural probes consisted of open bookcase in briarwood, sewing tools, cassette players, old television, chest of drawers in briarwood, crocheted doilies, coat rack with hat, jewellery box, kitchen utensils for kneading, chessboard, drying rack with clothes, kitchen buffet, etc. The data from the cultural probes and the workshops gave us
important information about their pleasures and what is beautiful and important in their every day lives. Second part of the method was aimed at identifying the activities linked to the elements composing the system. This phase was articulated through a series of focus groups with therapists and caregiver, in order to tailor the activities on interests, past habits, typical behaviours of the patients attending the daily care centre. Initially, the potential activities were carried out by the therapists during organized cognitive and occupational activities sessions with the patients, reframed and re-tested in subsequent sessions. The final activities can be considered daily life actions, which demonstrated to have a potential nostalgic feeling for the patients, enabling them to recall past family roles, positive mood, past routine and familiar habits. Indeed, those nostalgic activities can be considered part of occupational therapies interventions, tailored through the use of nostalgic features.

Environmental system
Together with the therapists our research group designed an environmental device that contains three different domestic scenarios. Each scenario can be activated by therapists at a time and contains a set of objects used to trigger nostalgic memories associated with wooden illustrated panels on the walls. Sliding panels unveil one scenario, objects are contained inside it or disposed on the central table and the corresponding panels are placed on the walls. The three scenarios resemble a kitchen, a living room and a bedroom (Figure 1).

Figure 1: Grace Living Room: Living room and bedroom scenario

The activities, managed by the therapists, that take place into this environment, are considered Occupational Therapy interventions based on daily life activities. Those activities take into account the self-perception of the patients with respect to their needs, interests, beliefs, habits, social roles and skills. Daily activities enhance trust among residents and staff, and also represent an opportunity of conversation and involvement of family members. Daily activities can range from resembling housekeeping actions, lay the table, prepare some simple dishes, suggest and discuss receipts, discussion of newspapers news, watching old albums and photos, re-order clothing, knitting, re-order objects, fold tissues, etc.. Daily activities enhance trust among residents and staff, and also represent an opportunity of conversation and involvement of family members. The objects contained in every scenario add a wide variety of external stimuli (such as sounds, music, images) tailored on the patients past experiences. Thus, they can trigger nostalgic recollection due to their affective intrinsic qualities, widening the horizon to different innovative ways of engaging with people with dementia. Those three scenarios allow the patients to perform activities resembling house duties, in small groups or with a single elderly, in order to release stress, anxiety and agitation, through performing well-known simple gestures. The environmental system named Grace Living Room is not intended to be a replacement of a real living room. This system acts as a therapeutic environmental system.
enabled by the therapists, with specific groups of patients. Patients experiencing wandering or agitation episodes are conducted in the room where one of the scenarios has been activated, according to the specific group or patient. During the various evaluations the elderly spontaneously started to interact with the furniture and the objects (Figure 2). To maintain identity and foster self-esteem, it’s important for people with dementia to have engaging social relations with relatives, friends, residents and staff. Most of the times they started to reminisce together, talking about past pleasant experiences, telling each other stories and anecdotes, playing together resembling past experiences. Sometimes they became emotionally affected by some objects that were able to trigger past pleasant memories.

Discussion
The management of behavioural disorders typical of AD can be successfully implemented through therapeutic interventions aimed at avoiding the use of the drug as a first choice, fostering the use of therapeutic strategies to improve individual’s quality of life by facilitating relaxation and decreasing agitation and anxiety towards the environment. Interior design, due to its ability to work within a dynamic and flexible dimension, can easily shape an environment able to compensate the loss of capabilities peculiar of AD. Punctual specific interventions, with different level of stimulation, can create an environment able to enhance the well-being of people with dementia, living in a care environment (Biamonti, 2018). GRACE LIVING ROOM is a system of archetypical nostalgic elements that recreates three interior domestic scenarios. Recreating a system of elements that can be activated by the therapists, according to the specific characteristics of the patients, allows us to disconnect the therapeutic activity from the architectural environment, enabling the creation of a feasible system that can be continuously re-shaped according to the needs of the patients. During the design process we could discern three purposes for GRACE LIVING ROOM. These include increasing the elderly’s social interaction, calm down agitation or wandering episodes enabling people with dementia to perform daily life activities, engaging elderly through reminiscence interventions and the use of nostalgic elements as triggers for pleasant memories and emotional affection. Indeed, there are strong evidences that led us to consider nostalgia, and archetypical elements, as the active component of therapeutic success in Reminiscence Therapy in dementia care home design. The archetypical nostalgic elements of the system act as triggers for reminiscence activities, enabling elderly with dementia to recall past memories connected to a specific ambiance or style, or linked to specific objects found in the interior environment. During observations elderly with dementia actively interacted with each other or with the objects and they started to reminisce together, talking about past pleasant experiences. A few of them experienced the environmental

Figure 2: Grace Living Room: Reminiscence session
system with the help of therapists, showing a decrease in their agitation and a positive attitude and interest towards the elements.

References


Using Systems Thinking to Investigate The Sustainability of Digital Fabrication Projects in The Humanitarian and Development Sector

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Abstract:
Recently designers have started using digital fabrication to create new solutions to meet global challenges. However many technology projects in the humanitarian and development sector have been criticised for failing to deliver sustainable solutions. This study responds to these concerns by investigating the sustainability of digital fabrication projects in the humanitarian and development sector. A systems approach is used to synthesise knowledge from fourteen digital fabrication projects in healthcare, education and water and sanitation. Causal loop diagrams are created to investigate the relationships between the drivers and barriers to sustainability. Several systems archetypes are also identified revealing potential leverage points for driving more sustainable solutions. The paper contextualises these findings by drawing on theories from participatory development and cosmopolitan localism. It concludes that digital fabrication presents an opportunity for more local and participatory design, however sustainability is being undermined by a tendency to seek short-term solutions. This much-needed study enriches theory on sustainable design and design in social development. It also provides valuable insights for practitioners who are concerned about the sustainability of digital fabrication projects in the humanitarian and development sector.

Keywords: systems thinking, sustainability, digital fabrication, humanitarian, development

Introduction
The humanitarian and development sector are struggling to meet the rising demand for aid (Development Initiatives, 2018). Historically, technology has been viewed as a driver for social progress (Salam and Kidwai, 1991). Recently, the humanitarian and development sector have become interested in how technology can address global needs. A number of organisations have started using digital fabrication (3D printing, CNC milling and laser cutting) to produce essential items, such as prosthetics, shelters, medical equipment and spare parts (Corsini et al., 2019). Interest in digital fabrication has grown rapidly as it offers the potential to shorten the supply chain (Tatham et al., 2015), support local development (Birchnell and Hoyle, 2014) and to provide low-cost, customisable solutions (Saripalle et al., 2016).
Alongside this growing optimism, is the recognition that several technology projects have failed to deliver sustainable solutions to social problems (Corsini and Moultrie, 2019). There is concern that recent digital fabrication projects may be one-off solutions that do not deliver long term impacts (ibid). Within the aid sector, sustainability has often been used to refer to a project or an organisation’s ability to sustain itself: “measuring whether an activity or impact is likely to continue
after donor funding has been withdrawn” (ALNAP, 2007 in Haavisto et al., 2014); “being able to survive so that it can continue to service its constituency” (Weerawardena et al., 2010). More broadly, sustainability is commonly defined as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (Brundtland et al., 1987).

A previous study by the authors, based on literature, found several positive and negative factors that may affect the sustainability of digital fabrication projects (Corsini et al., 2019). There is an urgent need to gather empirical data to validate these factors and to examine their relationships. The following research responds to this gap in knowledge to investigate the sustainability of digital fabrication projects in reality. We use interview data as part of a systems thinking approach, to examine the cause and effect of different system elements (Sterman, 2000). This approach synthesises fragmented knowledge from a range of projects. It provides necessary insights to avoid the pitfalls of previous technology projects, which have failed to deliver sustainable impact.

### Methods

Systems thinking helps to map the current reality in order to solve a particular problem (Sterman, 2000 page 79). The following study investigates the sustainability of digital fabrication for humanitarian/development (DF4D) projects. In contrast to reductionist approaches, systems thinking takes a holistic view in which ‘the whole is more than the sum of its parts’. It is also concerned with cause and effect thinking, recognising that system elements are interdependent (Checkland, 1999 page 213). To define the causal structure of the system, it is necessary to define a system’s elements and identify the causal links between these elements (Sterman, 2000 page 137). By creating causal loop diagrams, it is possible to identify common patterns of behaviour and to identify leverage points for change (ibid).

To build up an understanding of DF4D projects, semi-structured interviews were conducted with twenty-seven designers, engineers and project managers. The interviewees represented twenty-one organisations, working on fourteen DF4D projects. Initially, projects were identified using online searches, word of mouth and attending conferences in the field. In an effort to capture the breath of DF4D projects, projects related to health care, water and sanitation and education were included in this search. A wide geographical area was examined, to identify DF4D projects in various low-resource settings (low income or lower-middle income countries).

Initial contact was made with organisations working on DF4D projects. Where possible, interviews with several employees were conducted to gather multiple perspectives on the same reality. This is an important way of building a shared reality, as people only have a local understanding of the system (ibid). In some cases, follow-up interviews were conducted to gather data from ongoing projects.

The semi-structured interviews were conducted in three main sections. First, organisations were asked to describe the digitally fabricated product, they were developing or had developed. Second, they were asked about the aims and actual impacts of the project. Third, interviewees were asked to identify barriers and enablers that influenced their outcomes, when working on DF4D projects. These factors are considered as potential positive and negative factors for the sustainability of digital fabrication projects. All the interviews were recorded with the participants’ consent and were transcribed verbatim. The interview transcripts were imported into the software MAXQDA.
To begin with, the factors which may influence sustainability, identified in the previous study (Corsini et al., 2019) were used to create a coding hierarchy in MAXQDA. All the interview transcripts were coded in MAXQDA using these factors, and five codes were added: entrepreneurial talent; local manufacture of production tools; incentives for collaboration; attitudes and reluctance to change; and, local design. This led to the definition of forty-seven positive and negative factors that influence sustainability. In some cases, these codes were updated to reflect the actual language that was used by the interviewees. For example, the original code *participatory and bottom up design* was changed to *user participation*.

To investigate the relationships between these factors, MAXQDA maps, an analysis tool in MAXQDA was used. MAXQDA maps generates diagrams to show the relationships between codes. Codes that were found to overlap at least twice in the interview transcripts are shown as linkages in Appendix Figure 1. The size of the circle reflects the number of times that code was mentioned by interviewees. This analysis has some limitations, as it overlooks cases when codes are adjacent but do not overlap. It also assumes that frequency is an indicator of importance, which may misrepresent the importance of factors. Regardless, it provides a useful starting point for investigating the key factors that influence sustainability and the relationships between them. The map provides evidence that causal links are directly supported by interviewee data.

A causal loop diagram is useful for communicating important feedback that are responsible for a particular problem (Sternam, 2000 page 137). In this case, we investigate the problem that some DF4D projects are not sustainable. Rather than mapping the entire system, each diagram corresponds to an important part of the story being told (Sternam, 2000 page 155). In this analysis, we present three main causal loop diagrams. These are related to (1) people; (2) materials and tools; and, (3) production. These themes emerged after reflecting on the key elements in the design process and some of the important connections in Figure 1.

The causal loop diagrams were developed through an iterative process of comparing Figure 1 with the interview data, drawing on all experiences and knowledge to map the system (Sterman, 2000 page 158). The diagrams are intended to represent general patterns found across the projects interviewed, not to represent a single project. In some cases, links not shown in Figure 1 were added, based on additional sources of data found in reports and articles about the DF4D projects. Some other links that represented obvious relationships that were not mentioned in the interviews were also included. The causal loop diagrams (see Figures 2-4) were created using VensimPLE software.

Common patterns of behaviour found within systems have been identified as systems archetypes (Braun, 2002). By comparing our causal loop diagrams with these well-known systems archetypes, it is possible to identify “recognisable story lines or plots that recur across a wide variety of social issues” (Stroh, 2015 page 68). This analysis helps to develop a preliminary understanding of behaviour that influences sustainability and to suggest leverage points for driving change.

**Results**

**People**

The first causal loop diagram (see Figure 1) focuses on people, referring to both human capital i.e. the knowledge, information, ideas and skills of people (Becker. 1964) and social capital i.e. networks with shared norms, values and understandings that facilitate cooperation (Healy and Côté, 2001).

In many humanitarian and development contexts, there is a skills gap (see Figure 1, label 1). This is partly a result of employee turnover and the brain drain, as well as poverty, which undermines local
education and resources for development. This is a particular challenge for digital fabrication projects, as technologies are relatively new and most software is proprietary, increasing the barrier to entry for people low-income countries.

Faced with a lack of local skills, some organisations rely on importing exogenous skills in order to reduce the skills gap (Figure 1, loop 2). This meets the immediate demand for skills, however means that there is a natural reduction in local training and support, which therefore reduces local capacity building (Figure 1, loop 3). Local capacity building takes time and its effect on reducing the skills gap may take several years (Figure 1, loop 4).

Figure 1: Causal loop diagram related to people (human capital and social capital)

However, our findings reveal that local capacity building is a more fundamental solution that avoids some of the unintended consequences of relying on exogenous skills. For example, relying on exogenous skills can often lead to communication and cultural challenges (Figure 1, loop 5). A lack of understanding about the local context can result in inappropriate products being supplied. In contrast, local capacity building increases local ownership, which increases contextual understanding. Local ownership and empowerment supports greater user participation, which in turn results in greater project ownership (Figure 1, loop 6). This reinforcing loop is an example of a **virtuous growth** that increases impact. Importantly, our findings suggest that organisations can create conditions to help facilitate participation by local communities, however cannot guarantee that active participation will necessarily occur.

Over time local capacity building offers the potential for job creation and market based development (Figure 1, loop 7). Local entrepreneurs can use digital fabrication to create products for commercial markets. This in turn reduces poverty and the skill gap, providing a **balancing action**. However, it should be noted that local capacity building fundamentally relies on access to resources (Figure 1, loop 8).

Almost all the interviewees emphasised the challenge of accessing funding. Our results showed that this leads to an increasing inability to address poverty (see Figure 1, loop 8). In the loop highlighted in purple, it can be seen that poverty reduces access to financial resources, which reduces local capacity building, which in turn fails to reduce poverty. In this case, financial support from the aid sector may
provide relief. However, many organisations were critical of the aid sector’s provision of short-term funding, instead of supporting sustainable growth.

**Materials and tools**

The next causal loop diagram is related to the *materials and tools* used in production (e.g. 3D printers, filament etc).

Facing a growing number of crises, organisations are turning to digital fabrication for solutions (see Figure 2, link 1). This increases the demand for digital fabrication tools and materials, which have to be imported as they are not locally available (see Figure 2, loop 2). There are significant challenges importing digital fabrication tools and materials as infrastructure is often poor or disrupted and import taxes are expensive.

Some organisations relied on volunteers to informally transport tools and materials in their luggage to avoid challenges at customs. Our findings suggest that this activity is another example of **shifting the burden** (Figure 2, loop 3). Although it resolves the immediate problem, it diverts financial resources that could be invested into the local production of tools and materials, and it fails to provide a sustainable solution.

Seeking alternative solutions, demand for the local production tools and materials emerges. Once this demand reaches a critical level, there is enough incentive for local manufacturers to begin producing digital fabrication tools and materials. As demand increases, economies of scale mean that tools and material become more affordable. This further increases the demand for local digital fabrication tools, resulting in reinforcing loop of **virtuous growth** (Figure 2, loop 4).

The shift to local production thus reduces challenges supplying digital fabrication tools, providing a key **balancing action**. Furthermore, locally produced tools are believed to be more suited to the contextual needs of humanitarian and development settings. Using locally available resources also eliminates lengthy supply chains for importing spares and repairs.
Ultimately the shift to local production relies on access to funding and human resources, which we identify as **limits to growth** (Figure 2, links 5). Moreover, the creation of this local production industry takes time, which may be an obstacle for organisations seeking immediate results.

In general, the interviewees suggest that there is a reluctance towards local production, because of negative perceptions about quality. We recommend that the development of a quality culture (Figure 2, loop 6) presents a long term approach to improving the quality of local products. This **balancing action** can increase demand for local materials and tools, and reduce demand for imported goods. Finally, the increased affordability of materials and tools naturally improves the provision of low cost designs that can address crises (Figure 2, loop 7). This loop reveals another **balancing action** that mitigates crisis.

**Production**

The final causal loop diagram focuses on new modes of production i.e. the design and manufacture of humanitarian and development items.

![Causal loop diagram highlighting production-related elements](image)

In response to crises, the humanitarian and development sector traditionally import products (see Figure 3, link 1). This leads to supply chain challenges, as infrastructure is often poor or disrupted. These experiences increase the demand for locally manufactured items. The diagram shows that local manufacture is facilitated by an ecosystem of designers and makers. This ecosystem fosters information sharing and greater partnership and collaboration, which in turn creates a more effective ecosystem of designers and makers (see Figure 3, loop 2). Ultimately this highlights the **virtuous cycle** of collaboration that results in an ecosystem of designers and makers. To support information sharing and collaboration within the ecosystem, appropriate incentives for collaboration are needed. Individual actors need to understand how they can engage with the ecosystem, to convert its potential into tangible results.
The ecosystem supports the integration of local design and remote (distributed) design (see Figure 3, links 3). Our findings highlight that collaboration between local and global actors is needed to develop scalable and appropriate solutions for local problems. Remote or distributed design increases scalability, by leveraging global resources and reducing unnecessary replication of effort. Clearly, one of the motivations for using digital fabrication is the potential to share digital designs across geographically dispersed locations. However, this also increases the risk that designs will not be locally appropriate. Local design is therefore necessary to adjust these designs to ensure that they are suitable for local needs (see Figure 3, loop 4). This balancing loop challenges the belief that as long as designs can be shared openly, distributed design is sufficient. Rather than viewing distributed design as a plug-and-play solution, our findings suggest that it should be seen as a springboard for local design.

Finally, we recognise the potential challenge of fixes that backfire. In some cases, we found that organisations were using solutions that were just ‘good enough’ (see Figure 3, loop 5). This was driven by the belief that ‘something is better than nothing’. However, we suggest that although these solutions can provide a potential quick fix to the crisis, they may cause worse outcomes in long term and exacerbate the crisis. It is essential that new quality certifications and tests are developed to overcome concerns with distributed design and production. Until this balancing loop is established, digital fabrication cannot deliver sustainable outcomes and will be limited to one off ‘hacks’. We also emphasise that the creation of such regulation requires collaboration from multiple different actors, including government and regulatory bodies.

**Discussion and conclusion**

This paper has responded to concerns that digital fabrication for humanitarian and development (DF4D) projects lack long-term thinking and are struggling to deliver the impacts they desire (Corsini et al., 2019). We have adopted a systems approach to investigate the drivers and barriers of sustainability in this context. In doing so we have revealed three thematic models related to (1) people, (2) materials and tools and (3) production. These models have highlighted many positive behaviours that are expected to drive impact as well as highlighting problem-generating behaviours that are limiting sustainability. These findings reveal the potential of causal loop diagrams to make explicit the cause and effects within a system, and to encourage action through identifying blind spots. They also allow us to interrogate the sustainability question from a relative and temporal perspective (Sarriot et al., 2015).

In the causal loop diagrams, we have identified several virtuous cycles that are increasing impact. First, looking at people we predict that an increase in ownership and empowerment will reinforce user participation, thereby increasing the potential for ownership. Second, considering materials and tools we show that as the demand for local digital fabrication tools increases, they become increasingly more affordable and therefore desirable. Third, focusing on production we expect that greater partnership and collaboration will help to foster an ecosystem of designers and makers that encourages information sharing within an enabling ecosystem. In all of these models, the relationship between local and sustainable solutions is made clear. Our findings confirm that digital fabrication is increasing the potential for local solutions, however this is not necessarily happening in all stages of the supply chain.

This study shows that the persistence of importing resources (including human resources, materials and tools) reveals a tendency to shift the burden. In the search for quick fixes, there is an apparent
reluctance to address the underlying need to invest in local capabilities. The people-model (Figure 1) makes clear that this behaviour is problematic. It shows that importing skills undermines local capacity building and potentially results in the creation of less contextually appropriate products. Furthermore, the materials and tools-model (Figure 2) shows that formally or informally importing materials and tools (e.g. 3D printers and filament) disincentivises the creation of a local production industry, which could have led to wider socio-economic benefits (Birchnell and Hoyle, 2014). As pointed out by the interviewees, local production of materials and tools is also expected to result in more low-cost, reliable, and easy to maintain and repair solutions. Our findings show that despite rhetoric that digital fabrication is driving more local solutions (Díez, 2018), imported resources are still being used as a quick fix.

There is an urgent need to distinguish between short-term small successes and quick fixes. As Stroh (2015, page 43) explains “quick fixes are solutions that produce short-run benefits, which are typically neutralised or eroded by longer run consequences of the same actions. Short term small successes are improvements that are planned from the beginning with the long term in mind and are vital to encouraging persistence and maintaining momentum.” This is a particular challenge in the humanitarian and development sector, in which interventions are either short-term or expected to end after a particular duration. Our findings highlight the problematic attitude that ‘something is better than nothing’. The production-model (Figure 3) shows that using products that are perceived to be ‘good enough’ but do not meet rigorous quality standards, can exacerbate the original crisis if they fail. This system archetype – the fix that backfires – is an example of a quick fix being mistakenly taken as a short-term small success. We urge policy makers and government to take an active role in developing new standards and regulations. We also highlight the pressing need for new product quality certifications and tests. More broadly, we echo calls for a more coherent approach to humanitarian and development aid (OECD, 2017), to ensure that short-term plans are consistent with long-term goals.

On the whole, our findings suggest a new, more sustainable relationship between local and global production. The study underlines the potential for distributed manufacturing (i.e. local, connected and decentralised sites of design and manufacture) to leverage resources in different geographical locations. The fundamental difference between this approach and traditional approaches is that resources are not ‘imported’ but instead, designs are shared so that they can be locally adapted and implemented. We strongly contest the view that distributed manufacturing enables products to be instantly ‘made anywhere’ (Srai et al., 2016). Instead distributed manufacturing can be a catalyst for local design, which is necessary to adapt solutions for the local context. In addition, distributed manufacturing disrupts the traditional one-way flow of products from the Global North to Global South in the aid sector (VanderSteen et al., 2009). Instead, designs can be locally driven and shared to create mutually beneficial outcomes that enrich global production.

These findings provide evidence that digital fabrication expands cosmopolitan localism, “a creative balance between being rooted in a given place and community and being open to global flows of ideas, information, people, things and money” (Manzini, 2013). This local and connected approach is highly relevant to the sustainability of digital fabrication projects, as it is believed to promote community resilience (ibid). Alongside this, our findings highlight the relationship between participation and sustainability. This aligns with calls for more participatory development (Nelson and Wright, 1995) and the increasing recognition of the agency of affected communities (Betts et al., 2015).
Overall we recognise that many projects are in their relative infancy and can be viewed as experiments or prototypes (Hillgren et al., 2011). However in order to realise long-term impacts, there is a need to transition from opportunistic to strategic approaches. The potential for digital fabrication to support more local and participatory solutions could advance sustainability. However, we have highlighted several barriers that need to be addressed first. In general, there is a need for more systemic thinking that avoids quick-fixes. Additional resources must also be allocated to local capacity building and local production of digital fabrication tools. Finally, concerns around quality require urgent attention.

References


Manzini, E. (2013). Resilient systems and cosmopolitan localism—The emerging scenario of the small, local, open and connected space. Economy of Sufficiency.


Appendix

Figure 1: Map to show relationships between codes in interview data
A Trial to Redesign Project Learning for Proper Transmission of Regional Resources

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Abstract: Nowadays, regional revitalization has become a social issue, and even in the field of design, many regional collaboration activities have been seen, such as efforts to improve the product design and added value of regional specialty products. Furthermore, with the spread of ICT, the infrastructure that distributes regional products to the major market has become more common. However, we think that there is a big difference between the metropolitan area’s global market consumer and local market consumers in terms of values and product evaluations, so people in the region have difficulties to appeal local products or tourism resources appropriately. We believe that people living in the local area do not have chances to learn the points that consumers in the metropolitan area evaluate, discover the resources to evaluate, and advance the technology to express them.

In this research, we aim to redesign project-based learning activities we have conducted for these six years to introduce regional resources to general consumers in the metropolitan area, referring to human-centered design methods and processes with formulated and evaluated a lecture plan.

First, we examined user survey methods to understand what the target consumer’s values are and how their product evaluations are structured. Realistically, it is difficult to conduct interviews and surveys to users because of cost and schedule limitations, so we decide to use the virtual ethnography which bases on comments written on blogs and SNSs on the Internet, and after that we plan to create a persona. Based on the previous survey results, we will create user scenarios or customer journey maps, so we prepare a CJM format, which students can easily understand and create by themselves, to describes how users use regional resources and finds values in them.

Regarding general value expression to regional resources, we surveyed existing websites that disseminated information for the global market, selected necessary information items, and formulated web page layout format. For students, guidelines concerning production process which was intended to show the purpose of each information item and enhance the contents were created. Finally, we conducted a discussion with teachers and students related to the activities to find out possible issues for these entire projects to be smoothly implemented.

Keywords: Information Design, Regional activation, Project learning
Abstract: The purpose of this study is to gather basic intelligence which is essential to design entrepreneurship education in the Association of Southeast Asian Nations (ASEAN) where few such educational programs have been developed. This region is enjoying remarkable economic growth in these years. The important political agendas for each country are to incubate new businesses and to develop proper entrepreneurship education methods. However, few studies in the field of entrepreneurship have been conducted in the region. Therefore, it is difficult to acquire entrepreneurial characteristics which should be cultivated thorough entrepreneurship education. The authors conduct questionnaire research to reveal the entrepreneurial characteristics of the college students. A minimum of 100 participants was secured from each surveyed country except for Singapore. The results of the nine countries excepting Singapore are discussed in this paper. Participants surveyed were 2,287 students in total. The Caird’s General measure of Enterprising Tendency Test (GET2) (2013) is adapted to assess the level of entrepreneurial characteristics of the participants in this survey. This test measures five essential qualities: the need for achievement (NACH), need for autonomy (AUT), the creative tendency (CT), calculated risk-taking (RT), and internal locus of control (LOC). Also, participants were asked if they have wishes to be entrepreneurs and confidence to be entrepreneurs, so as the types of entrepreneurial awareness classified them. There are four types of entrepreneurial awareness: “Ready” which has both confidence and wish to be entrepreneurs, “Potential” which has a wish but no confidence, “Dormant” which has confidence without a wish, and “No No” which has neither wish nor confidence. The results of this survey reveal some features of each country which should help to design the education program. The combination of the outcome of GET2 and “Entrepreneurial Awareness” suggests the role of entrepreneurship education according to each countries’ entrepreneurial situation. A country where many students have both entrepreneurial characteristics and awareness, the purpose of entrepreneurship education is to encourage students to launch their business practices. On the other hand, in a country where the students have neither entrepreneurial characteristics nor entrepreneurial awareness, the specific factors which correlate strongly with “confidence” or “wish” to be entrepreneurs should be clarified. In this paper, important entrepreneurial tendency of the ASEAN countries’ college students is illustrated as the results of the survey, and the core elements which should constitute the entrepreneurship education program for college students of each country are discussed.

Keywords: Entrepreneurship education, ASEAN countries, Entrepreneurial characteristics, College students
Prototyping Temporary Urban Solutions in Milan

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Abstract: This paper will explore a research and teaching project that involves a number of different Milanese associations: several small local communities of the Martesana District, Cargo, a private furniture company, and a group of students from an elective 2nd-year course in the Master’s Degree of the School of Design of Politecnico di Milano, all working together for the common purpose, to create new social inclusion in the neighbourhood. By strengthening the social fabric and generating new ideas of citizen well-being, the quality of the social and physical contexts together with collaborative actions create new forms of community and spaces which have a higher value. Behind each of these promising cases of social innovation are groups of people who have been able to imagine, develop and manage them. The re-occupation and re-design of public and urban spaces are increasingly frequent, especially in the suburbs, far from the city centre. This is principally thanks to co-design and co-participation with the inhabitants of the neighbourhood, promoting activities and new scenarios. In this attempt to activate new solutions, scenarios and strategies are proposed, bringing together the resident population and the small local communities, through the students’ design skills, to create synergies and new processes of inclusion and social innovation. The project described in this paper takes advantage of Cargo’s spaces, a furniture store located in the north-east of Milan. Cargo Hi-Tech asked the Polimi DESIS Lab, a research team of the Design Department of Politecnico di Milano, to help improve their relations with the neighbourhood while also offering the residents a new space for gathering, community and sharing. After an in-depth concept analysis of the context and the associations involved, the course will generate a prototyping event, Martesana Fest, also including some co-design sessions open to the neighbourhood. Over the course of a day the students gave a public presentation of their projects, with scale models and full-scale details that best expressed their project. Design practice is trying to go through and across the barrier created by the framework of market-driven economies, by co-designing and using a community-driven approach at its core.

The role of the designer, and in this particular case, of forty design students, is to help these communities consolidate themselves through co-design and to help generate new ideas, and then to spread and replicate them in an urban context. The general vision is to move from being relatively marginal to becoming more widespread and, in the not too distant future, to be mainstream through a new social communication network within a neighbourhood. This event is a first step, with the constant assistance of the local communities, intend to act as spokespersons for a new regeneration and to build original solutions to the needs of contemporary urban living.

Keywords: co-design, networked society, social innovation, open innovation, local communities, social communication.
Introduction
The project is the product of a collaboration between Cargo Hi-Tech, an iconic furniture store located in the north-east of Milan, and Polimi DESIS Lab, a research team from the Design Department of the Politecnico di Milano, to help increase the company’s relations with the district and also to offer residents a new space for coming together, a sense of community and sharing. After an accurate conceptual analysis of the context and the associations involved, the workshop will generate a prototyping event, including a co-design session extended to the whole district. Co-design is a fundamental aspect of the project, particularly because the six local associations of the neighbourhood have been chosen for their work and their intention to strengthen the identity of the area. The local communities carry out an important role for the project in question, because it is interesting to understand what dynamics are created between a group of students who follow a teaching method and how this is applied in terms of design on an urban scale. The main intention is to help these communities consolidate through co-design and help generate new ideas to be disseminated and replicated in an urban context. Thanks to the path of co-design and involvement with the people living in the neighbourhood, promoting activities and new scenarios, the reoccupation and redesign of public and urban spaces are becoming more frequent, especially in remote areas that do not have a good network of communication and internal relations.

Context
According to Voorberg et al., (2015) to design for social innovation means the creation of long-lasting outcomes aimed at addressing societal needs by fundamentally changing the relationships, positions and rules between the involved stakeholders, according to an open process of participation, exchange and collaboration with relevant stakeholders, including end-users, and therefore crossing organizational boundaries and codes (Hartley, 2005; Bason, 2010).
Collaboration, and consequently co-production, are seen in this essay as the citizens’ and local community associations’ motives for becoming involved in the co-production of social services. Particularly relevant is the relationship between different stakeholders involved in the same process of designing social innovation, such as students as designer, local community, a private company and local associations and third sector organizations. The latter can be described as a range of organizations that are neither public nor private sector. They include voluntary and community organizations (both registered charities associations, self-help groups and community groups), social enterprises, mutual and co-operatives (NAO, 2010). The main purpose of the described process is, by strengthening the social fabric and generating new ideas of citizen well-being, to increase the quality of a particular social and physical context in a collaborative manner with creative actions which aim to create new forms of community and new spatial changes that are of a higher value.

The third sector is often viewed as an important force in social innovation, indeed according to Maxwell in Goldenberger et al., (2009) “in communities, the non-profit sector plays a vital role in social innovation”. Particularly in the suburbs, far from the city centre, the re-occupation and re-design of public and urban spaces are increasingly frequent, which is also thanks to co-design and co-participation with the inhabitants of the neighbourhood that promotes activities and new scenarios (Camocini & Fassi, 2017).
In this essay, new activating solutions, scenarios and strategies are proposed, bringing the resident population and the small local communities into relationships, through the students’ design skills, to create synergies and new processes of inclusion and social innovation.
The starting points of this research are the private spaces of a Milanese furniture store named Cargo, which is located in the north-east of Milan. Cargo asked the Polimi DESIS Lab to help them increase their connection with the neighbourhood by offering the residents a new space where they could gather together. After an in-depth concept analysis about the context and the associations involved, the elective course Temporary Urban Solutions (TUS), involving 40 students from different backgrounds, aimed to generate a prototyping event, including some co-design sessions open to the local community. Using a community-driven approach at its core, the purpose of the design practice is to go through and across the barrier created by the framework of market-driven economies, by co-designing and testing the solutions with the involved community.

Many local associations have been involved in this process, and they are all located in the Martesana District, a region characterized by a complex cultural fabric that is socially fragmented. The ability to expand their influence was being blocked, because of the barrier shaped by the complex spatial fabric, culture and generation gap within the district. The investigation shows that 20% of the residents do not know any associations in their district, 70% of the residents know at least one, and only 10% residents know several associations. The point is, after being engaged in this district through field research and the co-design process with local residents, a huge requirement of community activities is to show their strong necessity to and aspiration to improve social connections. The district has an extensive foundation of bottom-up and grassroots energy for design-driven social innovation.

Beckmann (2012) describes the promise of social entrepreneurship as follows: “the public sector has preference for the status quo – solutions already known and tested. Social entrepreneurs, in contrast, are able to test much riskier and innovative approaches. Once these solutions demonstrate their effectiveness and deliver the proof of concept, other actors, including the public sector, can adopt them. Social entrepreneurship can thus achieve a potentially high dynamic impact over time”. This project contributes towards social innovation, by developing a sustainable ecosystem which includes tangible spatial design and intangible service design to enhance the connection among the third sector, local enterprise and local residents. According to Manzini (2015), “social innovations are solutions based on new social forms and economic models. They are those social changes towards sustainability when they can reduce the environmental impact, regenerate common goods and social fabric”. To achieve that, public space design is where social innovation takes place, the activities happen, and the values of the service appear. Sustainable long-term social innovation can be produced during the multidisciplinary process of the practice, and it can be said that all those sectors are components of social innovation.

Martesana District
The original memories of this district were rural. Then with the development of urbanization, it gradually became part of Milan city with vastly increased numbers of immigrants. This highlights the complex characteristics of the culture and history of the Martesana District as an abandoned industrial area which has a lot of hidden space, and a lower cost of living that attracted many small creative associations who continue to increase the complexity of regional society, with the result that an invisible wall has been built.

The government has made some top-down contributions to the building of the infrastructure and is very important in promoting quality of living, as well as continually being an important force in building the metro or increasing the amount of public space for local people to communicate or spend their leisure time. However, all those contributions cannot generate a sustainable and inclusive system to integrate communities without continuous impetus.
Complex historical factors influencing the environment surrounding Cargo Hi-Tech show an organically but sometimes non-linear development of urban expansion. The complexity of this district, on one hand, is made up of many different components like diverse types of immigration, but does not depend solely on this, on the other hand, the complexity is due mainly to the fact that the core element of cities is multiple actions. As Portugali (2016) observes: “As a set of material components alone, the city is an artifact and as such a simple system; as a set of human components – the urban agents – the city is a complex system”. The diverse associations and mixed functional public spaces show the trace of the superimposed urban fabric. The core of identifying and regenerating the district by the local communities themselves is to build a sustainable and inclusive network which bring about all the making and reconstructing relationship activities.

Co-production of new social services with six different local associations

Six Associations

The main focus of the research project is to focus on the Martesana District, making it a model for the entire metropolitan city of Milan: transforming the area from an invisible district to an important peripheral centre, where cultures, events, commercial activities, work, study, and entertainment for the old and the new generations converge. It is important to connect all the separate associations, to give a voice to citizens so that they can start from scratch and cultivate all that is possible to achieve, in order to improve the lives of residents.

In order to activate the citizens and the district itself, recourse is made to the work of the non-profit associations of the district, which fight for the principles of aggregation, enhancement of culture, and social inclusion, and which are defenders of civil rights and mediators in establishing relations with the Municipality.

Promoting the character of local communities – through cultural, artistic and debating activities, social cohesion and economic development, makes the neighbourhoods into a theatre for different audiences. Different actors such as institutions, companies, students and artists, and different generations with different cultural backgrounds, all contribute to this process.

Starting from a system of social and communicative activation in the surrounding areas, cultural, artistic and debate activities are aimed at different audiences, not only local residents, to transform their territories into new centres of attraction and stimulation for all the other neighbourhoods around the city. Making a neighbourhood richer in events, activities and social commitment also means helping its economy, thanks to a network of active collaborations between citizens, local shopkeepers and the activities and associations already present in the territory and exploiting the public and empty spaces in the neighbourhood that have potential for development. The reclaiming of public spaces allows people to come together in an inclusive way – opening roads, squares, and the city itself to be freely enjoyed by all. Understanding new actors’ motivation to initiate and drive bottom-up projects could help policymakers work together with them and design policies to make best use of the energy and skills within these community groups and organizations (AA. VV., 2018).

This new enterprise and innovative planning of public spaces is happening more and more frequently, especially in the peripheral and semi-peripheral districts. This paper wants to give voice to a teaching and research project that starts with the collaboration of different actors such as the small local communities of the Martesana district, who will be protagonists of a co-design with forty students from an elective TUS course, supervised by the research group Polimi DESIS Lab that was contacted by the private Milanese company Cargo Hi-Tech, an icon of the district. The role of the design discipline is to exploit the fertile context of the Martesana District of Milan by proposing new activating solutions,
scenarios and strategies, and connecting the resident population of small local communities by using the skills of design students to create synergies and new processes of social inclusion and innovation. The challenge is to create a new dialogue with the various multifaceted and identities of the Martesana District, through the involvement of six local communities: small non-profit organizations that are based on the principles of equity and sustainability, and deal with contemporary art, culture, pedagogy, social experimentation, music and entertainment.

Some of these associations are very active in the area and the choice fell primarily on those small organizations with strong potential and a strong desire for growth in terms of activities within the district and that are concerned with strengthening the social aspect of internal relations. Each of them deals with different themes and aims, so much so as to be chosen as the object of study and co-design for the students of the TUS course: their themes have been analyzed, put into practice through a research into the needs and requests of citizens in the form of prototypes for new temporary urban solutions.

The first association chosen is G.A.S. (ethical purchasing group) Crescenzago, a local community of people based on the rejection of the consumer lifestyle, the care of natural products and fair pricing. The main activities of G.A.S. are the production, purchase and consumption of seasonal food ingredients, which are produced without the use of strong chemicals and artificial flavours and colouring. A purchasing group does not just look for the lowest price, but puts people and the environment before profit, choosing products and producers on the basis of respect for the environment and solidarity among group members, traders and producers.

The second association was chosen for its approach to using art forms as a means of expressing an ethical and social direction. Assab One is a non-profit organization that provides artists with a non-conventional environment for research and expression, and produces and promotes exhibitions, events and art projects which focus on initiatives that integrate different languages capable of reaching beyond the art world. Assab, the name of an African port, has thus become the symbol of a meeting place where exchanges take place between different individuals, associations and cultures.

WeMake Fablab, supports and provides a space for digital and traditional manufacturing, and also provides access to fablab technologies to explore new fields of innovation involving the local and global community in different skills and learning processes. WeMake is a multifunctional urban factory that plans and develops courses, workshops, initiatives and co-design sessions to stimulate the exchange of knowledge and develop new areas of innovation.

Associazione Sonomusica was also chosen. Their main objective is young people, but they interact with all ages. It is a large community that puts music at the centre of a training and social project, in which children, adolescents and adults can enjoy musical and cultural experiences through meaningful opportunities.

Another association is Arti Girovaghe, which promotes the spread of a culture of promotion through socio-cultural, educational, research and social experimentation, particularly in creative development and free expression, to create processes of socialization for a new social community.

The last is City Art, a non-profit cultural association where thoughts, forms and actions that reflect on complex everyday life, become energized and dynamic. It represents a multi-functional place for reflection and meeting about public and social art through local events, shared with the inhabitants of neighbourhoods and schools. City Art’s projects concern the protection of and respect for the environment, social relations and the mediation of conflicts in all those places where the capacity for active participation in social and public life can be increased.
The choice of the associations was a fundamental element in order to start a co-planning process for the creation of new scenarios for the Martesana district, with the aim of creating stronger networks of relations between other local communities and those who live in the area, while at the same time encouraging social growth and identification with the already more developed areas of Milan.

**Methodology**

Cargo asked the Polimi DESIS Lab to help extend their relations with the neighbourhood by offering the residents a new space for coming together, community, and sharing. After investigating the place Cargo is located, an initial concept was generated in the teaching group. Cargo’s request offered very coherent opportunities to apply the concept on the elective course TUS, which is a practical course focused on combining design theory with practice to create new opportunities for social innovation in service and spatial design fields. The characteristic of Cargo as a local enterprise and the complexity of the location and local communities including associations and residents raised the following questions:

- how can the new position of a specific public space be redefined in the complex urban fabric?
- how can a sustainable and inclusive ecosystem be generated among local enterprises, associations and residents through design?
- how can design facilitate the self-identification of this district?

During the course, forty students from different professional backgrounds – interior design, service design and product design – and from different cultural backgrounds were divided into six groups to explore an undefined area through the design approach, including co-design sessions, design thinking, human-centred design, and community-centred design. Working and discussing together with small local communities involved various types of resistances and diverse stakeholders.

The course took place over six intense weeks, each having a specific design phase that created a linear educational process to reach the final prototyping stage. During the first week the students focused on the analysis of the context and the local communities to create their own general overview of ideas and actions. In the following three weeks the groups were involved in the ideation phase through a brain-storming phase and concept generation. During this time the most interesting element for the generation of ideas was the co-design session with the assigned local communities, to learn more about the problems and needs of the neighbourhood and understand which positive aspects were to be most valued. Finally, the course ended with the design and prototyping phases, where the latter was staged during a public event organized to show the results of the students as a first step of urban renewal and social innovation. Students as activators of improvement of the neighbourhood, using their designing ideas, co-designed with different local associations. To build the social network among communities and to allow the idea of the local to deeply integrate into communities requires the participation of both space and service. Thus, a specific concept of redefinition of this public space was generated, a social platform for sustainably and inclusively integrating and merging the ever-growing requirement of the communities.

Within the social platform co-created by all types of stakeholders, the third sector plays an important role. As mentioned on the previous paragraph, there are some places where state and market lack of the ability to provide support, but it is in those areas that third-sector organizations can accomplish more (in particular with regard to social innovation). This is because they are accepted as the organizational embodiment of civil society: “NPOs encourage social interaction and help to create trust and reciprocity, which leads to the generation of a sense of community” (Donoghue, 2003).

Third sector organizations are described as “facilitators of social learning” (Valentinov et al., 2013). This in turn increases acceptance of innovations and serves as a significant variable in building and
maintaining the legitimacy, which has proved so crucial for social innovation viability, sustainability, and, ultimately, impact.

Human-centred design is regarded as an important design methodology approach, through the deep comprehension of the communities and the understanding from their perspective which creatively solved the problem. Just as IDEO (2019) has stated, starting with the people you’re designing for and ending with new tailor-made solutions to suit their needs are the main features of this process. There are several steps that need to be taken, and questions which the students need to consider: how can students have this deep empathy with people? And how can this empathetic research have long-term support for the “social platform” contributing to autonomy and to taking communities’ initiatives further? The requirement for the students learning from the experiences of human-centred design research is the importance of understanding in which stage of development the social innovations need to seek support from designers and for how long is needed to make initiatives become self-sufficient and the community ‘competent’ (Meroni & Sangiori, 2011).

The first of the four phases of human-centred design is Empathy, which means learning about the local residents the students are designing for. In this step, students need to think about how to deeply engage in the local context. Several methods were offered: desk research and field research, and tools like interviews and photo reportage. Define means defining and focusing on the questions which are generated from the stage of empathy. Third, ideate through co-design sessions that are opened up to the local communities, understand their ability, necessity and aspiration through the use of different tools and methods. And finally, Test, to find a precise way to implement the solution to reality, and to a market in the real world.

Those four steps were applied over six weeks. During the kick-off session, the student group gave a presentation to explain the core values and plans about the temporary urban solution class, and from the first to the fifth week, the students needed to complete the four stages mentioned above. In the final week the students hosted the prototyping events for Cargo and the six associations, and also invited local residents.

This is a designer’s way to intervene in people’s lives, motivate actions, activate stakeholders, and create “spaces of the context”, which will reveal and challenge configurations and conditions of society that already exist. This is also an opportunity to turn designing ‘for’ the community to designing ‘with’ the community into allowing communities to design ‘by themselves’ (Brown, 2009). By sharing what has been done with the people you’re designing for and also putting innovative new solutions into the world, it is therefore about producing ideas and building prototypes. As the central core of the process, keeping the same people you are designing solutions with means a far higher probability of success with more. Therefore, students were required to participate in the local communities, not only once, but in all different stages of the process in order to promote social innovation and build sustainability.

**Martesana Fest: new scenarios and social inclusion prototypes**

*The results*

Design is often the perfect tool for finding solutions to problems. The idea and the design can help increase profits by making the whole system more functional, attractive and safe, and by helping improve compliance by taking advantage of the optimal use of urban space.

The research and teaching project, which involved the active part of the local communities in the neighbourhood, set up the six projects in terms of space applications, services and future vision through Virtual Reality (VR) technology. To involve the neighbourhood, Cargo organized a public event in its outdoor spaces to invite all the local residents and specifically to show the associations how their
activation and participation has brought added value to the regeneration of the area. The event, Martesana Fest, took place in May 2019 as the perfect ending to the six-week intensive course. In a single day the students gave a public presentation of their projects, with scale models and full-scale details that clearly explained their project. The communication of the event, supported by the research team, regulated the setting and the arrangement of the space. Each group had a single station, set up according to the main characteristics of their project, together with booklets describing the design process that each interested user could read and analyze in depth. During the event there was a much active participation, both from the neighbourhood and the associations involved in the design.

The first project was **RE-MIX**, which aims to give priority to human factors and to re-establish a better connection between people, creating a larger and stronger community. The students collaborated with the G.A.S *Cresenzago* group. In order to create a social, efficient and pleasant activity, that was at the same time environmentally friendly, they invented a strategy for the reusability of waste materials and their transformation into furniture or other useful objects. To facilitate this process and make it accessible they designed a mobile shed, containing the tools necessary for the construction of the objects. The result is the creation of a new community, which is concerned with more intelligent consumption, and the upcycling of goods for better environmental awareness. During the event they explained and demonstrated how recycled plastic can become a fixed joint for structures such as benches, bookshelves and flower boxes.

The **DYNAMIC ART** project was born in collaboration with *Assab One*. The desired goal was to change the appearance of the neighbourhood by involving people through activities: looking through panels cut into the shapes of different body positions that are placed in front of an existing wall to change their artistic perspectives; painting the surface of the bridge, that connects the Martesana canal with the Cargo Hi-tech, with thermochromatic paints that change colour with the movements of the body; and finally, inviting people to jump, climb, throw and paint using textured objects, hands and to burst balloons with darts, giving rise to a new attractive wall. This last activity was repeated during the event, inviting all participants to make their own artistic contribution.

The third project was **iCreate** with the participation of *WeMake Fablab*. The project consisted of an urban garden that hosts a series of workshops on how to grow and harvest fruit and vegetables with the use of technology, as well as how to transform the crop for consumption (raw food). This promoted more innovative and sustainable social activities for urban activation and community revitalization through the development of technologies for everyday life. The activity proposed during the event was
to simulate these new technological approaches with the use of a 3D pen for the creation of food and everyday objects.

The ECHO project is a stage that will be raised in front of Cargo’s shop to host musical events (in the day and night). Its purpose is to bring together the inhabitants of the area along the canal and create a stronger identity for the neighbourhood. The project was born from the collaboration with the inhabitants of the neighbourhood and the Associazione Sonomusica through interviews, surveys and co-design activities. The contribution of the association was fundamental to the event because the stage was used for the first time for the performance of one of the music students at Sonomusica, whose voice was a positive addition to the exhibition.

Figure 2: Martesana Fest - ECHO project and performance of Sonomusica’s singer

The project in partnership with Arti Girovaghe was SEEDS OF POETRY. It aimed to develop a new social experiment in which people are free to participate and express themselves. By purchasing the kits available in the surrounding shops, people would have the necessary items to plant seeds and write their own poetry. People were attracted by the large number of kits present on the day of the event; they could be customized with their own poems and they could choose whether to take them with them or leave them on show in the vertical structures available.

As in a textile each single filament increases the structural strength of the final whole, the potential of a community can be expressed through a healthy collaboration between its inhabitants. This is how the TRAMA project, born from the co-design with City Art, was described. It proposed the creation of a collaborative open space that led to the creation of rope artefacts, through knots, with the collaboration of the inhabitants of Martesana. The rope was also the leitmotif of the activity they proposed during the event: thanks to a full-scale module you could participate in the creation of these nets through a tutorial and with the help of the students who presented it.

Figure 3: Martesana Fest - TRAMA Project
Design practice is attempting to go through and across the barrier created by the framework of market-driven economies, by co-designing and using a community-driven approach at its core. The role of the designer, and in this particular case, of forty design students, is to help these communities consolidate themselves through co-design and generate new ideas that can be spread and replicated in a wider urban context. The general vision is to move from being relatively marginal to becoming more widespread and, in the not too distant future, to be mainstream through a new social communication network within a neighbourhood.

Conclusion
The project to reinvent the Martesana district, presented during the public event and exhibition of the students of the TUS course, is only the first of many achievements. This is made explicit because the activation of local associations is only a first step in trying to unify the neighbourhood and give it a new identity. Cargo, with the participation of the six groups, will commit themselves to maintaining a stable relationship, proposing these projects to the neighbourhood in order to move on to the phase of complete realization. In the future these two major actors, with the constant assistance of the local communities, intend to act as spokespersons for a new regeneration and to build possible original solutions to the needs of contemporary urban living. Defining the needs, starting from the experiences that they are confronted with, allows us to assume a dynamic perspective towards needs by constantly redefining outlines and a conscious and reactive approach towards the future that they anticipate. A future that urgently requires that the ability to activate individuals and communities be received and integrated by public and private decision-makers within a framework of systemic vision.

References


Power of Design in The Future of Orthoses

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Abstract: According to the United Nations, world population is ageing and growing, which is especially significant in Japan, Germany and Italy. Since senior citizens are more likely to fall ill or get injured, complex treatment solutions are needed. It is estimated that every person on the planet will experience some sort of short-term disability during their lifetime, and World Health Organization’s (WHO) action plan for 2014-2021 suggests paying more attention to the health of people with disabilities or movement disorders. Such initiative should encourage technological advancement in healthcare sector. However, orthotics products are lacking radical innovations, rather relying on minor changes, such as softer materials or different clasps. Such solutions mostly focus on functionality of the product, quite often neglecting the experiences of the user. Therefore, a new approach to healthcare design is needed – an approach that considers positive user experiences as well as the new design’s impact on environment.

In the present paper I ask what better, yet realistic orthotic solutions could be designed to help injured people? By applying general cultural history, medical theory, and social design theory, I briefly describe the contemporary medical trends of precision- and personal-medicine and see how these principles could be applied to product design in healthcare. Also, I reflect upon findings that beautiful aesthetics create positive emotions, which in turn speed up the healing process. Therefore, I conclude that user emotions should be considered when designing for patient care by enriching the products with positive experiences, thus creating medical “design for happiness”. This could be done by using the principles of experience design, and by creating highly personalized items.

Through technology mapping, I look into three-dimensional manufacturing technologies that enable the making of customized products; therefore I investigate 3D printing technologies and how they could be applied in healthcare designs, as well as examine the qualities of 3D printed materials that are needed to create functional, safe and sustainable orthoses.

However, some of the most important sustainability principles – minimizing consumption and maximizing product life cycle are not suitable for designing short-term orthoses, therefore in the present paper I outline how the principles of circular economy could be applied in creating these healthcare products. Finally, I conclude with a set of qualities that I suggest be included when designing contemporary orthotic solutions.

Keywords: Healthcare, Product design, Experience design, Circular economy, Personalization

1 An orthosis is an externally applied device used to modify the structural and functional characteristics of the neuromuscular and skeletal system.
Introduction

According to the United Nations, world population is ageing and growing, which is especially significant in Japan, Germany and Italy (United Nations, 2013). Due to ageing population the demand for- and costs of healthcare is growing (including in-patient, out-patient and rehabilitation treatments), because senior citizens are more likely to fall ill or get injured, therefore complex treatment solutions are needed. In European Union the number of injuries, including bone fractures, is rising every year, and is expected to be 28% larger in 2025 than it was in 2010 (United Nations, 2013). It is estimated that every person on the planet will experience some sort of short-term or long-term disability (directly or through a family member) during their lifetime, and World Health Organization’s (WHO) action plan for 2014-2021 suggests paying more attention to the health of people with disabilities or mobility disorders World Health Organization, 2014) by strengthening – among others – rehabilitation programs. Such initiative should encourage technological advancement in the healthcare sector.

However, orthotics products are lacking radical innovations, rather relying on minor changes, such as softer materials or different clasps. Such solutions mostly focus on functionality of the product, quite often neglecting the experiences of the user. Therefore, a new approach to healthcare design is needed – an approach that considers positive user experiences as well as the new design’s impact on environment.

In this paper I apply general cultural history, medical theory and social design theory to look into contemporary medical tools for short-term disability treatment; how using experience design could improve healing processes; and how sustainability could be taken into account when designing short-lifespan orthotics. I apply technology mapping when analyzing 3D printing technologies and materials, and foreseeing their future possibilities in orthotics applications.

In this paper I focus on physical disability of movement, and I use such terms as long-term disability to describe a life-changing movement disorder – inflicted by an injury or a disease – which could be slightly reduced, but not reversed (such as paraplegia); and short-term disability – inflicted mostly by injury – to describe a movement disorder, which could be reversed (such as bone fracture or ligament tear).

The context of long-term mobility disability is widely researched. This is admirable, as long-term disability has lasting effects on the lifestyle and livelihood of an affected person. However, short-term disability is lacking such attention, mostly focusing on the functionality of medical products, with very little inquiry into user emotional experiences. Having in mind that the number of injuries is rapidly increasing worldwide, that it affects mostly active individuals of all ages, and that even a short-term disability can have a (smaller but still) lasting effect on the health of a person, I find it necessary to look into this rather neglected subject.

Experience of an injury

Existing experiences

Many limb injuries are nowadays treated surgically, yet a conservative treatment by immobilizing\(^2\) the limb is still an important standard worldwide. Orthotic products, such as casts\(^3\), splints\(^4\) or braces\(^5\)

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\(^1\) Immobilization refers to the process of holding a joint or bone in place with a splint, cast, or brace. This is done to prevent an injured area from moving while it heals.

\(^2\) Casts are generally used to immobilize a broken bone. Casts are custom-made to fit each person, and are usually made of plaster or fiberglass. Casts offer most support compared to splints or braces.
that are currently on the market are focused only on functionality without any (well-designed) emotional value.

Plaster cast is still the most popular orthotic in the world – it is the cheapest, fastest and most sustainable option to treat fractures. However, this product causes negative functional – heavy weight, non-water-proof, non-adjustable size, skin irritation – and psychological – bad smell, unwashable, uncomfortable, unaesthetic – user experiences. Moreover, prolonged immobilization of the limb causes muscle atrophy\(^4\), which leads to the cast being too large, thus reducing its immobilization function and increasing healing time. In developed countries plastic splints are more commonly used due to being waterproof and lightweight. However, plastic orthoses are more difficult to mold and more prone to wrinkling than plaster, therefore their application is limited. Common 4-8 week immobilization of the injured limb causes joint contracture\(^5\), muscle atrophy\(^7\) and skin irritations, such as blisters, ulcers, rashes or itchiness, which might lead to skin infections. Hygiene is also affected due to the mostly closed design of these orthoses. Such problems of the splints and casts currently on the market indicate that the most important aspect of these orthoses is the immobilization function, often neglecting other factors, that could contribute to the better healing process – including early rehabilitation and positive patient experiences.

**Positivity in a negative product**

Studies show that a large part of happiness depends on activities (Appel, H.J. 1990) and is, therefore, variable. This could be explored by designers when creating happy activities within the products. However, an orthosis in itself is mostly an unhappiness-inducing product, due to being a conclusion of an unhappy action – i.e. injury. It might seem as a difficult task to turn a negative product in to a positive one. However, Fokkinga and Desmet (Fokkinga S. F. & Desmet P. M. A. 2013) suggest mixing positive and negative emotions to enrich user experience, thus the negativity that is already associated with a cast could help to enhance the designed positive emotions of using it.

It is obvious that an injured and immobilized limb will cause some discomfort to the patient. However, as designers, it is our job to make sure that our products do not add to the negative experiences, rather reducing possible post-traumatic complications and enhancing positive emotions.

\(^4\) Splints are often used to immobilize a dislocated joint while it heals, as well as used for finger injuries. Splinting is also used to immobilize an injured arm or leg immediately after an injury. Splints may be made of acrylic, polyethylene foam, plaster of paris, or aluminum.

\(^5\) Braces are used to support, align, or hold a body part in the correct position. Some braces can be taken on or off, and many braces can also be adjusted to allow for a certain amount of movement. They can be either custom-made or ready-made, and they usually have less support than casts or splints.

\(^6\) Joint contracture is the limitation in the passive range of motion of a mobile joint. Extensive immobility has been identified as a causal factor.

\(^7\) Muscle atrophy – a decrease in the mass of the muscle. It can be a partial or complete wasting away of muscle, and is most commonly experienced when persons suffer temporary disabling circumstances such as being restricted in movement.
of using (often undesirable) product. “Experiential consequences of things are inevitable. They do not simply vanish by excluding them from design or keeping them vague.” (Hassenzahl M. et.al. 2013)

Still historical and contemporary orthoses prioritize functionality, providing only minimal product personalization in size (functional) and sometimes color (psychological). Gerald C. Cupchik of University of Toronto explains that positive user experiences enhance their emotional state (Cupchik, G. 2016), while Barbara Fredrickson’s research (Fredrickson, B. 2009) shows that positive emotions, which include gratitude, joy, serenity, hope, interest, pride, amusement, inspiration and awe, help people gain creative perspective on their circumstances and improve their health. Therefore, improving the experience while maintaining the functionality of medical designs could benefit the overall comfort and health of the user.

**Personalization as a source of positive experiences**

Still, only in exceptional cases and only for the long-term disability are medical products personalized more than by size or color. Yet product customization or personalization is one of the main tools in creating product-and-user (or brand-and-user) emotional bond. This can be seen in various examples from Nike’s customizable shoe designs (Nike 2019) to Lancome’s personalized color matching make-up (Lancome 2019).

Customization is also important in modern treatment methods, with a focus on precision and personal medicine. Those terms are sometimes used interchangeably, yet are somewhat different. Using precision medicine methods, the patient’s treatment is personalized according to the individual characteristics of the disease (in case of injuries – by the nature and location of the injury, as well as the healing data of other patients with similar history), while using the methods of personal medicine, one is treated according to the data of one patient (i.e. the patient’s physical distinctions). These principles of customized medicine are already being used in post-injury rehabilitation (Koo, S. S. et. al. 2011), yet the orthotics – i.e. physical objects – that are necessary to treat these injuries are based on one-fits-all mentality with only size personalization. The disadvantages of current orthotics are mostly visible in open-fracture cases, when a cast is replaced by a partial splint in order to avoid covering the wound – this results in less than optimal immobilization.

Personalization of products for individual patient anatomy is one of the most important factors of comfort in order to provide the user with as many positive experiences as possible in a negative situation (i.e. after injury). Yet psychological personalization must be just as important when designing for a contemporary user. Having in mind that this became technologically possible about a decade ago, and financially feasible only recently, many orthotics are still engineered rather than designed. With rapid technological advancements (including 3D printing) and growing demand, orthotic designs should be treated less as bio-engineered objects and more as designed products, which are part of short-term disability treatment experience as well as part of the whole mobility healing system – i.e. rather than an making an object immobilizing a limb, the designer should consider the system this product is in, including the user’s lifestyle at home and in the clinic.

Additionally, when designing experiences of a medical object, it is important to consider both groups of users - the medical professionals, who will use the product during the procedures, and the patients, who are directly involved in the procedures and who will have to wear those medical products prescribed by doctors (i.e. not by choice). The designs of the worn medical objects and the experiences they cause have a great impact on the psychological state of the patient. Positive experiences have a potential to accelerate the healing process (Vedhara, K., et. al. 2010), therefore functionality must be taken for granted, and experience design should become the main goal. This
should include considering the functional and psychological comfort, as well as aesthetic needs of the patient-user, and ease of access to the medical-professional-user.

**Personalization in a sustainable age**

*3D printing possibilities in healthcare design*

Technological innovations allow the integration of personalization not only into soft products such as user interfaces or rehabilitation services, but also into physical objects. One such technology is 3D printing, enabling designer to anticipate product changes and to easily implement them in production.

The manufacturing of a 3D printed product still takes longer and is more expensive compared to other mass production technologies (e.g. injection molding). However, traditional manufacturing methods are designed for uniform products – their price decreases as the number of items produced increases. Meanwhile, the cost of 3D printed objects does not depend on quantity of uniform products, but rather on the total volume of items being produced. While this technology is still not yet optimal for manufacturing uniform products, it gives designers the ability to personalize every item produced to suit the custom needs of each user.

In orthopedic market, hard-case casts and splints are still hand-made to perfectly fit the patient’s anatomy. These orthoses require several hours (and – in case of high demand – several days) of human labor to be manufactured. Meanwhile, 3D scanning and printing technologies could change these processes. By designing the standard digital cast and then using adaptive algorithms to fit that digital design to a specific patient’s anatomy, human labor can be significantly reduced when compared to current hand-made practices.

Production time and price might still be seen as disadvantages of 3D printing, but it should be taken into account that the same orthotic product that took 20 hours to produce and cost approximately €2100 in 2013, now can be manufactured in approx. 5 hours for €190⁸, while a finger splint takes approx. 30 minutes and costs under €4 to make. Granted, the costs are still higher than an average orthosis, but such great technological improvement in a relatively short time could soon make 3D printed casts competitive. Having in mind the personalization, sustainability, and reduced human-error issues, 3D printing technology could be the future of orthopedic market.

*Applying circular design principles to orthoses*

As orthotics are designed to fit specific person’s needs for a specific amount of time (4-8 weeks), especially when the product is highly-personalized to enhance the user experience, it becomes important to take into design consideration not only the active use of the product, but the end of its lifespan as well.

The consumption of orthoses is rapidly increasing due to population ageing, these products must be used for a specific amount of time (no longer than needed), and to be functionally personalized to meet the hygienic criteria and to fit every patient’s anatomy, therefore such products cannot be re-used for the same purpose. Thus applying two of the most important principles of sustainability – reducing consumption and increasing product life-cycle – are not possible when designing orthoses. According to the principles of the circular economy, the durability of an object should correspond to its lifespan (Bakker, C., et. al. 2014). Often this principle is understood as maximum lifespan

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⁸ This is the author’s design experience when working on 3D printed cast prototypes.
extension, but creating truly temporary products (rather than the products, whose lifespan was artificially shortened) requires a synthesis between the functionality and toughness of the object – strong enough to perform a function and be reliable, but also fragile enough to be easily destroyed after use. When the lifespan of an orthopedic product is relatively short, it becomes necessary to extend the lifespan of this product’s materials.

Among the splints currently on the market, only a traditional plaster cast is compostable. Fiberglass casts and most plastic splints are made of composite materials, recycling of which become difficult and expensive, therefore such splints are usually left to deteriorate over time in the landfills. In this context it becomes important to find new comfortable and sustainable orthotic design solutions.

So far plastic splint is superior to plaster cast by means of comfort – lightness, water-proofness, breathability and size adaptability. Yet when taking sustainability into account, there is a need for a new approach to use this material. The problem with plastic orthoses, as mentioned above, is mostly their use of composite materials. A standard plastic splint (see Figure 3) will consist of a thermo-moldable plastic sheet (a textile, foam or fluff layer will likely be glued on one or both sides of the sheet), a few riveted hook-and-loop strips, and a foam strip glued to the edges of the splint to soften them. If we were to design the exact same splint with dis- and re-assembly in mind, we would use un-covered plastic sheet, hook-and-loop strips that loop around the splint instead of being riveted, and we’d round the edges of the plastic sheet to avoid adding the foam strip. To minimize the amount of plastic used, we could use the sheet with larger holes. However, such solution would weaken the structural strength of the product if the thickness of the plastic sheet is not increased. Therefore a different approach to molding plastic splint is needed. A 3D printed plastic cast could be a good solution, as this technology allows to not only wrap the plastic around the limb, but also to add thickness in the specific areas that need extra strength while keeping other parts as thin as possible.

**Designing for disassembly and recycling**

When 3D printing a cast, first the injured limb is 3D-scanned and the orthotic design is applied to the anatomical surface digitally, thus reducing the risk of human errors of applying the material to the naturally soft tissue (as is currently done when making moldable plastic splints). A digital design then can be analyzed for the weak points and adjusted by adding extra material only where needed. With minimized surface errors (i.e. skin irritation) and maximized material-use efficiency, design is then printed. As size adjustability is one of the key qualities of a good orthotic, the selected clasp method – be it hook-and-loop, pin-and-hole or other – need be connecting onto itself by looping or onto the splint without a third material or glue (see Figure 4). The least different materials and actions are
needed to make the splint, the faster is the manufacturing and disassembly processes, and the easier and cheaper the recycling of this product becomes.

When designing for disassembly and recycling, it is important to take into account that very few materials used in 3D printing can be recycled and are biocompatible (skin-friendly for a minimum of 30 days). In 3D printing Fused Deposition Modeling (FDM) and Selective Laser Sintering (SLS) technologies are capable of making recyclable objects. However, when manufacturing – especially anatomical – structures FDM has a disadvantage of strength in Z (upward) direction, while SLS has very limited choice for recyclable materials.

One of the options is to use compostable organic plastic (PLA), however, the technical specifications, such as thermal stability or tensile strength, of this material is inferior to other 3D printed or molded plastics, resulting in increased use of the material to even the structural needs. When using compostable materials it is also important to evaluate environmental impact of the product (Tabone, M. D., et. al. 2010), as its materials will disintegrate rather than being re-introduced back into the market, thus possibly wasting energy and sources used for growing this virgin material.

In the light of these disadvantages of the organic plastic it is currently advisable to use oil-based plastics that can be recycled multiple times in designing orthotics. It is noteworthy, that “environmental sustainability does not require a decrease in the value of consumption, only in its volume, or weight” (Cooper, T. in Bakker, C., et. al. 2014), therefore if we choose to keep using oil-based plastics, they should 1) be non-composite materials, and 2) we should drastically reduce the amount of plastic material used per cast. In such case 3D printing could be a good solution, as 1) there are no cuttings (as in sheet material) and the building supports, if necessary, can be dissolved in water or recycled, thus reducing material waste in production; 2) more open structures (i.e. with more strategically placed holes) could be designed and strengthened in crucial areas by adding thickness; 3) digital cast application on the scanned surface significantly reduces the dangers of ulcers by removing the risk of imprints or cast wrinkles, which are common in hand-made orthoses; and 4) in contrary to other automated manufacturing processes, 3D printing allows for unique products to be made at reasonable prices, thus empowering the functional and psychological personalization of the orthosis.

Additional challenge of recycling is actually getting the object to the recycling station. However, as the orthotic product has a specific place of end of life – the clinic – it becomes much easier to manage the disposed cast, having available waste management systems already in place. FDM 3D printed orthoses could also easily be made and used in places with limited available resources or accessibility – a digital cast may be printed, used and then recycled back into printing filament for other products. Recycling and filament production can be made cheap and easy by open-source projects, such as Precious Plastic initiative.

F.A.C.E.S. qualities

To design a positive experience of an orthotic I propose to take into account F.A.C.E.S. qualities – Functional, Aesthetic, Comfortable, Empathic, and Sustainable:

Functional – an orthotic must do its job – the primary function is to immobilize the limb, therefore the product should be strong and trustworthy in this matter.

Comfortable – an orthotic in its nature is restricting some movement and changing natural behavior of the user, thus reducing the comfort. However, designers must strive to improve the comfort of the patient as much as possible. Therefore an orthotic should be hygienic, lightweight, waterproof, and skin-friendly; have maximum skin breathability (to ease perspiration and drying, reduce bad smell);
reduce immobilization to a minimum (only where necessary); equally distribute pressure on skin and muscles, etc.

Aesthetic – aesthetic qualities are often neglected, yet it has been established that beautiful aesthetics create positive emotions, leading to improved healing. Here aesthetic qualities do not mean blending orthotic’s appearance with the body (e.g. by using skin-colored plastics, which usually are still designed to fit only Caucasians), but rather enhancing the visuals by treating the orthotic as an accessory or a piece of jewelry. This approach can already be seen in metal ring splints for fingers. User’s aesthetic preferences could also be resolved by partial co-creation, and computer-generated structures could help in providing functional strength while allowing for more diverse orthotic designs.

Sustainable – when designing short-lifespan orthotics, it is important to also design the end of the product life. A sustainable orthotic should be made either from organic and compostable or recycled and recyclable materials; and designed with easy disassembly in mind when more than one material is used. Such object should also be designed for durability, which matches the products actual use.

Empathic – I encourage designers to look for a special feature that could further improve user experience and healing through empathic approach towards the patient and the medical professional. Consider how this feature could cause user’s gratitude, joy, serenity, hope, pride, amusement, inspiration or awe (Fredrickson, B. 2009).

Orthotics that are currently on the market fulfill steps 1 and (partly) 2 – they are functioning well and are comfortable to a degree (plastic splints are lightweight, waterproof, their size is adjustable). The slow incremental innovations of orthotic market haven’t significantly improved short-term disability experience in decades, but I believe that rapid technological growth gives opportunities to develop better, more radical designs.

Conclusion

In this research paper I ask what better, yet realistic orthotic solutions could be designed to help injured people? I analyze current orthotic products and their issues of experience design and sustainability. I base my suggestion for a personalized orthosis on psychological research, which indicates that positive emotions lead to improved healing. Therefore, I come to a conclusion that a better orthoses should be highly-personalized, not only in functional, but also in psychological ways – by adding comfort and pleasing aesthetic qualities. Moreover, these products should also be made with their end-of-life in mind, designed for easy disassembly, and manufactured from recycled and recyclable (or organic and compostable) materials. I suggest 3D scanning and printing as a possible alternative to current hand-made cast manufacturing processes, while assessing this technology’s advantages in reducing human-error related product failures that might cause infections, and its current disadvantages of longer lead times and higher production price. I find it important to focus on designing patient experiences rather than just the object itself and strive to minimize the unavoidable negativity of cast as a product, and enhance it with as many positive emotions as possible, thus creating a medical “design for happiness”.

Finally I suggest five qualities that a better orthotic should have – it should be functional and comfortable, aesthetic and empathic to further improve user experience and healing, as well as sustainable in regards to increased orthoses’ consumption.
References
Challenges in Product Design for Traditional Societies: A Field Study with Novice Designers

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Abstract: New product design and dissemination in traditional societies have been reported to face resistance. The cause of resistance has not been well reported in literature. Also, the product design processes for traditional societies have not been studied and reported readily. This paper reports a field experiment with 10 novice designers who were socially immersed in the traditional environment of animal husbandry by rural women for about 40 hours each after which they designed new products and tested them. Daily life and pain points of women were observed, new products were designed to solve the problems and prototypes were tested with the users. At the end of the field study, the designers were interviewed qualitatively using semi structured protocol, one on one, for one hour each. Analysis was done on behavioural observations of novice designers during immersion, design and testing activities along with analysis of qualitative data from the interviews. The findings suggest that a) novice designers working on innovative products for social development need to understand the social, traditional and cultural context of the recipient users’ and the quality of such social immersion depends on social match of the designer with the users which in turn is influenced by prior exposure to such societies, gender match, duration of exposure, age, language etc. b) skill of the design team to empathise with users influences the design thinking process c) rapport building skills during immersion influences the quality of data collection and d) the quality of new product ideation depends on the match between the social context of the designer and user.

Keywords: Social Innovation, Culture, Design, Tradition, Novice Designers, Design Thinking
Designing Local Marketplace
-From multi-level service ecosystem perspective-

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Abstract: In traditional marketplace design, components of the marketplace are designed separately and operated by different stakeholders. As a result, each stakeholder applies their resources independently without connections between each level. The model discussed in this paper integrates these components based on the multi-level service ecosystem perspective depicted in Service Dominant logic. This paper illustrates the model with case study analysis of the local marketplace service in Japan, which integrates logistics, e-commerce and social media. This study shows that the multi-level service ecosystem works with local marketplace design, and it delivers meaningful value creation among stakeholders in the community.

Keywords: Marketplace, Service Design, Service Dominant Logic, Ecosystem

Introduction

As the production and distribution system in the modern industry era emerged, the local economy was integrated into a large distribution network model. Before the modern distribution system occurred in local societies, local producers and local buyers exchanged products with face-to-face interaction. After modern distribution systems emerged, local producers brought their products to formal marketplaces. As the distribution system became more sophisticated, producers brought their products to larger marketplaces, which were typically located far from the place products originated. This large level production - consumption system provides people efficient transactions, however it loses meaningful connection between local producers and local consumers. Local consumers purchase products from a large retail network with less person-to-person connection. Once consumers lose the direct connection between producers, they lose sight of the value of local producers, which leads to price competition, and eventually local producers lose profit.

This paper focuses on the agricultural marketplace in local areas as a case for a new marketplace design. Agricultural markets with face to face connections between producers and consumers have trust and social connection that distinguishes it from the global food system (Hinrichs, 2000). Direct connection marketplace such as farmers markets and community supported agriculture (CSA) have a positive impact on farmers, consumers and communities (Brown & Miller, 2008). Consumers prefer locally grown rather than nationally grown and are willing to pay more for a product from a closer location (Darby et al., 2008). This paper explores the characteristics of the direct connection marketplace model compared to the current more common marketplace design.
Research question

The research question investigates how the local marketplace design model could be redefined apart from a large distribution network model. The large distribution model is designed to be an optimized and efficient system. However, it becomes hard to create meaningful value among producers and consumers compared to the traditional person-to-person transaction marketplace model.

This paper provides a design framework that addresses the issues with a large distribution network model. This paper investigates the following questions. What are the problems of the design process behind a conventional large distribution network? What is the design model that creates meaningful value among stakeholders? What are the key elements for this new design model?

Problems of local marketplace design

The problem of the current marketplace design is that it’s designed to be an optimized system in each process and function, rather than a value creating system that supports each stakeholder’s benefit. Local producers bring their products to a large distribution network because they are able to sell their products efficiently in large amounts. The large retail network purchases products at scale and distributes them efficiently. Consumers buy products in a large retail store, because they are cheap and convenient. The process is designed for efficiency, however it brings less per product profit to producers and has less meaningful value to consumers.

Identifying stakeholders is a key activity in describing the management environment (Mitchell et al., 1997). Stakeholder mapping is a design method used to understand current stakeholders and visualize them in physical form (Stickdorn et al., 2011). Based on understanding of the stakeholders, prescriptive stakeholder mapping such as a prescriptive value web (Kumar, 2012) is applied in order to illustrate ideal status of the stakeholder relationship.

A customer journey map helps to design the experience of each stakeholder. A service blueprint (Shostack, 1982; Bitner et al., 2008) maps all key activities involved in the experience and specifies the linkage between these activities. The service blueprint model was developed based on the person-to-person single channel service model. A Service Experience Blueprint (SEB) (Patrício et al., 2008) provides a multidisciplinary method for designing multi-interface service experiences. Expanding the concept of SEB, the Multilevel Service Design (MSD) (Patrício et al., 2011) is developed in order to integrate the different service system levels. MSD provides a design perspective which includes the service concept, service system, and service encounter.

Studies of service design methods argue the expansion of the service system and service interface. However, the design approach of optimising a single system, which lacks an ecological perspective, is still more common.

Research framework

Service Dominant Logic

This paper illustrates the model of local marketplace design from a multi-level service ecosystem perspective depicted in Service Dominant Logic (S-D Logic) (Vargo & Lusch, 2004). S-D logic is a theoretical framework which explains value creation from the service exchange perspective, and it
provides a new framework of marketing and the marketplace. This paper includes the S-D logic perspective as a key theoretical component, in order to discuss new model of local marketplace design. S-D logic defines service as the fundamental basis of exchange, and service is a process of applying resources for the benefit of another. S-D logic has five axioms with eleven fundamental premises (FPs) (Table 1). In S-D logic, value is co-created by actors within the resource integration process. According to S-D logic, the marketplace is defined as a process of co-creation, which allows actors in the marketplace to apply each resource to generate value (Lusch & Vargo 2014). In this approach, the marketplace is designed as a place of service exchange.

<table>
<thead>
<tr>
<th>Axiom 1/FP1</th>
<th>Service is the fundamental basis of exchange.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axiom 2/FP6</td>
<td>Value is cocreated by multiple actors, always including the beneficiary.</td>
</tr>
<tr>
<td>Axiom 3/FP9</td>
<td>All social and economic actors are resource integrators.</td>
</tr>
<tr>
<td>Axiom 4/FP10</td>
<td>Value is always uniquely and phenomenologically determined by the beneficiary.</td>
</tr>
<tr>
<td>Axiom 5/FP11</td>
<td>Value co-creation is coordinated through actor-generated institutions and institutional arrangements.</td>
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</tbody>
</table>

**Service ecosystem perspective**

S-D logic also states that value is co-created by multiple actors and the service ecosystem is used to identify the actor network to co-create values (Vargo & Lusch, 2016). S-D logic started to capture the new form of the relationship between corporations and customers first. Later, S-D logic expanded the scope of the theory to larger interactions beyond merely corporation and customer relationships to include the actor-to-actor perspective and ecosystem concept. The service ecosystem is defined as "relatively self-contained, self-adjusting systems of resource-integrating actors connected by shared institutional arrangements and mutual value creation through service exchange." (Lusch & Vargo 2014; Vargo & Lusch 2016).

Within the S-D logic perspective, the marketplace is considered a service ecosystem that allows multiple actors to co-create value. In S-D logic, the concept of a multi-level service ecosystem, which consists of micro, meso and macro levels, was introduced in order to the apply S-D logic perspective to wider range of social interaction (Chandler & Vargo, 2011).

The ecosystem perspective is also discussed in entrepreneurship literature as “entrepreneurial ecosystems” (Stam, 2015). Entrepreneurial ecosystems are defined as sets of actors, institutions, social networks and cultural values that produce entrepreneurial activity (Roundy et al., 2018). A multi-level approach is argued in the discussion of entrepreneurial ecosystems (Theodoraki & Meseghem, 2017). In local marketplace design, a multi-level service ecosystem is applied to various levels of the service ecosystem that forms the local marketplace. Each level of the service ecosystem is connected in order to assist with values creation among actors in the service system.
Method

In order to illustrate the new design framework, this paper will use a case study method (Yin, 2009). The subject of the case study analysis is the agricultural products marketplace in local areas in Shizuoka, Japan. There is a conventional marketplace system for distribution of agricultural products in this area. However, there are problems with the existing system. The start-up company ML developed the new marketplace service called YB and implemented with local vegetable products transactions. This paper uses the design process and analyses it according to the theoretical framework in order to answer research questions.

Case study analysis

Background and problems

The Shizuoka prefecture is located in the middle of Japan with a population of 3.7 million people. Shizuoka is comprised of urban area and rural areas, and there are many farmers in rural areas who produce various vegetable products. Shops and restaurants purchase the vegetable products in the urban areas.

There are problems with the distribution of vegetable products in the region. First, farmers usually use a large logistics network and it takes a few days to distribute their products to consumers. Consumers in Shizuoka buy products circulated through the marketplace in Tokyo, even though the products are originally produced in Shizuoka. Second, the farmers usually sell their products to wholesale distributors at lower per product price, and it results in less profit. The whole seller aggregates products and brings them to the larger marketplace in order to sell them at scale. In this model, the whole seller is able to make money, whereas farmers make less. Third, farmers do not have a chance to communicate with consumers directly, and they have less knowledge about what consumers need and how consumers feel about the farmer’s products. This makes it difficult for farmers to produce what consumers really need.
New marketplace design

Service YB, a marketplace service which was designed and operated by company YB, in order to address the problems occurring in the large distribution network described above. Company YB is the joint venture company established by the agricultural technology start-up ML and logistics large corporation SY both based in Shizuoka. Company YB is the start-up company which operates YB service. Service YB is an e-commerce platform with a limited region logistics system. The farmers receive the order, harvest the vegetables, and leave the vegetables at the "bus stop", which is the only dedicated spot for service. The driver picks them up and drops them off at the designated bus stop. The consumers visit the bus stop and pick up the vegetables.

Service YB is combining logistics, e-commerce and social media. Company YB aimed to solve the problems of a large distribution network, and designed the service YB. Service YB has accomplished many outcomes that improve the vegetable market.

First, the shared logistics system reduced the average 4-day delivery time to same-day or next-day delivery. At the same time, it lowered delivery costs and distribution costs by 10% and 75%. Second, the e-commerce system made the ordering process easier. It also assisted farmers in receiving the order and delivering vegetables without a rush. Third, the social media function allowed both farmers and consumers to communicate with each other. Consumers are able to see the farmer’s face individually, and consumers recognize the value of vegetables through the communication between farmers.

Figure 2: Structure of service YB
Discussion

Through the design of service YB, results indicated that the multi-level service ecosystem can be applied as a marketplace design.

Service YB consists of three service levels; logistics, e-commerce and social media, and service YB works to integrate these levels. In the conventional marketplace design model, each level is designed independently and individually optimized. As reviewed in the case study analysis, before service YB was implemented, there were systematic problems with the separate optimization of each component. Service YB is designed to integrate each function as a single service to solve the systematic issues.

In each level of service, there are actors who integrate their resources to create value, as indicated in the service ecosystem framework. In e-commerce and social media, major actors are farmers and consumers who are connecting and exchanging information, and co-create the value that comes out of the marketplace. In conventional marketplace design, there is less interaction between actors. Information and products are transacted one way.

There is also interaction between each level of service, which enhances values co-creation by actors in each level. Once consumers see the information generated in the social media level, they recognize it as valuable information about farmers, which let them order vegetables in the e-commerce level. When the e-commerce system received an order, it immediately sends the order information to logistics, which creates value of on-demand delivery from farmers to consumers. Once consumers receive the vegetables, consumers use social media level, which creates positive interactions between the groups.

Conclusion

Through the case study analysis of service YB, it was determined that the multi-level service ecosystem framework can be applied as a model of marketplace design. In a traditional design model, components of the marketplace are designed separately and operated by different stakeholders. This study showed the model leveraging the multi-level service ecosystem perspective depicted in S-D logic.
The model consists of three elements of marketplace design, which are 1) integration of ecosystem levels, 2) actors to integrate their resources to create value and 3) interaction between each level of ecosystem. The marketplace inherently has multi stakeholders and levels. In the process of forming a large distribution model, each stakeholder applies their resource independently without connection between each level. This study indicates that designing integration of levels and interaction of actors in each level are key elements that allow the marketplace to create meaningful value among stakeholders in the community. This model was illustrated through case study of service at a local area in Japan. Further research with cases outside of Japan is needed to make this model applicable to other contexts.

References


Stickdorn, M., Schneider, J., Andrews, K., & Lawrence, A. 2011. *This is service design thinking: Basics, tools, cases*. Wiley.


TRACK 2: Meanings of Design in Technological Development

Topic 2.1: Design for New Paradigms in Production
Design Drivers: A Critical Enabler to Meditate Value over The NPD Process Within Internet of Things

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Abstract: With the emergence of Internet of Things (IoT) as a new source of 'big' data, businesses face new opportunities as well as emergent challenges. Recent research claims digital technology can enable new kinds of development processes that are distinctive from their counterparts in 20th century. However, although academics and practitioners often critically debate the IoT, minimal attention has been focused on New Product Development (NPD) processes; arguably, one of the most critical marketing planning and implementation process activities undertaken within the organisation. Thus, this paper aims to contribute to a new understanding of IoT NPD processes. To achieve this aim, a comprehensive literature review was undertaken on traditional NPD design processes and reviewed against, a featured case study, IoT NPD processes. The relevance of IoT NPD against the characteristics of existing NPD processes, are subsequently reviewed and critically debated. Finally, NPD processes and the meaning of design within an IoT context is reframed. Finally, this paper summarizes how NPD processes and the role of design could be improved and proposes a set of guidelines with an accompanying conceptual framework for IoT NPD processes.

Keywords: New Product Development Processes for IoT, Internet of Things, IoT development risks, Value creation for IoT, Design for Io

Introduction

Over the last few decades, a compelling wave of innovation based on digital technology has emerged with the invention of World Wide Web (WWW). The internet, an open and distributed network by which people can communicate and share information, has become a vital platform. In recent years, it has become possible for almost any physical object has been connected to the internet and transformed into an IoT device. As such, it is estimated that 30 billion devices around the world will be connected to the Internet by 2020 (IEEE Spectrum, 2016). The emergence of IoT as a new source of ‘big’ data, whereby people enter new relationships with objects and businesses are increasingly reshaping business models and strategies. In industry, the IoT is regarded as a fertile field for commercial enterprises, it has been forecast that one in every six businesses would be engaged in the roll out of an IoT-based product (Burkitt, 2014).

There are vital opportunities for new innovation (Lasi et al., 2014; Radziwon et al., 2014; Xu, 2012; Yoo, 2013) by amalgamating sensors, actuators, and cloud computing with non-digital products and services (Yoo, 2010). In this regard, it is estimated that the total global impact of IoT technologies could generate anywhere from $2.7 trillion to $ 14.4 trillion in value by 2025 (McKinsey, 2013). However, it has been revealed that most businesses are adopting the IoT only to a limited extent, at the proof-of-concept stage (McKinsey, 2017) and nearly three-quarters of IoT device implementations are failing (Cisco, 2017). Reichert (2017) argued that one of the significant reasons challenging the early IoT
initiators is the lack of experience in IoT development. This is because digital technology radically changes traditional ways of business activities such as: how to operate supply chain (Gartner, 2014); how to develop products and services (Henfridsson et al., 2014; Yoo et al., 2012); and how to create meaningful value (Hui, 2014).

The continual development of new products and innovation are widely accepted as a requirement for companies’ sustainable growth. Consequently, the subject of innovation, New Product Development (NPD), development risks and risk management has gained a considerable amount of attention from academics and practitioners over decades and has increased in the last ten years (Machado, 2013; Susterova et al., 2012; Smith and Merritt, 2002; Thauser, 2017; Teller et al., 2014). However, despite growing popularity and opportunities of developing IoT products and services, there has been little attention focused on NPD processes for IoT; arguably one of the most critical marketing planning and implementation process activities undertaken within the organisation in the future. As software is becoming increasingly embedded within a variety of design artefacts, it is imperative that emerging perspectives in order to both feed and draw insight from the broader design discourse. Scholars from marketing and design (Ng & Wakenshaw, 2017; Speed and Maxwell, 2015) argue that it is time to reframe conventional NPD processes to satisfy current needs and potential commercial opportunities in the era of IoT.

**Methodology**

This study explores how IoT products and services, which aim to increase organisational value, should be developed, and as such to contribute to a comprehensive understanding of NPD for IoT. In order to achieve these aims, the following research questions were proposed for critical discussion: (1) How are the conventional NPD processes and value creation different to its counterpart in IoT context? (2a) How are IoT products and services actually being developed and (2b) what are the risks inherent over the duration of the NPD process? (3) How should design be reframed as a critical enabler to mediate value over IoT NPD process? This research study was conducted using a strongly qualitative research methods approach, including an extensive examination of current literature and a single in-depth case study.

Books, articles, academic text and white papers were selected for a comprehensive literature review through searching electronic databases such as ProQuest Business Premium, Springer Journals Archive, Wiley Online Library Journals, and Google Scholar. Search terms used, included 1) “NPD”, “Innovation process”, “software development”, “design and development process”, “linear value creation” and “role of design” 2) “IoT development”, “digital innovation”, “digital artefact”, “value constellation” and “digital economy” 3) “development risks”, “IoT development risks”, and “IoT risks”. These are then supported by a manual investigation of abstracts and articles published in select journals- Journal of Product Innovation Management, Journal of Information Technology, European Journal of Innovation Management and Journal of Association for Information Systems. Each text was critically examined for their relevance to the primary question(s) of the main research study.

A case study was selected as it is argued as one of the best means of investigating a contemporary phenomenon within a bounded system (a single case) (Yin, 2009; Stake, 1995, 2005) or multiple bounded systems (cases) (Yin, 2009; Eisenhardt, 1989; Stake, 1995). Although this research only includes a single case study, as it is the early stage of current research, the overall research programme will contain a multiple case studies to generalise and validate the findings (Eisenhardt and Graebner, 2007). Bounded system can be any special unit such as a program or an activity (Creswell, 1998). As the object of investigation was NPD process for IoT, the unit of analysis for the case studies bounded
as the whole journey of IoT products and services development rather than a company which is common in business studies (Mills and Durepos, 2013).

The case study involved a semi-structured interview and document reviews, such as public marketing material and presentations. Multiple sources of data were used to ensure a thick description and increase the trustworthiness of findings (Grandy, 2010; Stake, 1994). The case for the research was selected relying on purposeful sampling (Merriam, 2009) rather than random sampling. Considering the research aims, accessibility and resources, the case needed to satisfy the following criteria were considered: a) the geographical location of case was limited to the UK; b) the project should aim at developing a new IoT products and services. A small number of leading industry white papers on IoT case studies leading the industry were reviewed to develop the list of possible case studies and further internet searching was conducted to contact the company.

In order to select appropriate participants, job roles were considered rather the job titles, such as: 1) those who are in charge of managing the development process; 2) those who are involved strategic decision making over the process; 3) and/or those who hold the authority to drive IoT development project. The interview was conducted at the interviewee’s office over 90 minutes in February 2019. The interview was transcribed by the researcher and analysed using qualitative content analysis method (Zhang & Wildemuth, 2009) which enables the researcher to focus not only on the explicit text itself, but the experts’ intention or contextual meanings around the text. At the level of analysis, findings from the literature review and single case study were analysed to critically understand NPD processes for IoT products and services.

### Conventional NPD processes and design

**Conventional NPD processes**

NPD is a complex business activity, which aims to transform customers’ requirements into organizational value through products and/or services in the market. Over the half a century, NPD processes have been constantly refined by the practitioners and researchers (Best, 2006). A number of different NPD models for physical products have been developed within manufacturing economies, then in the late 20th century the models started to be modified and developed specifically for service and software development. This research study explored conventional NPD processes and it identified that whether developing physical product, software, or service, the process begins from identifying the latent needs for delivering the product(s). However, depending on the characteristics of the objects (physical, digital or service), there are specific ways of designing and developing new products.

The majority of the development processes for traditional products represent conventional sequential approaches, often referred to as ‘a stage gate system (Cooper, 1990)’, ‘over the wall process (Trott, 2012),’ and ‘parallel processing models (Takeuchi and Nanoka, 1986)’, but also there are a few models with different representations of NPD, such as ‘Unger and Eppinger’s spiral model (2009)’, and ‘a cyclical innovation model (Berkhout et al, 2010). As the economic paradigm has transformed from good-dominant logic to service-dominant logic, and emerging digital technologies disrupt existing NPD processes, new approaches toward service and software development appear and affect physical products development which are ‘service design process (Johnson et al, 2000)’, ‘V-model (Forsberg and Mooz, 1991)’, ‘agile development method (Beck et al, 2001)’, ‘double design process (Design Council, 2007)’, and ‘open innovation (Chesbrough, 2004)’. 
Existing NPD models remain continuously evolving, supported by emergent trends of increasing significance of NPD activities, such as: a) NPD process runs simultaneously b) a cross-functional approach; c) external network interactions; d) iterative and incremental approach. These factors not only serve to progress NPD processes, they also to widen the designer’s horizon and working methods in the design process (Jacobs & Cooper, 2018). However, conventional models are regarded as obsolete in order to create value for the IoT products and services. This is mainly because they do not reflect the characteristics of digital technologies, the role of data, and specific ways of developing digital artefacts. Therefore, the attention of this discussion focuses on more details of development risks, and NPD process for IoT products and services.

Emergent NPD processes for IoT- a case study in agri-tech
Although UK dairy exports are growing and the long-term outlook for the industry is positive, UK Farmers have faced financial challenges caused by low milk prices. An IoT system targeting dairy industry has been developed in order to satisfy the increasing world-wide demand for good quality animal products in combination with responsible farming, such as reduction of environmental impact, diminishing resource use and increasing animals’ welfare. It combines real-time sensor data gathered from neck collars with GPS, machine learning technologies and cloud-based services to create more value in the dairy chain. The neck mounted collar monitors animal’s fertility and health through by detecting its eating behaviour, heat expression, and rumination 24/7. Once real time data is analyzed, meaningful information is transmitted wirelessly to the farmers’ devices to support decision-making and service provisioning.

The new development process for this IoT system is identified and illustrated by an interviewee who led the development as a co-founder, Director and CTO of the start-up company. The NPD process has continued over a 13 year period- and continues still- from initiating the IoT solution to a global company providing products and services to the dairy industry, comprising multiple cycles of design and development phases. Each discrete stage of activities within the NPD process were critically examined (Figure. 01).
Figure 1: The emergence of value over a thirteen-year period.

1st Cycles of Discover and Define
The ‘Discover and Define’ phases encompass market foresighting and segmentation, validating product feasibility, capturing product features and evaluating performance. This phase was 12 months in duration. The market needs were identified and validated within the market foresighting stage through a series of consultations with the sector supply chain, such as farmers, herdsmen, main retailers, logistics, milk recorders, artificial inseminators, nutritionists, animal scientists, and technology providers. All the agriculture segments from crops to chickens were assessed and the appropriate market segment was identified as dairy herd management. Identifying the most appropriate market segment is crucial as it drives nearly all of the business decisions. Once the market was identified, the project team validated the viability of the product through specifying the features embedded within the final product/service of the solution.

1st Cycle of Develop
The product features and performance requirements were then specified in detail at the solution design stage considering the competitive landscape. Designing and prototyping a solution was achieved through a series of lengthy iterations with primary stakeholders involved from the outset in the product definition. In the development of the solution and managing the input from industry stakeholders, critical decisions were reached such as; what is the minimum viable feature set of the product?; what is the form factor?; what is the products’ lifetime requirements?; the definition of the deployment process?; and what is the overhead in terms of the maintenance cost?. Subsequently the initial product hardware prototype was developed and evaluated in partnership with dairy farmers.
who not only to test functionality and operational characteristics of the hardware but also to collect data in order to create and validate a software algorithm that identified accurately the onset of heat (to optimise pregnancies) automatically.

In order to increase the accuracy of the algorithm, the project team incorporated the understanding the farmers’ knowledge of the characteristic behaviour animals at or near the onset of ovulation and interpreting data into an actionable event through an alert. It is fundamental to ‘listen to your customers’ during the entire IoT NPD process but specifically at the stage of understanding current on-farm practices, in turn informing on what and how data should be presented, core to all IoT system.

The team enjoyed a good relationship with a small number of research and commercial farms from the outset of the project, as such; access to the farms was not a significant issue. However, the stages of developing the initial algorithm, testing and validating the accuracy of algorithms, and refining algorithms were time intensive and resource consuming. Primarily this is due to the ovulation cycle of the animal (which is one year); thus, the robust validation of the impact of the solution relies on the collection and analysis of 12 months of data. For the initial product, the period was 36 months as the stages of development, test, and refining algorithms was iterated through a series of many iterations.

Moreover, even though the team had the access to on-farm environments and were allowed to deploy the neck-mounted collar on appropriate commercial animals, the annotating of videos for a significant number of animals to gather truthing data against which the algorithms would be compared was both time-consuming and costly. During the stage of algorithm development, there were three internal researchers, but three or four operatives at each of five farms simultaneously became involved to annotate the video over a series of iterations.

Securing funding was also a significant issue in order to ensure that the team generate sufficient on farm data to validate the algorithms. On top of the funding from InnovateUK, they succeeded in securing close to £1m from Scottish Enterprise. The phase of developing, testing, validating and refining algorithm was a long and challenging journey. Apart from time and financial issues, the team encountered a series of development risks such as: the performance of the IoT system; the risk of misunderstanding the appropriate market segment; the risk of not having algorithms(s) which are fit for purpose; and the risk of limited market traction. Thus, the development risks in an IoT NPD process could be more difficult and complex when compared to a traditional NPD process.

1st Cycle of Deliver and Discover

In order to commercialise the IoT product, the Return of Investment (RoI) of the system had to be accurately validated. As discussed earlier, the natural cycles is one pregnancy per year which means that RoI takes the similar amount of time to capture. The pace of development was another associated risk since validating RoI and algorithm were challenging; whereas the actual feature set and algorithm development definition was quicker. At the stage of market launch, a commercial company who had a partnership with the team progressed the sales and marketing strategy. The start-up company focussed primarily on the IoT system development from analysing the market through to delivering the collars to the farm, the market attraction was a major challenge. The dairy farming sector have followed many years of standard practices which are difficult to change quickly.

2nd Cycle of NPD process

While commercialising the IoT product, the project team received market feedback and collected data which enabled them to identify farmers’ latent needs in monitoring animal’s health. The team identified that monitoring health is achievable indirectly from the muscle movement of the animal to
derive accurate measurements of the time spent rumination and eating with the same hardware. After understanding how the veterinary doctors and farmers judge when the animal is unwell, they accessed the farm environment to record the muscle movement and made efforts to develop and refine the algorithm for a further 12 months. The value of the IoT system is to provide automatic indication of the animals eating behaviour, heat expression, and rumination to the farmers, which would then support their decision making on the optimum intervention. Finally, the company developed the IoT system which has subsequently been acquired by an established business in 2016.

Discussion

Reframing NPD process for IoT through reflecting challenges and opportunities
From the case study, it was identified that approaches towards IoT NPD process seems to be similar to a generic NPD process. In addition, the fundamentals of IoT business success are not much different to its counterpart of traditional business success such as: listening to the customers to understand and articulate their requirements; capturing the understanding of users’ behaviour and fusing it into the right solution within the right business purpose; having a good relationship with lead partners and stakeholders. However, several factors, the characteristics of digital technologies (Yoo et al., 2012), the dimensions of big data (McAfee & Brynjolfsson, 2012), the properties of digital artefacts (Yoo, 2010), and the dimensions of digital innovation (Yoo et al., 2012) allow a distinctive approach to existing NPD activities and development risks.

The difference in approach towards NPD for IoT products and services proves to that it is not linear but continuous and emergent process (Jacobs & Cooper, 2018) which indicates that value propositions are able to keep evolving for enhanced customer experiences. Over the first and second cycles of the NPD process, the value of the IoT system was evolved from only proposing fertility monitoring to proposing animals’ health monitoring. Flexibly adding new sets of value to the same IoT system is desirable but it also means that design of IoT products and services are unable to be fixed which increases the time and/or cost for project completion (Gil and Tether, 2011). The rapid pace of digital technology development (Yoo et al, 2010) also results in keeping design fluid.

Further, real-time data on customers’ experience enables the spatial and temporal division between discovering, defining, developing, delivering, and consuming offerings to coincide. Over the 1st cycle of the delivering stage, while farmers were using the fertility monitoring service, health monitoring service, the new offering, was being discovered and developed simultaneously. Unlike developing hardware or software products, developing digitized artifacts increases risks and complexity of development activities due to their multifaceted architectural and abstraction layers. Hence, the multitude of stakeholders and the two different production (hardware and software) process should be carefully curated in terms of creating value for IoT.

Development risks over the IoT NPD process is more vulnerable compared to its counterpart in the conventional NPD process. Because it takes longer, to test feasibility of IoT system as sufficient data is collected and the accuracy of algorithm is therefore validated. While the importance of iteration of processes has long been regarded as significant factors in NPD process, the iteration within each phase of the process becomes even more of a design imperative. Thus, the business should cultivate the ability to manage the fluidity and the uncertainty of their own NPD process.
Design contribution to create value in the context of IoT

Creating value for a new and yet to be explored technology, such as IoT, is a compelling challenge for businesses and designers who contribute to adding value to digitized artefacts. Due to their continuous connection to the internet, products are better considered to be services. Thus, the organisations and designers trying to create value with their own connected product should gradually transform the way of designing and business tactics from a goods-dominant logic to service-dominant logic.

Over decades of a goods-dominant logic, designers have become skilled at mediating value (Speed & Maxwell, 2015). By this, they have frequently played a significant role in providing ways to further understand the customer’s needs and solve problems from a user-centred perspective. However, through the traditional NPD processes, more often than not, designers were excluded from the majority of discussions around the creation of a product’s core value, and instead, were hired to add value through the use of type, colour and form at an elementary level. Moreover, developing innovative products in the past, challenged designers as they were only able to access to limited information on existing needs in a reactive manner at a single point beyond its selling point (Speed & Maxwell, 2015). After launching a product, designers played a significant role in adding value to a product through marketing campaigns, making sure that a product’s ‘worth’ was commensurate with its perceived value but not exceeding the costs of production. There was a peak moment of value which is the point of sale (see Figure 2A. below) when consumers perceived value for a product or service was ‘worth’ the offer made by the company. The limitation of the designers’ contribution to the object of design (a thing) and marketing campaign is illustrated with the yellow area on Figure 2A.

![Figure 2: The emergence of Value in the Time Frame.](image)

However, in the context of IoT, there is no critical peak moment of adding value due to the underlying connection to the internet. The value of connected objects, therefore, does not decrease while being used, instead it increases depending on what value is provided through the networked objects. Moreover, the emergence of value has a rising curve as new services are added (Figure 2B. above) based on a growing constellation of internet products. This is due to real-time data frequently being analysed to construct personal value propositions. Through the analysis of large, linked data sets, organisations are thus able to keep creating and refining value propositions across a broad spectrum of stakeholders. Real-time data which is not a natural medium for designers to work with challenges
designers, however, it enables more effective and faster feedback about the assumptions of where value lies, whilst further analytics are able to track the production of unforeseen value. The acceleration of these cycles ultimately leads to the co-production of value through the push and pull between producers and consumers. This is one of the reasons why design is now at the core of many successful products and services in the digital economy. As such, designers should get involved in value creation more actively over IoT NPD processes which is illustrated with the yellow area in Figure 2B. Certainly, an important way to begin to create value with an IoT business model is to start with identifying latent human needs that are concealed beneath huge amounts of customer-generated data.

Conclusions
The authors examined established literatures and a featured a case study to provides attention to the core research questions at large: 1) How are the conventional NPD processes and value creation different to its counterpart in IoT context? 2a) How are IoT products and services actually being developed and 2b) what are the risks inherent over the duration of the NPD process? 3) How should design be reframed as a critical enabler to mediate value over IoT NPD process? Although this study has explored issues and value creation related to design and development processes for IoT, there are a number of limitations. As a single case study is only explored within this study, risks and activities of each stage are not profoundly uncovered and limited in findings and generalizing. Notwithstanding these limitations, however, the authors argue that the research study also has some important contributions for wider adoption. For practitioners, this research will enable industry practitioners to understand how design contributes to value creation through a defined NPD process. For academics, this research project contributes to augmenting the body of literature regarding emergent innovation processes for IoT and serves a starting point of future in-depth research on IoT NPD processes.

References


Yoo, Y. (2013) The tables have turned: how can the information systems field contribute to technology and innovation management research? J. Assoc. Inf. Syst. 14, pp. 227–236.

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The Relationship between Design Orientation and Brand Orientation -Toward Theoretical Integration-

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Abstract: When companies pursue marketing excellence, it is essential to have a customer-oriented organizational culture and a system that supports the creation of market knowledge (Peters and Waterman 1982). The principle that implementing marketing activities based on the customer and the market is called "marketing concept". This concept is counter of over concentration on technologies or selling, and now this has become the basic idea of today’s marketing. The literature on marketing excellence has mainly focused on the appropriate implementation of marketing concept in organizational context and its relation to business performance. In this field, “market orientation” is the most prominent approach (Moorman and Day 2016). Market orientation is the organizational culture that most effectively and efficiently creates the necessary behaviors for the creation of superior value for buyers and thus continuous superior performance for the business (Narver and Slater 1990). Development of market orientation research and its measurement scales have enabled the quantitative evaluation of the effects and determinants of market concept. On the other hand, the limit and theoretical fault of the market orientation have been criticized. One of the famous critiques are made by Christensen and Bower (1996). They pointed out that if firms listen too carefully to their customer, they lose their industry leadership. To filling these theoretical gaps, two approaches have emerged; Design orientation and brand orientation. Design orientation represents an organizational vision and includes the set of conscious, reflective, and creative ways of concluding, planning, and making of products and services that generate values for the customers and which enable them to engage in their individual or social boundaries endeavors be utilitarian, functional, material, communicative, symbolic, or experiential (Venkatesh et al., 2012; p. 291). Brand orientation is an approach in which processes of the organization revolve around the creation, development, and protection of brand identity in an ongoing interaction with target customers with an aim of achieving lasting competition advantage in the form of brands (Urde 1999; pp.177-178). Intriguingly, these two approaches have many similarities of research question and theoretical development despite their different backgrounds. However, no research has been found focusing on the relationship between the two concepts. Therefore, in this literature review, we demonstrate each uniqueness and complementarity, propose the possibility of theoretical integration and overview the future studies.

Keywords: Market orientation, Brand orientation, Design orientation, Value creation, Design driven innovation
Value Circulation and Entrepreneurship
-Proposing The Concepts for The Design of Service Ecosystem-

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Abstract: This article aims to present a conceptual framework for service design, and in particular service ecosystem design. The importance of building a service ecosystem has already been recognized. However, the following arguments have not been fully exhausted; If any state, whether it can be said that the service ecosystem is well performed? What is the conceptual framework to capture it? And, what kind of attitude do you need to build a service ecosystem?
As a concept to consider these questions, we focus on the concepts of value circulation and entrepreneurship. The concept of value circulation was advocated in the 1920s by the German business scholar Heinrich Nicklisch. His argument has been criticized as esoteric since that time, and in addition the normative character of the doctrine has been the subject of criticism. However, if you calmly reconsider his theory, the concept framework of value circulation is pioneering in terms of service design. Therefore, we try to use Nicklisch’s value circulation framework to grasp the service ecosystem. Furthermore, it is entrepreneurship that embodies the holistic aspect of the service ecosystem. The idea is focused on presenting an aesthetic perspective and sharing it with participating actors and stakeholders.
With this conceptual consideration, we attempt to provide a thought framework for designing service ecosystems.

Keywords: Value Circulation, Service Design, Service Ecosystem, Entrepreneurship, Aesthetic Perspective.

Introduction
This paper aimed to clarify that the framework of service design is effective in considering and driving value creation by companies, especially in designing the service ecosystem. In this regard, we discuss two concepts “value circulation” and “entrepreneurship” as clues. By using these concepts, service design can be considered from a managerial point of view.
So, this article consists of the following five contents: (1) Service Design as a new framework for value creation, (2) Value (co-) creation in the Service Ecosystem, (3) a dynamic building of Service Ecosystem with “Value Circulation (Wertumlauf)”, (4) the “Holistic” as a dynamic equilibrium in service ecosystem, and (5) aesthetic perspective of a function of entrepreneurship. Through discussions on these contents, I would like to provide management-oriented suggestions for the design of the service ecosystem. This article focuses on the design of service ecosystem in business practice. Though, the conceptual framework presented in this paper can be applied to the public domain and sectors where business and non-profit are mixed.
Service Design as a new Framework for Value Creation

Service design is gradually becoming known in business and public practice. First of all, we have to think about what service design is. The definition of service design is diverse. Among them, for example Mager (2017) defines that “Service Design choreographs processes, technologies and interactions within complex systems in order to co-create value for relevant stakeholders.” Also Stickdorn, Lawrence, Hormess, and Schneider (2017) propose the 6 principles of service design; (1) Human-centered, (2) Collaborative, (3) Iterative, (4) Sequential, (5) Real, (6) Holistic. So, they define that “Service design is a practical approach to the creation and improvement of the offerings made by organizations. It has much in common with several other approaches like design thinking, experience design, and user experience design, has its origins in the design studio, and harmonizes well with service-dominant logic. It is a human-centered, collaborative, interdisciplinary, iterative approach which user research, prototyping, and a set of easily understood activities and visualization tools to create and orchestrate experience that meet the needs of the business, the user, and other stakeholders.” (p. 27)

These concepts focus on the value creation through the relationship with stakeholders. Here, we understand the word “value creation” as following; a subject obtains compensation by creating and providing offerings that satisfy the desires of the other subject, and the subject itself eventually fulfills its own desires. This definition may seem to emphasize the subject’s selfishness. However, from the point of view of mutualism, sustainable value creation is difficult if both the other party and oneself are not fully satisfied. The core of the service design is an attempt to satisfy the diverse desires of diverse stakeholders in simultaneously. What comes to the front here is the service ecosystem and value co-creation.

Value (Co-) Creation in the Service Ecosystem thinking

One of the central issues in service design is the construction of a service ecosystem. As is well known, the service design framework is based on Service dominant logic (S-D Logic). S-D logic was advocated in 2004 as an alternative to the traditional goods dominant logic by Lusch & Vargo. The main features of S-D logic can be summarized in the following two points. The S-D logic does not classify subjects based on fixed roles such as conventional producers and consumers, but adopts the viewpoint of an actor as a resource integrator. And rather than exchanging products and fees, S-D Logic sees businesses as exchanging services and services.

According to Vargo & Lush (2016), S-D logic consists of the following five axioms.

Axiom 1 : Service is the fundamental basis of exchange.
Axiom 2 : Value is cocreated by multiple actors, always including the beneficiary.
Axiom 3 : All social and economic actors are resource integrators.
Axiom 4 : Value is always uniquely and phenomenologically determined by the beneficiary.
Axiom 5 : Value cocreation is coordinated through actor-generated institutions and institutional arrangements.

Axiom 1 states that the object of exchange as a transaction between actors is services (in Germany, it is said “Leistung”). Even when tangible goods are exchanged, what is proposed there is the service provided by the tangible goods. This is on the same vector as Levitt’s marketing myopia. Related to this axiom 1, it is axiom 2 that has an important meaning in S-D logic. Here as we mentioned earlier, it is pointed out that actors participating in exchange integrate Operand resources with Operant resources and create value beyond the concepts of production.
and consumption. At that time, an actor generally called a customer is called a beneficiary. In this axiom, the proponents of some services (including the provision of material Operand resources) do not create value alone, but beneficiaries use the Operant resources and Operand resources that they themselves possess. Therefore, light on the phenomenon of bringing out the value, not the value creation but the concept of value co-creation is used. Axiom 3 and Axiom 4 support this axiom 2. Furthermore, Axiom 5 points out that co-creation of value is coordinated by some kind of system or institutional adjustment. This includes contracts and organizational adjustments.

Based on this axiom system, if you capture the phenomenon of creating value, the concept of “eco-system” emerges inevitably. In S-D logic, the concept of service ecosystem is used. Services are propositions for beneficiaries to create value by integrating resources. In other words, providers and beneficiaries co-create value through the service as a value proposition. This network is a service ecosystem. In the service ecosystem, various phases are linked temporally and spatially, such as value proposal and payment for it, and resource integration inside actors. As a result, circulative phenomenon occurs.

For service design, establishing a good circulation is one of the important issues. Nevertheless, the conceptual framework for grasping this circulative phenomenon has not been fully developed. Specifically, there are following; (1) the description of internal processes in each actor such as acquisition and integration of resources, service creation, acquisition of money as exchange media etc., (2) the depiction of the temporal and spatial development of exchange relationships that occur in the ecosystem, (3) the creation and sharing of the underlying "meaning". It is impossible to consider all this in this article. So, in the following, we will conceptually discuss the possibility of grasping the service ecosystem with the concept of value circulation, the creation of the meaning, and the entrepreneurship as a role of presenting an aesthetic perspective that appears as creating the system of meanings.

**Service Ecosystem with “Value Circulation (Wertumlauf)”**

In the service ecosystem, services that participating actors want are provided. Let's call this a value exchange relationship. Participating actors create and provide services that the other party wants them to exchange. Products as goods are also positioned as Tangible, thereby providing some service. When this Tangibles and Intangibles are handed over to the actor as a resource integrator, where value = satisfaction occurs, the service ecosystem becomes a circulation.

We explain this with the concept of value circulation (Wertumlauf). The concept of value circulation was presented by German business scholar Heinrich Nicklisch in the 1920s. Originally, it started from the research task of grasping various activities of companies numerically such as production activity and sales activity. In considering this issue, Nicklisch noticed that relationships with various actors / stakeholders would be important. In this regard, Nicklisch noted that value exchange would not be achieved if it did not take into consideration not only the company's profit-earning but also the actor / stakeholder's desire as an exchange partner. Nicklisch calls it “Wirtschaftlichkeit”. It can be viewed as a dynamic balance of value exchange. The dynamic balance of value exchange is realized by the desires possessed by both or many actors being satisfied by the provided service. This balance is often realized at different times. In order to realize value co-creation at different points in time and space, it is necessary to have trust and mutual understanding among actors. In order to explain this point, Nicklisch launched
the concept of “Betriebsgemeinschaft”. Since this is based on German idealism, it is difficult to apply as it is today. However, the intention is valid even today. Therefore, Nicklisch’s value circulation framework is positioned as a starting point for stakeholder-oriented firm theory (Yamagata 2015). It may have influenced Drucker’s early business theory. The concept of value circulation is based on accounting. Accounting records internal activities and transactions with external actors. And, in the numerical value described there, it is shown through the media of money how one subject evaluated to some kind of object. Of course, there are also valuations that can’t be shown by money. This includes intellectual assets such as brands, related assets, and the trust. In this article, the accounting aspect is not important. Rather, the perspective of inflow (reception) or outflow (provision) of activities or services is important. What is flowing in the service ecosystem is services as activities that may generate some value to the other party. The design of the service ecosystem is to build the whole of this inflow and outflow in a balanced manner.

Stickdorn, Lawrence, Hormess, and Schneider (2017) named it Holistic is the total balance of the service ecosystem. Here are some points to keep in mind. That is, the ideal Holistic situation is variable. Moreover, it is difficult to recognize which form is most desirable for humans as imperfect and incomplete beings. Nevertheless, with the concept framework of value circulation, it is possible to draw out what the actors and stakeholders who participate need and what they offer, and how they relate to each other.

The idea that has been described so far as a case that has developed in business, we will consider MH's practice in the next section. MH does not design business based on the conceptual framework of service design. Nevertheless, they are working to design a service ecosystem with circulating value, satisfying the desires (real / ideal / emotional) of the actors / stakeholders.

The “Holistic” as a dynamic equilibrium in service ecosystem: with Case of MOTHERHOUSE Co. Ltd.

In order for the service ecosystem to be sustainable, the desires and jobs (Jobs to be done; Christensen et al 2016) possessed by the actors / stakeholders must be satisfied, and value must be created in each actor / stakeholder. Moreover, the desires and jobs held by stakeholders can change depending on the situation. Taking this into consideration, it becomes important how to derive a dynamic balance in the service ecosystem. Nicklisch (1922) said it was “wirtschaftlich” when such a situation was realized. In other words, it means that value is being created for each actor and stakeholder, including the earning of revenue.

This is not a situation where only a single actor or stakeholder is filled. This point is also taken into consideration in the service design definitions listed at the beginning of this article. Above all, the principle of “Holistic” is oriented at the situation where the circulation of value is smoothly carried out as a whole service ecosystem as well as fulfilling the desires of individual actors and stakeholders.

I understand that the holistic principle in service design is the total depiction of the value circulation around this service ecosystem. It is probably not easy to holistically portray the ideal of the service ecosystem. But at the same time, it is an attractive project.

In order to think about this issue, we will take up a company as a case study. MOTHERHOUSE Co. Ltd (In the following, MOTHERHOUSE is abbreviated as MH.) that we take up as a case. Why do we take MH as a case? There are two reasons; (1) the business model of MH focuses on
building a community or ecosystem by fulfilling the desires of various stakeholders through their business, (2) The business model is driven by the integration of aesthetic entrepreneurship and value circulation design.

An overview about the business model of MOTHERHOUSE: Community / ecosystem-oriented business design

The corporate philosophy of MH is “We spotlight the potential of developing countries through our products to establish an international brand.” MH is a company that producing bags and apparel products to developed countries by utilizing the resources of developing countries and the skills of artisans living in the area. The proposed bags and apparel products have high quality, so are evaluated by the customers in developed countries. And the obtained added value is provided to employees working in developing countries with a high level of treatment.

In addition, they regularly establish opportunities for direct communication between employees and craftsmen working in developing countries and customers, promoting mutual communication. As for product development, MH is also characteristic. MH’s products are designed by founder and Representative & chief designer Ms. Eriko Yamaguchi, but other than that, they are planning products through dialogue with customers. For example, there are products created through dialogue with general customers, and products jointly developed with blind football players and their associates. Here, along with product development based on Ms. Yamaguchi's aesthetic perspective, there is a stance to co-create the value generated in the customer usage phase.

MH is an apparel maker. However, they are successful in building a good ecosystem by linking and providing their products and related services beyond the framework of manufacturing industry. The service ecosystem of the MH is characterized by the fact that each actor / stakeholder who participates in it creates value together. Such a service ecosystem is designed by Co-Representative Vice President Daisuke Yamazaki and other members. In addition, members of each store also interpret MH’s corporate philosophy and practice it in the store as a contact point with customers.

MH does not deploy business practices using a service design concept framework such as service ecosystems and value co-creation. Nevertheless, the practice of MH overlaps with the service design framework. In particular, it is most important to realize dynamic balance by designing a cycle that enables actors / stakeholders participating in the MH ecosystem to satisfy their desires and jobs and recognize their values. This can be regarded as incorporating service design into business practice.

The integration of aesthetic entrepreneurship and value circulation design.

So far, we have considered service ecosystem thinking as a new conceptual framework for value creation, and proposed that it be grasped more dynamically and realistically by the conceptual framework of value circulation.

From this case, it can be understood that the entrepreneurial attitude and role are important in the construction of a service ecosystem in which good value circulation is realized. In the case of MH, chief designer Ms. Yamaguchi presents an aesthetic perspective, and Vice-president Mr. Yamazaki translates it into a design of value circulation based on community-oriented idea. According to Yamaguchi (2019), management is the act of beautifully harmonizing all the elements that make up a company or brand as an integrated organism (p. 117). At that time,
MH places importance on the sense that each member feels. These senses include a sense of incongruity and aesthetic sense in everyday life. The attitude of MH and Ms. Yamaguchi is to continue to explore ways to creatively overcome contradictory issues by incorporating the senses of all members. Their various sense is embodied into community-oriented value circulation by the management staff, including Mr. Yamazaki. For an overview of the value circulation, we have already mentioned above. Since the overview of the value circulation has already been described above, it is omitted here.

Although there is only one case to be taken up in this paper, it is understood here that the role of Entrepreneur is to present and share an aesthetic perspective and translate it into a value circulation in the construction of a service ecosystem.

**Entrepreneurship in Service Design**

So what is the Entrepreneurship? This has always attracted attention in economics and business administration. Especially famous is Schumpeter, and recently, Sarasvathy’s concept “Effectuation” has also attracted attention. But here we focus on Shackle and Lachmann, which belong to the Austrian School of Economics (Shackle 1949, Shackle 1970, Lachmann 1956, Lachmann 1977, Hébert & Link 1982). These two scholars emphasize the imagination in the role of entrepreneurs. In other words, this is Expectation. Expectation is a depiction of what the future wants to be, based on the subjective image of the environment perceived by the entrepreneur. As a result, resources (in the Austrian school, the term capital is used) owned by an entrepreneur or firm are arranged temporally and spatially.

Now, resources that you do not own need to be obtained from other actors/stakeholders or complemented by working with them. Shackle and Lachmann focus on the elements of imagination and expectations. As such, Shackle and Lachmann have not discussed in detail which actors/stakeholders get resources entrepreneurs don’t own, and even how they collaborate with other actors/stakeholders. On this point, Albert O. Hirschman (1958) discussed from the perspective of entrepreneurship. Hirschman points out the crucial importance of cooperative elements in entrepreneurship that based on the work of Chester I. Barnard (1938) and Robert Gordon (1945). In fact, it is impossible to realize value creation with only a single company or individual in modern society. Based on this point of view, S-D logic is the basis for thinking about future value creation such as service design. The inquiry for entrepreneurship by Hirschman is the key to linking service design with entrepreneur theory.

Furthermore, the aesthetic approach to business phenomena developed by Strati and Verganti etc. is also noteworthy. Because business practice is also based and directed not only by problem solving but also by sensibility as well as other life practices. In particular, actors with entrepreneurial attitudes try to create ideal life situations not only in terms of problem solving but also in terms of good and beauty, and to realize them. In other words, aesthetic entrepreneurs envision not only rational problem solving but also space-time shared emotionally.

This entrepreneurial aesthetic approach reinforces the ideas of imagination and expectations as an entrepreneurial aspect advocated by Shackle and Lachmann. Shackle and Lachmann do not mention aesthetic aspects. However, concepts such as imagination and expectations are deeply connected with human’s emotional aspect. On the other hand, the aesthetic perspective of entrepreneurship acts as a common sense for the design of the service ecosystem, and more
specifically the design of the value cycle between actors and stakeholders who participate in the ecosystem. This is the basis for shaping service exchanges in real. In this regard, there is no need to think that entrepreneurship is carried out by a single person. As in the case of MH, it is quite possible that a person who presents an aesthetic perspective and a person who translates it into a value circulation or service ecosystem design can exhibit entrepreneurship jointly. Entrepreneurship is extremely important in carrying out service design. When considering entrepreneurship in the context of service design, we need not only Schumpeter’s concept of entrepreneurship (= person who makes innovation) but also a concept of entrepreneurship who project (=entwerfen) the imagination / expectation including aesthetic perspective and translate into the design of value circulation / service ecosystem. This is the point that we advocate through this article.

Conclusion
In this article, with the aim of being able to co-create service design and business science more richly, we tried to construct a conceptual framework for that purpose. Service design is a new framework for thinking and practice towards collaborative value creation. If we emphasize the aspect of collaboration, we need to create value for each of the participating stakeholders and actors. As a clue to this point, we introduced Nicklisch’s concept of value circulation. This concept takes into account not only the exchanges between stakeholders and actors, but also the flows of value within the stakeholders and actors (internal value circulation). Internal flows of value are just the lives of stakeholders and actors. We think that drawing service design is a more meaningful life. And it is entrepreneurs who play a role in envisioning this ecosystem and value circulation. There is no problem even if there are multiple actors with entrepreneurship. In business administration and management practice in the German-speaking area, there is the expression “Mitunternehmer”. This is not an entrepreneur as a funded manager but a person who co-works with entrepreneurship. In service design, how to cultivate entrepreneurship will be important in the future (especially in Japan).

References
https://www.service-design-network.org/community-knowledge/meet-birgit-mager-
president-of-the-service-design-network
MOTHERHOUSE official website http://www.mother-house.group/
Nicklisch, H. 1915. Rede über Egoismus und Pflichtgefühl, Zeitschrift für Handelswissenschaft
und Handelspraxis, 8, S. 101 ff.
Nicklisch, H. 1922. Wirtschaftlichen Betriebslehre, 6. Aufl. der allgemeine kaufmänischen
Betriebslehre, Stuttgart.
Nicklisch, H. 1929-1932. Die Betriebswirtschaft, 7. Aufl. der Wirtschaftlichen Betriebslehre,
Stuttgart.
Stickdorn, M. & Schneider, J. (ed.) 2011. THIS IS SERVICE DESIGN THINKING : Basics-Tools-Cases,
BIS Publishers.
Stickdorn, M., Lawrence, A., Hormess, M., & Schneider, J. 2017. This is Service Design Doing:
Vargo, S. L. & Lusch, R. F. 2016. Institution and axioms: an extension and update of service-
Verganti, R. 2016. Over Crowded : Designing Meaningful Products in a World Awash with Ideas,
MIT Press.
Yamagata, M. 2015. Heinrich Nicklisch’S Model of ”Value Dynamics (Wertumlauf)” as Stake-
Rethinking The “Innovation of Meaning” from A “Benefit of Inconvenience” Perspective

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Abstract: This paper introduces the concept of “Benefit of Inconvenience (BoI)” that may provide a new scope to investigate the “Innovation of Meaning (IoM)” and contribute new insights to the meaning of designing. On the one hand, we can assume that IoM occurs once changes in meanings are recognised. However, there is little knowledge regarding criteria for judgement on when meanings have changed or not, and whether a change is radical or incremental. On the other hand, the research field of BoI involves established barometers to evaluate the convenience of a product and its benefit in objective and subjective perspectives. BoI, which is sought to be yielded through revision of the value of extant things, aims to explore the advanced user value that can only be achieved due to an inconvenient perspective of things. Being inconvenient is a relative state that is defined by the amount of labour, consisting of “physical and intellectual human efforts” and “time”, that is necessary to achieve a certain objective; the more labour is required to achieve an objective, the more inconvenient it is. Being convenient and being beneficial should nonetheless be recognised as separate matters when considering the meaning of things. Subsequently, the amount of objective and subjective labour, and objective and subjective values (i.e. utilitarian and hedonic values) respectively determine whether and to what extent a product and/or service is convenient and beneficial. BoI is a process-driven value by nature, which is found in the processes of production and consumption themselves, as well as in the outcomes that are brought about by finished items and/or services. BoI can therefore be utilised to propose a new sense of direction for current design principals that merely strive to create more convenient products and services. BoI design aims to discover methods of designing “comfortable uncomfortableness”. Considering that IoM seeks to leverage the multi-layered “inside-out” process(es) involved in the creation of meaning, the insights of BoI, in combination with the frameworks of objective and subjective labour and utilitarian and hedonic values, may spur on further the future development of design research and practice.

Keywords: Benefit of inconvenience, Innovation of meaning, Design principles

Introduction

It has been a while since the concept of Innovation of Meaning (IoM), also known as design-driven innovation, was introduced to the field of design management research. IoM aims to create an absolute emotional attachment between products and consumers through a radical reformation of the meaning of current products (Verganti, 2009). Factors that go beyond functional consumer needs are especially important for product development as technology becomes more and more ubiquitous (Nurkka, Kujala & Kemppainen; 2009). According to Verganti’s point of view, it can be assumed that
IoM occurs once changes in meanings are recognised. However, some cases may in fact make us wonder: “Is this actually IoM?”. For example, let us think about a hot spring; would you fancy visiting a hot spring located in a secluded place without any connection to modern traffic networks? Put simply, this is just an inconvenient hot spring. However, what if we advertise it as a hidden hot spring surrounded by healing nature in an unexplored region? At this point, the meaning of the inconvenient hot spring has changed, turning it into a precious place that refreshes you from the trials and tribulations of modern life. But, as we mentioned above, is this actually IoM?

**An issue of the Innovation of Meaning**

IoM begins with enquiring the inner self; product and service are made sense with one’s professional career and in the context of socio-cultural system which construct a multitude of “personal lenses” (see Darke, 1979; Dorst, 2011; Rowe, 1987; Verganti, 2017) providing a source of new future visions. By contrast, traditional market research aims for a deep and accurate understanding of what the market requires. To improve product design and development, it is indeed important to consider the socio-cultural context of a market (Bloch, 1995; Demirbilek & Sener, 2003; De Mooij & Hofstede, 2010; Forlizzi, 2008). In other words, designers are expected to design for different needs that are yielded from different values (Jagtap, Larsson, Hiort, Olander, Warell & Khadiilkar, 2014; Manzini, & Cullars, 1992; Maslow, 1943; Nisbett, Peng, Choi & Norenzayan, 2001; Rosenman & Gero, 1998). Due to this nature of design practice, Shigemoto (2019) emphasises the importance of a holistic interdisciplinary approach in order to design methods of product development which may generate products that people cannot help but love. What, however, happens if the personal lenses of an innovator do not correspond with the current socio-cultural zeitgeist? The answer may simply be the failure of the respective product. Interestingly, although people might not be able to state in precise terms what exactly they want, they do sense rather clearly what they are not attracted by. Such awkward feelings tend to result in a state of confusion that could be put into words as follows: “Yes, I can see a change of meaning in this product, but is this innovation?”.

*Rethinking the “Innovation of Meaning” through a “Benefit of Inconvenience” perspective*

Given the problematic situation that research regarding IoM has not yet seen objective criteria for judgement on when meanings have changed or not, and whether a change is radial or incremental, we propose that IoM research may be further developed by learning from *Benefit of Inconvenience (BoI)* research. The concept of BoI has been developed in the realm of informatics and user interface design which shares similar perspectives with IoM. BoI research attempts to revise the value of products and reverse their inconvenience into a source of beneficial outcome in the context of human value. It involves fairly concrete barometers to evaluate the conditions that turn harmful inconvenience into beneficial inconvenience. Despite the shared interest between IoM and BoI, these topics have been discussed together only rarely. This paper therefore seeks to achieve a better understanding of IoM through the viewpoint of BoI by conducting a comparative review of cases of IoM and BoI. Theoretical models regarding the change of meaning and human value, based on which consumers make judgements on products and services, will be presented.
The Benefit of Inconvenience: an introduction

Contemporary society is oriented to seek for more convenient systems. Thus, the majority of producers and consumers holds the belief that the more convenient a thing is, the higher it is valued. It is a fact that we have striven to develop more and more convenient products and services, which indeed improve the quality of our lives – on the one hand. On the other hand, convenient systems can be regarded as causing harm to human beings (Norman, 2005). “Convenient” products and services have been developed to minimise the amount of human effort and/or time that has to be spent in order to achieve a certain purpose (Hasebe, Kawakami, Hiraoka & Nozaki, 2015). Utilisation of such items and services therefore exhibits the potential to decrease physical functions, professional skills and the psychological motivation of a person, while the pleasure of consumption itself may also be lost. For example, the US Federal Aviation Administration reports that continual use (or overuse) of automatic flight systems lessens the pilots’ performance during quick recovery manoeuvres of aircrafts from unbalanced states (Federal Aviation Administration, 2013). Accordingly, a perspective based on the demerits of convenience may provide a space to consider a new direction for design principles. And it is the BoI that takes on such a role. BoI is sought to be yielded through revision of the meaning of extant things and services in such a way that more human efforts are involved to achieve certain objectives. In other words, BoI is the advanced user value that can only be realised due to more effortful human activities.

Being inconvenient is a relative state

Kawakami (2019) defines being convenient as requiring less labour to attain a purpose. He thus indicates that being convenient and inconvenient are relative states which are judged between a set of bipolar notions – there are no objects that can be independently convenient or inconvenient. Kawakami’s understanding of being inconvenient and/or convenient corresponds with the view of the psychologist Osgood who determines people’s affective responses to objects to be based upon a set of bipolar concepts (see Osgood, 1964; Snider & Osgood, 1969). Consequently, this paper too adopts the point of view that being inconvenient equals being not or less convenient.

Being inconvenient is defined by the amount of “effort and time”

Subsequent to the assertion that inconvenience should be regarded as a relative state, this section explores the constituent factors by which people perceive convenience. Kawakami (2019) argues that judgement of something being convenient or inconvenient is made based on the amount of labour, which consists of the “effort” and “time” that are required to be spent to achieve an objective. His view corresponds to the connotative descriptions of terms related to convenience found in Cambridge and Oxford dictionaries (see Table 1). The marketing literature has also discussed this topic for a while, and it is commonly assumed that convenience means effort saving and time compression. In other words, being convenient is considered as saving more effort and/or time (see Jiang, Yang & Jun, 2013; Reimers, 2014; Warde, 1999).
Table 1: Dictionary definitions of key terms in the Bol research

<table>
<thead>
<tr>
<th>Convenience</th>
<th>Inconvenience</th>
</tr>
</thead>
<tbody>
<tr>
<td>• the state of being convenient (C)</td>
<td>• a state or an example of problems or trouble, often causing a delay or loss of comfort (O)</td>
</tr>
<tr>
<td>• the state of being able to proceed with something without difficulty (O)</td>
<td>• the state or fact of being troublesome or difficult with regard to one’s personal requirements or comfort (O)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Convenient</th>
<th>Inconvenient</th>
</tr>
</thead>
<tbody>
<tr>
<td>• suitable for your purposes and needs and causing the least difficulty (C)</td>
<td>• causing problems or difficulties (C)</td>
</tr>
<tr>
<td>• fitting in well with a person's needs, activities, and plans; involving little trouble or effort (O)</td>
<td>• causing trouble, difficulties, or discomfort (O)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Effort</th>
<th>Labour</th>
</tr>
</thead>
<tbody>
<tr>
<td>• an attempt to do something; the energy that you need to do something (C)</td>
<td>• work that you do with your hands and body (C)</td>
</tr>
<tr>
<td>• a vigorous or determined attempt (O)</td>
<td>• work, especially physical work (O)</td>
</tr>
</tbody>
</table>

*C=Cambridge online dictionary (n.d.), O=Oxford online dictionary (n.d.).

Types of effort – physical effort and intellectual effort

Following the establishment of the two frameworks regarding the judgement of inconvenience and the components of labour, this section further explains the types of effort to be given attention to. Effort can be regarded as being comprised of “physical” and “intellectual” portions, as described below:

- Physical effort; effort which requires kinetic energy
- Intellectual effort; effort which requires cognitive energy (e.g. concentration, memorisation, conception, and so forth)

These definitions are in accordance with the concepts proposed by Jiang, Yang and Jun (2013) who describe that people’s perceptions of convenience are associated with their perceptions of the cognitive, physical, and emotional effort to achieve an object. The latter emotional dimension will be discussed in the next section, which will explain objective and subjective conceptions of inconvenience.

Additionally, there exist specific skills in the domains of the physical or intellectual efforts, or across both. In this paper, such skills are considered as physical and intellectual skills. For example, the physical performance of Olympic athletes belongs to the dimension of physical skills, whilst the construction of theories as conducted by scholars belongs to the dimension of intellectual skills. Finally, a craftsman’s techniques, which are shaped by their inimitable skills and knowledge, are viewed as a combination of both physical and intellectual skills.

In summary, Figure 1 presents the conceptual framework for passing judgement concerning inconvenience; “labour” denotes the effort and time necessary to be spent in order to achieve an objective, while “inconvenience” is defined as requiring more labour (= effort and time) to achieve the objective.
Evaluation of the Benefit of Inconvenience

Inconvenience and Benefit

If we seek for a continuous development pursuing a “convenient world” in the sense as defined above, will our lives become more beneficial? What if the future sees a golf club that guarantees anyone a successful putting? What about a lift that takes hikers from the bottom of a mountain right to its summit? While these might be extreme cases of diminishing the necessary amount of labour, it is quite imaginable that some activities, rituals, and behaviours may lose their original meaning in the context of our lives when a part of the labour usually required is omitted. This fact casts light upon the issue inherent in the current conceptions regarding the design of products and services, which are only concerned with and evaluate them on the basis their convenience – namely, the minimised amount of effort and time – to provide the same amount of functional performance.

This paper therefore proposes that being convenient and being beneficial should be recognised as separate matters. In general, “inconvenience” and “benefit” may be perceived as contradictory terms, but Kawakami (2019) regards these two notions as compatible. Consequently, the evaluation of products and services, as well as design decisions should actually be based upon the dimension that is drawn by the two sets of orthogonal bipolar axes that consist of 1) convenience and inconvenience, and 2) benefit and harm.

Objectivity and Subjectivity

Inconvenience is evaluated with regards to the necessary amount of labour in objective and subjective dimensions. Labour can both be universally (objectively) measured by anyone and individually (subjectively) perceived by someone. According to Kawakami (2019), objective and subjective labour are hence defined as follows:

- Objective labour; the amount of effort and time measured by objective criteria
- Subjective labour; the self-reported perception of the amount of effort and time

Objective and subjective perspectives are also applied to the judgement of benefits, the value of an object. Within Shigemoto’s (2017) conceptual framework concerning people’s perception of the value of a product, the objectively measurable value and the subjectively perceived value are described as “utilitarian value” and “hedonic value”, respectively. Utilitarian value denotes tangible changes in the real world that are achieved through the physical function of a product, whereas hedonic value denotes intangible changes within a consumer’s mind that are achieved through the emotional satisfaction of using or owning the item. These changes can thus be measured and
evaluated by objective criteria and self-reported impressions, respectively, the same scaling methods that are used in order to judge inconvenience.

- **Utilitarian (Objective) value;** the amount of tangible changes in the real world that are measured by objective criteria
- **Hedonic (Subjective) value;** self-reported impressions of the amount of intangible changes within one’s mind

Utilitarian and hedonic evaluations can be positive (+) and negative (−), and the amount of changes indicates a more beneficial (or more harmful) object amongst options. Positivity and negativity, in combination with their respective degree of salience, determine being beneficial or harmful; the more positive the value is, the more beneficial an object is.

**Conditions for acknowledgement of the Benefit of Inconvenience**

Having discussed objectivity and subjectivity as used in judgements of inconvenience and benefit, this section explains the conditions where BoI is acknowledged. The conditions are as follows:

1. Inconvenience is recognised both objectively and subjectively.
2. Benefit is recognised either objectively or subjectively.
3. Inconvenience and benefit belong to the same person.
4. Benefit is found by means of an inconvenient “process” to achieve an objective.

Firstly, both objective and subjective labour need to be recognised. In other words, an act conducted in order to achieve a certain purpose must require more time and/or effort than other methods that are regarded as standard approaches to attain the same objective, and one must perceive said act as inconvenient. By contrast, with regards to benefit, recognition of either positive utilitarian or hedonic (or both) values is sufficient to confirm BoI. Therefore, tangible improvement in the real world and/or intangible satisfaction in one’s mind needs to be clearly recognised.

Accordingly, inconvenience and benefit must be perceived by the same person. If one receives benefits by causing inconvenience (trouble) for someone else, it is not regarded as BoI. The person who gains benefits must also be the one who handles the inconvenience involved.

Finally, BoI refers to the benefit that is found through a process within which more labour is spent towards the achievement of a certain purpose. BoI thus differs from the benefit that is brought about by achievement or improvement of the target objective. By the same token, BoI is not reliant on users’ affective responses which occur due to the nostalgic feeling of using old-fashioned items that are, as a result, regarded as inconvenient in comparison to the updated models. It rather aims to discover a new meaning in the human effort that is involved in a consumptive process of products and services. In short, the feeling of value towards inconvenient items as a symbol of old life is not regarded as BoI. Old-fashioned items need to be viewed from a functional perspective, not from their symbolic association with one’s youth.

**BoI-driven evaluative matrix for the meaning of design**

Based upon the concept of BoI, we now have two axes for the evaluation of the meaning of design: the assessment of inconvenience and benefit. Consequently, the combination of both axes generates
four evaluative quadrants for the sense of design that involves BoI (see Figure 2 in the next page). The “benefit of convenience” and the “harm of inconvenience” are rather self-explanatory since every product is in general perceived in these two domains. An exemplary case of the “harm of convenience” is the decline of human skills due to convenient products and services that minimise (human) effort (Nolin & Olson, 2016). People who usually use the stairs may be able to maintain a better fitness (i.e., physical function) than those who tend to use lifts. This example paradoxically indicates the benefit of inconvenience that ascending stairs may increase one’s fitness. As discussed, inconvenience and benefit are evaluated according to the objective and subjective dimensions on the matrix (i.e. objective/subjective labour, utilitarian/hedonic values).

Figure 2: Evaluative matrix for a meaning of design (Convenience/Inconvenience and Benefit/Harm)

The process-driven benefit and the inside-out process of meaning creation

Figure 3 is a visual summary of the above descriptions regarding BoI. It presents a holistic view of how BoI is recognised and evaluated.

Figure 3: A complete process through which BoI is generated (recognised)

BoI is a process-driven value by nature. It seeks to unveil unexplored (or forgotten) value in the processes of production and consumption themselves, as well as in the outcomes that are brought about by finished items and/or services. Consequently, BoI can be utilised to propose a new sense of direction for current design principals that merely strive to create more convenient products and services. Being inconvenient does not equate to being uncomfortable. BoI design aims to discover methods of designing “comfortable uncomfortableness”.

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IoM, on the other hand, seeks to leverage the multi-layered “inside-out” process(es) involved in the creation of meaning, which is inspired by vision-driven interpreters and is advanced by companies that project the future socio-cultural models towards which they create new products and services. In order to challenge the current problem inherent in IoM research regarding the evaluation of the change of meanings, the insights of Bol, in combination with the frameworks of objective and subjective labour and utilitarian and hedonic values, may spur on further the future development of design research and practice.

**Prospects for future research in the field of Innovation of Meaning**

Combining the perspectives of Bol and IoM, this paper proposes that the value of products and services should be defined as a holistic entity of outcome-driven and process-driven values. Traditional innovators have sought to “increase” outcome-driven and process-driven values by means of the market-pull innovation. The radical technology-push innovation and the radical design-driven innovation have endeavoured to change the outcome-driven and process-driven values, respectively. When both outcome-driven and process-driven values are successfully changed, a so-called technology epiphany occurs, through which the dimension of competition itself is innovated.

Furthermore, the investigation into the inside-out process innovation may have a large impact on the mainstream of innovation research that seeks to explore methods of improving innovative practices by use of the traditional outside-in process to achieve innovation. Although some researchers have recently attempted to contextualise an open innovation which aims to exploit the knowledge network around a company to bring about innovations (see Lifshitz-Assaf, 2018), their perspectives are still focused on looking at the “outside-in” process in which the external stakeholders provide professional knowledge that is gathered and shaped as new products and services by a company.

Finally, Kansei Engineering relies on consumer data to advance new product development, thus employing the same approach the outside-in innovators use (see Nagamachi, 1995; 2002). However, it is surprising that the outcome (i.e. the finished product) created by the Kansei methodology tends to have as much innovative sense as the items which are developed through the inside-out approach of vision-driven companies. The Kansei approach can perhaps be regarded as a methodology that enables consumers themselves to achieve meaning creation by means of the inside-out process in a very natural and effective way. But Kansei methodology has been neither investigated nor systemised in the academic contexts of management studies, and therefore its introduction to the research community of management may also provide further opportunities to gain advanced insights on IoM.

**Conclusion**

This paper has reviewed IoM from a Bol perspective. With regard to the current issue exhibited by IoM research, which lacks evaluative criteria for the observation of the change of meaning, the scope of Bol has provided a clue to consider product meanings and a meaning of design itself. The Bol perspective objectively and subjectively assesses products and services in the 1) Convenient – Inconvenient and 2) Beneficial – Harmful dimensions. Subsequently, further research concerning the process-driven value and the inside-out process(es) of meaning creation, that respectively are the
natures of BoI and IoM, is anticipated for a mutually synergetic development between the two research fields. Furthermore, an investigation into the outcome-driven and process-driven values may further uncover the potential of future designing. This paper concludes by indicating future implications for the direction of design research that would potentially be capable of integrating the realms of design management, innovation studies and engineering.

References
Darke, J. 1979. The primary generator and the design process. Design studies, 1(1), 36-44.
Nolin, J., & Olson, N. 2016. The Internet of Things and convenience. Internet Research, 26(2), 360-376.


The Actor-Network of Distributed Intelligence Designed by Innovative Designer Rei Kawakubo of Comme des Garçons

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Abstract: In this presentation, we will examine how innovative designer Rei Kawakubo, the designer of Comme des Garçons, come up with creative new shape through the analysis of television documentary which photographing the process of making the works for the exhibition of Paris Collection, at the secret studio of Comme des Garçons in Tokyo. I examine the data from the viewpoint of Situated Learning Approach in cognitive science that has ethnomethodology as one of the theoretical backgrounds.

The two major achievements of Rei Kawakubo are called ‘Black Dress’ and ‘Lump Dress’. The Black Dress with many holes presented in 1982, which had relaxed silhouette that body lines do not appear, is for women who are independent and not standing by the male’s idea. The Black Dress releases ‘black’ out of the category of the funeral like gloomy, and repositioned ‘black’ as a distinctive primary color that everyone enjoy in daily life. The Lump Dress presented in 1996 reconstructed the understanding of the relationship of the dress and body. Instead of the belief that assumes clothing is something that follow the form in a subordinate manner. Accumulation of new proposals over three decades each year, Rei is considered as one of the most influential designers.

How Rei make herself so innovative? Rei does not draw sketches that designers usually do in order to direct the patterners to make the specific shape. Instead, Rei realize the shape through the ‘mutual investigation’ with patterners and material procurement specialist. The process of mutual investigation proceeds as follows. Rei talks to patterners what she thinks in abstract word only, and patterners must investigate the shape by themselves. What Rei talks to patterners are like follows. “Such as anger or, let's all have new things with energy, or sometimes let's create a more mysterious shape, and so on. ... I am not sure what I am thinking. It is mutual investigation between patterners and me. It will go on the verge of becoming crazy. I think this is the reason why patterners say it's painful.” The mutual investigations are held on the process of developing the new fabric, and it is held when the new fabric is shown to the patterners who have to reshape with new fabric sometimes they had never seen.

Based on the viewpoint of Situated Learning Approach, the ‘mutual investigation’ could be understood as follows. The ‘no sketch’ is what Rei does not confirm idea (on the object) in advance that usually designers (as the subject) do based on Information Processing Approach. Rei designed the actor-network of; designer, mannequins, staffs and fabrics as a distributed intelligence (out of designer’s brain) that makes staffs think by themselves. This actor-network enables staffs proceed their unique insight independently to the extent beyond Rei’s. In sum, Rei is the designer of actor-network of distributed intelligence instead of material forms.

Keywords: innovative, designer, situated learning, ethnomethodology, Actor Network Theory
Connecting Design to IT

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**Abstract:** Digital transformation has become an important management issue from the recognition that the progress of rapid digital technology is destroying the current industries. The purpose of Digital transformation is to develop new customer experience in an increasingly digital world for obtaining competitive advantage. For that reason, many companies have started organizing digital designing teams which design new customer experiences using design thinking or service design approaches. However, unlike traditional service design approach, understanding of the latest technologies such as AI, IoT, and cloud is required for this digital service design. These technologies are progressing rapidly and so without constantly catching up with the latest trends, the designed service would be easily outdated.

In addition, because new experiences provided will soon become normal experiences, the constructed IT services must be quickly updated all the time.

In other words, when designing a new service, we must be able to design not only the front side such as UX and UI, but also how to keep building, providing and updating it at the same time. Designers can not possess such specialized skills, thus collaboration with IT engineers is need.

However, there exist technical challenges in converting the designed experiences into a form of IT service, and they hinder collaboration between designers and engineers. In the field of IT, this type of system is called SoE (Systems of Engagement) and it is becoming a de fact to build systems using micro services, but the methodology, how to combine micro services to make designed service available, has not been established.

At the point of contact between ‘Design’ and ‘IT’, we perform a mapping operation to find appropriate micro service for the designed service from the micro service library, but there is a problem called service granularity problem, many companies are not able to build a library of services.

In this paper, we propose a method of designing a micro service - based system from service design that extends SOA design method developed by the authors, which contributes to solving this service granularity problem.

**Keywords:** Digital Transformation, Service Design, Microservice, SOA
Impact of Digital Fabrication and Virtual Reality on Design Process
-Application of Computational Design Tools to A Classical Design Project-

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Abstract: This research will discuss the application of computer 3D modelling (3DM), digital fabrication using computer-controlled machinery (DFUCCM) and virtual reality (VR) as process tools to realise a design project involving a temporary freestanding pavilion structure. The transition of the design profession from classical design embedded in traditional project development tools to computational design employing internet technology tools is already a subject matter of discussion (Maeda, 2018).
The paper will outline a design process model of how classical design and computational design tools can be applied in a project ambience to achieve an output with both physical and virtual dimensions. VR is an emerging visualisation technology which is increasingly used (Berg et al., 2016) and rapidly maturing (Schjerlund, Hansen, & Jensen, 2018) in the product design and architecture industry.
Employing digital fabrication and VR offered the designers an opportunity to restructure the design process and relocate the creative tools differently than in a traditional design process model i.e. ideation (incubation), project creation (insight) and final development (transformation) (Jones, 1980). Taking a virtual 3D model to digital fabrication opened process challenges such as rationalizing structure dimensions to equipment bed size, impact on detail design due to functional limitations of fabricating equipment, optimising production files to minimise raw material wastage.
VR opened challenges to project visualisation not faced in a classical design ambience. How can VR relocate 3D visualisation from the concept design (CD) to the advanced development phase (detail design (DD) and technical review (TR)) of a design project? How can VR enable testing refinement (TR) in true scale of details that are difficult to realize as scaled prototypes? What are the implications on detail design and error prevention as VR offers a close inspection ambience to the design team?
The research discussed in this paper was applied to a freestanding wall structure design project consisting of 3500 individual pieces covering a floorspace of 50 sq. mts. made from lightweight medium density fibre (mdf) wood (UMa, 2018).

Keywords: product design; virtual reality; digital fabrication; design process;
**Introduction**

This paper is framed with the *Expomadeira* project as the background, which was a purpose-built pavilion structure constructed for the University of Madeira’s (UMa). The structure was designed with a parametric building system to rapidly explore different shape configurations using the same underlying geometry.

The objectives of this project were aligned to explore design tools like application of computer 3D modeling (3DM), digital fabrication using computer-controlled machinery (DFUCCM) and advanced visualisation through virtual reality (VR) juxtaposed on the ambit of university pedagogy and praxis. The objectives considered were as following: (1) conceptually explore the deployment of (3DM), (DFUCCM), and (VR) as research and practical tools for both pedagogic training and project intervention; (2) consolidate these tools in a process model within a mixed context of academia (university pedagogy) and professional practice (companies and market); (3) make a general contribution toward eco-efficient design and reusability.

There were two strategic outcomes of the project. First to assess the effectiveness of using 3DM, VR DFUCCM as design tools. Second, to draw attention of the local / global community to the capabilities installed in the UMa Spatial Design Masters course to attract new admissions as the institutional goal.

A suitable description for a process model may be paraphrased as a sequence of activities located against a context to understand when such activities occur and why (Mendel, 2012). Models can also facilitate overcoming barriers of discipline specific communication language and best practices to catalyze knowledge synthesis and insight generation for problem solving.

The final design solution targeted to create a parametric wall construction system that was highly efficient (environmentally and economically), could be rapidly deployed, and reused.

**State of the Art**

Existing literature describes the creation of something both useful and new as a central concern for design (Reswick, 1965). More specifically product design concerns the planning of fabricated objects (Buchanan, 1992, Portman et al., 2015). Jones (1980) in his seminal work on theory and process of design (Hileman, 1998) called Design Methods, elaborated that designing itself is aimed at “creating change in man-made things” and drawing is a tool for creation and creative thinking of traditional designers.

Designers are perpetually positioned to operate in the future, as they need to “predict the behavior and response” (Jones, 1980) of their users towards their creation. This prediction is done on the basis of utilizing models (process).

John Maeda (2018) notes that Design is evolving from classical design (craft and industrial revolution manufacturing driven) to design thinking (customer needs driven) to computational design (Moore’s law and internet technology driven). Developments such as artificial intelligence, machine learning, VR, algorithmic design will be emerging trends with maximum impact on design. Maeda crafted the term computational designer as a creative professional skilled in classical design though also proficient in applying internet technologies and design thinking for problem solving. If within the arguments of Maeda, a computational designer is somehow accepted as a future 21st century next generation evolution of the traditional, then according to Maeda their most important future skill set will include communication, raising insightful questions, cross-culturalism, and human behaviour. Of note in this argument is that design is changing from physical dimensions to virtual. It won’t be laws of physics
creating constraints for design projects but rather limits of computational technologies and the human mind i.e. society, politics, values and ethics (Jones 1980).
A computational designer would thrive in intersectionality therefore acting as integrator of technology, creative thinking and craft, bringing inter-connectedness in problem driven projects (Maeda 2018, Buchanan 1992).

**Significance of VR to Product Design**

VR is a tool for showcasing interdisciplinary visual research and activity (Portman *et al.*, 2015). Like drawing, visualisation and VR are both rooted in the visual sense for communication. Visual transmission of information through imagery is advantageous over voice and written word because the visual sense is the dominant human sensory faculty (Portman *et al.*, 2015, Bruce, Green & Georgeson, 1996).
The emergence of VR is quite recent with the seminal work on this area being the benchmarking study and industry survey on the state of the art of VR and its application by Fred Brooks in 1999 (Berg and Vance, 2016). Even though a standard definition of VR is difficult to find (Portman *et al.*, 2015), the authors have extracted recurring qualities of VR emerging from a literature search which can be located on the VR definitions currently existing in the subject matter literature (Choi *et al.*, 2015, Portman *et al.*, 2015, Makris *et al.* 2012, Berg and Vance, 2016).
VR as a visualisation technology deployed towards product design and development offers advantages in cost saving, decision making time reduction and promotes natural interaction (Choi *et al.*, Portman *et al.*, 2015, Makris *et al.* 2012, Berg and Vance, 2016). VR technology can be useful in the context of high complexity products testing and verification when time and budget are constrained (Makris *et al.* 2012).
VR has great potential to increase the level of intuitiveness and interactivity from non-expert users for design review tasks (Makris *et al.* 2012). A unique strength of VR not achievable in traditional 2D desktop workstation based virtual design is true scale immersive interactivity between the synthetic design geometry and designer thereby offering a spatial interactivity on a more natural scale (Berg and Vance, 2016). This observation highlights the utility of VR as a synthetic virtual simulation tool for testing refinement (TR) and detail design (DD).

Computer generate imagery has made great advanced towards realism in the past 20 years (Pittman, 1992, Portman *et al.* 2015). VR generated synthetic worlds have a great potential as storytelling tools to close the communication gap between the different stakeholders in a new product development (NPD) process (Choi *et al.*, 2015). Experts from different backgrounds oftentimes collaborate in a design process and are proficient across different communication tools (Berg and Vance, 2016). A true scale immersive visualisation of the design geometry helps to create a shared experience, increasing collaboration between the design team members (Wang, 2007) and promoting spatial conception (Portman *et al.*, 2015) thereby trimming time and cost towards TR and DD in a NPD.

From a product designer-user relation perspective, VR brings the users perspective into the design process thereby expanding the NPD workflow to include both the designers’ and users’ understanding (Portman *et al.*, 2015). Portman, Natapov, and Gewirtzman (2015) argue that the problem space – solution space process model can thus be expanded to also include a virtual space, which the authors perceive as a synthetic dimension where the non-expert user and the design team can teleport into for virtually experiencing the simulated geometry using visual sensing. A virtual experience may be defined as one where the user is immersed into a responsive virtual world (Brooks, 1999).
Interdisciplinarity, Collaboration and Comprehensive Design Model (CDM)

Design research and practice can (and should) involve teams and experts from various disciplines, with the aim of systematically surveying reality and exploring what people perceive to be useful, desirable, and beneficial in the future. These perceptions create a way to accomplish the desired state or scenario. In the context of the Expomadeira project, collaboration of the UMa design team, with Madeira Interactive Technologies Institute (M-ITI, Critical Practice Lab research unit), local commercial suppliers, and UMa’s accounting unit allowed a group of specialists from different areas to gather providing the basis for the lending of expertise for the development of the project. Through this partnership it was possible to materialize the project and benefit from the know-how and the installed institutional capacity.

This interdisciplinary and collaborative approach allowed the authors to identify roadblocks within the university (in the ecological, economic and human aspects) and from there to formulate safer solutions rooted in a concrete reality. The interdisciplinarity of the project team was factored into the formulation of the design process model as a strategy to promote system design thinking.

System design resolves the connections between the constituent elements (components and products) relating more to the assembly of components (Choi et al., 2015) rather than individual parts. This approach to design process lends a reference to Buckminster Fuller’s “comprehensive design” approach.

Since the definition of design is still a contested ground, this research has established its arguments based on the starting definitions located in man-made object creation and the physical dimension. The arguments presented thus far establish that the design profession is moving toward higher levels of complexity such as systems thinking and machine technology thus the skillset of the design team would need to be adjusted to this reality. Design is a fluid discipline, open to radically different interpretations (Buchanan, 1992) therefore no individual skillset is core to its practice.

The Buckminster Fuller’s Comprehensive Design Model (CDM) is appropriate to the systems design approach. It was developed in his interdisciplinary teaching at MIT in the 1950’s to students from engineering, industrial design, material scientists, and chemists (Dubberly, 2005).

The 7-step model can be outlined in our case as: 1. choose problem > 2. define problem (set problem) > 3. define preferred state (build scenario) > 4. describe present state (fix constraints) > 5. design preferred system (concept design) > 6. develop implementation (detail design & testing refinement) > 7. develop artifact & communicate (production and propagation).

Design Process Model

Since there are so many variations for visualising the creative process, JJ Foreman’s (1967) problem-solution model is a good starting foundation for framing design activity. As the project work described in this research falls into the product design and spatial design sub-discipline of design, the authors also make a reference to the 5-step new product development (NPD) process described by Choi, Jung and Noh (2015) itself derived from “Product Design and Development” (Ulrich et al., 2011).

A design process must be coupled with appropriate mentality of interconnected thinking discussed previously. Jones approach to structure design thinking into 3 distinct phases is an easy to understand proposal: incubation, insight, transformation. Incubation is when a designer mentally churns a problem without directly attacking it. An insight occurs when connections between elements of a problem emerge. Finally, transformation occurs when the designer re-codifies the problem into a simple
structure for implementation. Incubation is a mental mode occurring in the problem phase and transformation is a mental mode occurring in the solution phase. The insight can be thought of as the boundary crossing between the two overlapping phases. The VR enabled virtual space can exist as an overlapping bridge between these 2 phases and thus can be understood as a connection between the insight and the detail design (DD) and testing refinement (TR) steps which lie firmly in the solution space.

The pavilion design project process model was conceived as an interdisciplinary system design approach, inspired by Fuller’s 7-step CDM: 1. set problem > 2. build scenario > 3. fix constraints (people, time, space) > 4. concept design (drawing, research, 3DM, concept generation) > 5. detail design & testing refinement (VR) > 6. Production and propagation (DFUCCM, Pavilion Assembly, Divulgation).

Upon appreciating this process model from a problem-solution perspective, steps 1º-3º lie in the problem space (analysis) and steps 3º-6º lie in the solution space (synthesis). Since the design project was given by the university leadership to the design team there was no necessity to choose a problem (step 1º of CDM).

Also of note here is that the creative interventions where design decisions were the primary concerns were mostly confined to the first four steps, the last two steps were more about implementation and communication. This observation confirms to existing literature which also claims that in projects design is typically applied early in the product development cycle (Maeda, 2018).

Project Development

The project had 2 editions, a 2018 1º edition without the deployment of a VR head mounted display (HMD) and a 2019 2º edition where a VR HMD was extensively used in detail design and technical verification.

1> Set Problem (2 Weeks)

The design team received the project request from the UMa leadership and analysed the points of intervention such as maximising the deployment of the project budget, building the design team and offering the student designers a training opportunity to expand their knowledge in the tools and process employed in the project.

2> Build Scenario (1 Week)

The situation under which the project would be built set the scene of the project development. The elements defining the situation included the budget available, branding identity of the university, local materials, limitation of suppliers.

3> Fixing Constraints (1 Week)

People

Identifying the synergy between academia, technology centers and supplier companies, the connection of UMa with M-ITI CTP Lab emerged as an opportunity to materialize to physicality the "imaginary objects" which only existed in the incubation mental search space of the design team. Realising to physicality a product also offered learning through direct contact with the limits of 3DM, VR, and DFUCCM. Given that two of the key objectives of the project were to train future designers and to raise the awareness of the institutions involved, it was clear to the project team that a suitable
product should be developed in this context. This was a strategy to also teach the students to operate at the intersection of business reality and research activity.

**Time and Space**

The time constraint of the project was fixed to two months, coinciding with the inauguration of the event. The formal dimension of the pavilion was dictated by the site geometry. The spatial constraints included site shape and site context.

**Circumstances**

The definition of the project program with UMa’s rectorial staff and the negotiation of the budget with UMa’s accounting unit.

The reflection of UMa’s social identity by symbolically incorporating Madeira’s mountainous topography into the structure design, and the decision to use computational tools to design a parametrically optimised building system consisting of 3500 triangular pieces and circular connectors for an economic cost-effective solution. The cost dimension also narrowed the building material choice to 3.5 mm medium density fibre (mdf) panels.

4> **Concept Design (3 Weeks)**

In the 1º edition of the project, upon analysis of the site shape, the project budget, timeline, and human resources available, the design team decided to explore a parametric self-supporting construction system inspired by Buckminster Fuller’s principles of maximising efficiency and performance. Various geodesic structural combinations were explored based on case studies, group brainstorming, and concept sketching. Finally, a conceptual composition of a parametric self-supporting wall structure based on triangulation was drawn on paper, refined through 3DM and visualized using photorealistic rendering techniques. The 2º edition of this project included these steps and a further synthesis and simplification (transformation) of the original concept for achieving greater efficiency in production and construction.

5> **Detail Design and Testing Refinement (1 Week)**

In the 1º edition of the project, the transition from 3DM to DFUCCM and finally to construction entailed a sudden change in scale of the design project from the 2D desktop workstation based environment to a 3D real world, which denied the design team an appropriate opportunity to perform a robust testing refinement (TR) action on the project. A VR head-mount display (HMD) was only deployed in the 2º edition of this project to improve the transition from 3DM to DFUCCM and introduce a true scale immersive experience in the design process. The true scale virtual simulation allowed the project stakeholders to come to a common visual understanding of the parametric structure. The VR HMD offered to the design team a great degree of detail design opportunity towards joint geometry improvement, gap inspection, and spatial analysis. To the non-expert project stakeholders, the VR HMD offered an experience of a non-existent reality (Portman et al., 2015) of the structure not yet constructed.

6> **Production and Propagation (1 Week)**

Final design specification was approved by the UMa leadership keeping the production limitations of M-ITI’s CTP lab machinery in the picture. The physical performance limits of computer-controlled machinery (CCM) to be deployed in the fabrication process were the primary limitations here. The
elements which defined the production phase included the design approach (parametric design), bed size limits of the CCM (laser cutter and CNC router), eco-efficient materials (MDF panels) selected based on economic, climatological and logistical realities of Madeira’s insular context. A prototype 1.0m wall section was realized in the CTP lab in order to verify the structural, technical and aesthetic viability of the design. The prototype wall also allowed to check the impact of transitioning from 3DM to DFUCCM and any resulting loss or distortion of design information. The prototype also allowed for a limited scale analog test of the assembly procedure thus far only tested in the virtual dimension. In the 2º edition of the project, the VR HMD was heavily deployment to improve this transition. On a reflective note, the deployment of the VR HMD on site during construction would also greatly assist the designers to face the structure virtually while assembling the component pieces of the structure system thereby accelerating greatly the construction process and also evicting the need to devise an intricate part number count for controlling the sequential assembling.

**Benefits of Inserting 3DM, VR, and DFUCCM in the Design Process**

The authors deployed 3DM as a base for the whole project (figure 1). 3DM serves as a departure point to build the VR and achieve the digital files which the computer-controlled machinery (CCM) is equipped to read. The VR made the understanding and interventions of the design clearer to all the participants of the project (figure 2). The DFUCCM offered the power of multiplication which machines have to achieve rapid and precise manufacturing of the repetitive pieces in the parametric structure. Therefore, to summarise 3DM is most capable in the component design, VR is impactful in increasing collaboration and human communication, and DFUCCM increases efficiency and reduces human effort.

**Concluding Remarks**

The project was assessed against the three stated mission objectives and two strategic outcomes. The views of the UMa leadership gathered in staff meetings and written testimonies, the printed press and web articles generated on the project fulfilled the institutional outcome. The pedagogic dimension of the outcome was assessed based on the proficiency which the student designers of the design team acquired in the use of 3DM, VR HMD, and DFUCCM. The contribution to eco-efficiency was addressed by building the project through locally available wood laminate basic material and designing the structure to be collapsible and reusable for future needs of the university.

The success of the 2018 1º edition project prompted UMa leadership to invite the design team to produce a 2º edition of the project in 2019. The 2º edition was to benefit from the lessons learned in the impact of scale when transitioning from concept design (4º step) to construction (6º step) of the pavilion. The acquisition of a VR HMD proved very useful to deploy in inspecting and validating the project geometry ensuring an optimal transition between the steps 4º to 6º to minimize mistakes therefore saving time and material.

Aligning with the claims of existing literature (Choi et al., 2015), the manner in which the design team deployed the VR HMD reflected more heavily in the detail design (DD) and testing refinement (TR) stages of a new product development (NPD) process, and not in the CD stage.

The transformational effects on the design team workflow due to the true scale model simulation achieved through VR HMD deployment greatly increased the transparency of the DD and TR actions in a project development scenario. The project communication quality between the project management (UMa leadership) and the design team also improved due to the true scale VR simulation (Berg and Vance, 2016).
The deployment of such powerful technology allows the design team to assume multiple competences of product designer, structural engineer, architect and construction contractor thereby contributing towards the formation of an interdisciplinary integrative thinker (Buchanan, 1992).

As this research presented VR as a communication and visualization tool much like drawing, a limitation which the design team felt while using the HMD VR was that it limited the visualization of the product geometry to only one user per time. This reduces the natural interaction between team members. A possibility to not just view an immersive virtual 3D model but also an opportunity to manipulate and collaboratively design it in the immersive world itself would be an interesting development the authors feel.

References
Reswick, J.B, 1965, Prospectus for an Engineering Design Center, Cleveland, OH: Case Institute of Technology.


TRACK 2: Meanings of Design in Technological Development

Topic 2.2: The Role of Design in Humanizing Technologies
Design Value in Future Tech Organizations - How Can Design Communicate Innovation?

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Abstract: Determining how design adds value to the communication of innovation in the field of future technologies in response to the UK Government's Industrial Strategy, this research is anchored in visual design as a driver of creativity and a contributor to innovation in the satellite and space industries. The originality of the research is to foster transformative opportunities in line with the Industrial Strategy in North West England to communicate novel ideas and to enhance the development of products, services and processes by creating conditions that are conducive to innovation. The hybrid of theory with practical elements is achieved through projects with partners in the industry, collaborative research, observations, field notes and visual material produced as part of the research process. Design value in case studies is tried and tested through a tailored design process. Problem solving approaches are generated through brand creation and development to visually communicate innovation activities.

Keywords: Design value, Communication, Innovation, Satellite and Space Technologies

Introduction

The research projects explore how design and creative techniques can contribute to growth and prosperity, fostering impact in the region.

As design is increasingly recognised as a driver for user-centred innovation (The European Design Leadership Board, 2012) and organisations are advancing by embedding design into their innovation processes (Bason, 2015). The hybrid character of future tech and creative design serves as a pioneering instrument and concurrently as a consistent quality asset. Design can enhance productivity and visually communicate future technology (Transformation North West Cohort, 2018).

As part of a larger study, two collaborative mini-projects involving brand development and creation in future tech organisations in England’s North West were conducted as case studies. The first case study was designing a brand for an intelligent transport application aiming to enter a new market. The second case study involved a start-up company that mines asteroids, that the author has worked with to create a brand identity to improve communication for prospective funders. Even though the nature of the projects and organisations differed entirely from one another, the same creative approach was applied throughout this research.

Background

Creativity and innovation

The following paragraphs discuss visual design and its relationship to innovation in the wider context relevant to the Industrial Strategy (BEIS, 2017).

In an extensive study Cooper et al. (2016) discuss design value in innovation. The study demonstrates design’s contribution can be measured, however difficult, through the relationship it has to innovation. Design is focused on successfully developing confidence in products and services through understanding its strategic position, nuances, and through identifying its factors. It helps to make sense and take decisions. As an iterative process, design directly advances innovation whilst also supporting
marketing and the brand building awareness and loyalty (Cooper et al., 2016). Inspiration drives an idea through to conclusions. Design represents an iterative problem solving approach. Users act as co-creators. Design is innovations-friendly, eases adoption, creates relationships, it helps transform organisations (Hernandez et al., 2017; Tech City, UK 2017).

Andi Davids, Senior Strategist for the design agency Superunion argues that creativity is a process (Superunion, 2018). Davids describes the source of creativity as producing ideas – which help solve problems and inspire humankind. The application of ideas to a business’ problems and the profit of solving it is a creative process. The creative process is a tool for change, it encourages collaboration and cultivates empathy. Challenges can be overcome if approached in new or novel ways (Superunion, 2018).

George Cox defines creativity as the generator of new ideas, either in “new ways of looking at existing problems, or of seeing new opportunities, perhaps by exploiting emerging technologies or changes in markets” (Cox, 2005).

Design is helping businesses in the UK develop innovation opportunities, become more productive and profitable (Benton et al., 2018). With applied design thinking, businesses can grow. Products can reach new users and the workplace becomes more effective as people are at the heart of design. As an adaptable, powerful tool the implementation of design results in a 20 times increased business revenue (AHRC, 2013).

Teresa M. Amabile, Professor of Business Administration observes that: “Figuratively, it is impossible to escape the reality that corporations must be innovative in order to survive.” Creativity in individuals and innovation in organisations are profoundly interconnected. Amabile defines creativity as the generation of original, practicable ideas of a person or small team, whereas organisational innovation is the effective execution of creative ideas in that organisation. (Amabile, 1988)

Innovation activities are accelerated by the impact of building a brand. Creating user insight helps the organisation to make better decisions and to improve the quality of their products and services (Cooper et al., 2016). Furthermore, design visualisation creates a conversation in the innovation context (Hernandez et al., 2017).

**Design process as method in literature**

The Design Council established the four stages of ‘the Double Diamond’ that summarises most designers’ processes. The first stage ‘Discover’ depicts background information of the design problem. The second stage of the idea finding process ‘Define’ clearly outlines prospective ideas brought forward from the first stage, for which then design routes are generated in the third stage ‘Develop’. These initial solutions are repeatedly evaluated before the process is finalised with the fourth stage ‘Delivery’ creating a working concept. A creative approach can be demystified, utilising and iterating ‘the Double Diamond’ throughout the process (Design Council, 2019).

Accomplished Graphic Designer Michael Bierut expressed his process after frustrated attempts as, to get to know the project through information and conversation with the client and through probable prior experience. Meanwhile, and this might occur before all information is gathered – an idea takes shape – unexpectedly and difficult to comprehend, “like magic”, for which then a valid strategy is determined, with a priorily persuaded client proving to be helpful (Bierut, 2018).

![Figure 1: Maker / Magic / Doer. Image credit: Bird & Gorton (2019)](image-url)
Creative consultancy Bird & Gorton uses a similar ‘approach’. When “Maker” and “Doer” come together, “Magic” unfolds, where the two overlap, as shown in figure 1 (Bird & Gorton, 2019).

In the future – case studies explained

Each generation may have their viewpoints on technologies of the future. This research identified intelligent transport and space mining as such technologies.

Intelligent transport

In Back to the Future Part III (set in 1885), Doc Brown predicts people will run for fun.

“Doc: And in the future, we don’t need horses. We have motorized carriages called automobiles.
Saloon Old Timer #3: If everybody’s got one of these auto-whatsits, does anybody walk or run anymore?
Doc: Of course we run. But for recreation. For fun.
Saloon Old Timer #3: Run for fun? What the hell kind of fun is that?” (IMDb, 2018)

Further, faster, more affordable as well as safer and punctual travel is made possible through satellites. By road, rail, in the air and at sea journeys become interconnected, creating a complex transportation system. Different technology works together in seamless connectivity, positioned via satellite. Satellite technology serves as a platform for increased transport efficiency, situational awareness and enhanced user experience, bringing together the best of technology. Space data is instantly updated and shared with each other, cutting response times and congestion, creating wealth through integrated logistics (Catapult, 2018).

During the first project ‘intelligent transport’ knowledge was gained on how satellite technology is used in day-to-day traffic. Whilst contributing to the organisation’s innovation by developing a brand language – that is a system of communication for their new to the market app, it was discovered, that ‘AI Traffic Flow’ is a multi-modal approach to improve productivity of intelligent transport between two major freight feeders in the North West – the Port of Liverpool and Manchester International Airport. Based on a technology design and development project for ambulances, the smart traffic project uses space data via GPS controlled sensors managed by big data principles to ensure green light corridors for, but not reduced to, trusted traders and suppliers moving through the entire urban transport networks that can cut congestion, idle and response times.

Through digitalisation as a tool on-demand, a multimodal future enables smarter cities (Intelligent Transport, 2018). Space data is precise and accurate, it is everywhere, every time. With constellations, sensors embedded in junctions, bridges and buildings, satellite technology serves as a foundation for autonomous driving, automated parking, recharging, emergency services, air traffic etc. Through design, development and its operation, satellite-based technologies implement navigation and communication with consideration of time and scope in economic terms (Catapult, 2018). The intelligent transport system uses this satellite technology to enable better and more efficient flow of traffic for the users.

Space Mining

“Mining the skies is no longer a subject of science fiction stories and movies”. What makes space mining profitable is the staggering market value of asteroids. The space mining sector determines probability of asteroid exploration by satellite. With a qualified asteroid in place, its features direct the mining approach. (Sukumaran, 2016)

The second project ‘space mining’ involved developing a brand of an aerospace start-up and pioneer in UK innovation. The space mining organisation is targeting the off-Earth commercial market with ground breaking technologies that will enable extraction, processing and use of materials from many millions near Earth asteroids (NEAs). At this point, the organisation is generating data to estimate NEAs, finding investors for their first satellite to launch in 2020 ahead of asteroid mining activities.

Asteroids contain large amounts of precious metals (Lewis, 1992), to a greater extent than earthly materials, advancing the economy by “trillions of dollars” (Jamasmie, 2017). They depict an overflow of valuable material that is conducive to space development. NEAs are likely the best starting point for
mining activities, due to its reachability, diverse resources and mining achievability. Precious commodities originating from space might soon outrun earth resources (Sonter, 1997). Asteroid Mining is a practicable ecological alternative for the approaching shortages on Earth (Ross, 2001). The aspiring space mining sector with its high profitability indicates a likely shift into a new era (Lewis, 2014), it is compared to a new gold rush, that is hopeful to be beneficial to all people, acting as a driver of human space exploitation (Sterling Saletta and Orrman-Rossiter, 2018). The commercialisation of space exploitation fosters prospective space colonisation and infrastructure (Ross, 2001).

Method
The mini-projects undertaken are practice-based, which involve the production of creative visual work. This draws upon engagement with key stakeholders in organisations to better understand their innovation, and through the application of design expertise, to help to visualise this. The intention is to 1) understand the nature of innovation, 2) work with the organisation to visualise their innovation, and 3) determine (in collaboration with the project partners) the potential for improvement of innovation and what role visual design may play in this.

The research aimed to pinpoint visual design as a driver for innovation. The two case studies were set in organisations working with satellite and space technology. Through action research, an imminent problem that needed solving was identified, as well as reflection, on how to improve the problem solving process as a benchmark for others. The empirical evidence was analysed primarily qualitatively through framework analysis, via record of direct observations and experiences, a design process was identified and a brand strategy applied to each case and then compared and feedbacked on.

Design process in this research
Based on the Design Council’s double diamond and Bierut’s as well as Bird & Gorton’s design approach, a new design process was developed for this research as a practical design method employed in the two mini-projects. This process has elements of design thinking approaches with divergent and convergent elements, as well as a more complex element in the ideation phase which was previously identified as ‘magic’. It is divided into five stages:

- KNOWING
- PACE
- CRESCENDO
- REFLECT
- RECOVER

The first stage KNOWING is to determine the organisation’s needs, to understand its values and gain insight of its current innovation processes. The second stage called PACE is part of the ideation and making process, where a creative orientation originates and the branding process accelerates. The third stage CRESCENDO was the actual creation of a design route, the peak of the process delivering visual outputs that aim to communicate the organisation’s innovation. The fourth stage REFLECT is to articulate feedback and advocate design application. And lastly, RECOVER stands for impact, connection to other mini-projects and to leverage future tech innovation. This process then iterates and can be compared to one another. The various stages often overlap and intertwine, generating a complex structure, unique to the organisation it is applied to.

Findings
The design process was applied and duplicated into the two case studies within organisations: an intelligent transport and a space mining project. Each stage of the brand creation or development process had input from the industry partner, during which data was collected through research observational notes, surveys, interviews and feedback.

Case Study 1: Intelligent Transport Project
Case Study 1 was conducted between March and July 2018, where the company aimed to accelerate their innovation by creating a cohesive brand language that reflects the technical nature of the project. The company was also seeking to utilise the project as an umbrella activity to help them move forward to introduce their new product to the market.

KNOWING – After an initial briefing from the partner organisation, the requirements for a brand language emerged for the smart traffic project. This involved developing a brand language which could now serve as a foundation for brand communication supporting new business development opportunities. PACE – This stage included the research on how brand language can be used to communicate the innovation process whilst identifying a suitable font, form, colours and illustration style. Key to this research addressed the exploration of how visual design can leverage innovation in future tech companies.

Figure 2: Logo development – from tilted square to free flowing shape. Image credit: J. Adler (2018).

PACE – For the company’s brand new smart transport project, the initial idea was a tilted square or diamond shape with four sides / corners pointing into the air or space, rail, road and sea connecting freight etc. via different modes of transport, see figure 2 and 3. CRESCENDO – During the process of creating the logotype, it became evident that the design needs to adopt a flexible role within development projects. The naming process (PACE) as part of the branding process had three parts, with the chosen name for the brand ‘AI Traffic Flow’. CRESCENDO / REFLECT – With ‘flow’ in the name, the idea of the tilted square had to become more flexible in shape – an unconfined, more organic, yet interconnected shape was formed, within the parameters of the shape of a diamond with four sides. A gradient of traffic light colours with the green light prevailing has helped shaping the logo for the new business case, as shown in figure 2.

Figure 3: AI Traffic Flow, screenshot from explainer video. Image credit: Red Ninja (2018).

The logotype was key to the company’s brand development, with its shape and colour palette, adaptable to further brand applications, as shown in figure 3.

Case Study 2: Space Mining Project
From October 2018 until April 2019, the collaboration with a space mining organisation culminated with the creation of a tailored, flexible design strategy. The priority of the project was to attract investors for their first satellite launch in 2020 ahead of asteroid mining activities, using ground breaking technologies that will enable extraction, processing and use of materials from near Earth asteroids. The project involved brand development to communicate the organisation’s innovation by promoting an optimal market position, concluding with a visual portfolio that also intends to assist the internal structure of the organisation.
KNOWING – The space mining organisation’s needs and wants were clarified during a conversation with the CEO and a variety of colleagues, e.g. engineers, geologists and designers, in the beginning of the project. The need of an investment brochure was most pressing to find additional funders for the upcoming satellite launch. A professional identity was desired with a business card specifically as a first impression of the start-up’s brand when attending events etc. PACE – To advance the development of the organisation’s brand, a creative orientation – an initial concept of prospective imagery, fonts, layout and colours, was designed to get an idea, how the identity is anticipated to look and feel.

CRESCENDO – A font was determined for bold, extended headers that represents attention, power and the horizon, urging slow reading to make keywords memorable. Depicting a contrast to the element of brand language and different uses of copy, the font for shorter text is geometrical and contemporary, and for main text a distinctive serif font was selected, that is easy to read. A thin line was formed as the brand element, complementing delicate perfection and contrasting the logotype’s hexagon shapes. The line depicts quality and weightlessness – near zero gravity, that is pointing upwards in the reader’s direction, diagonal, indicating floating in space and open-endedness, that symbolise excitement, anticipating growth. The amber shade depicts energy and looks confident and cheerful, combined with impartial, yet sophisticated warm grey tones, it creates a spectacular mood, especially when applied to imagery, see figure 5. REFLECT – In combination with the existing logotype and characteristic hexagon shapes, the brand was developed to create meaning directly linking to the organisation’s innovation by building confidence in the organisation’s propositions. The response was, that presenting a coherent, professional identity acts as a conversation starter that is adapted and further developed in the organisation’s processes.

RECOVER – both case studies.
In response to the Industrial Strategy, the two mini-projects discussed in this paper address issues such as the improvement of productivity by developing innovative opportunities, entering new markets and
improving access to information through design solutions as a communication tool between entrepreneurs and funders. The projects depicted support for local SMEs and start-ups, and as a result, a shift in thinking and value to the region (North West of England, UK). During the projects, creative thinkers sat on one table with engineers and business people among others as a catalyst for collaboration, stimulating innovation. The projects highlighted that within activities of cross-industry collaboration, there is a need to listen to a variety of voices to understand and balance collective perspectives and use this to inform the project development. Future technology has been opened up to a traditional workforce, e.g. whilst industry partners may think millions need to be invested to improve roads and build bridges, small interventions like sensor technology can be the answer, as a result of different ways of viewing the problem. A designer can help visually communicate this. Furthermore, creativity assisted in introducing new audiences to advancements in technology, instigating excitement of exploring developments with the organisation, ingeniously combining new technology with traditional ideas.

Discussion
The first case study, the intelligent transport project offered the opportunity to create a brand and through this development, the author was able to communicate the underlying innovation. These activities could lead to a business case to enter new markets. A brand can serve as a transformative tool and a quality asset to a company. It helps the user to gain confidence in a product, service or process, increasing profit and productivity and advancing other innovation activities. Design visualisation instigates conversation. Concerning the second case study, users can get excited with space exploration and exploitation. Brand development here can lead towards securing of funding by generating a professional identity that improves the organisation’s presentation, helping to establish partnerships. The promotion for an optimal market position is crucial at a stage where funding is still needed for a satellite to launch prior to space mining activities.

Conclusion
The hybrid of visual design communicating innovation in the field of satellite and space technologies was the driver for this research. Two collaborative case studies including a brand creation for an intelligent transport application and a brand development for a space mining start-up were examined. In the context of the UK Government’s Industrial Strategy, visual outputs helped build a business case to enter new markets and advance communication with prospective funders. The contrasting projects applied the same design process, that was tailored for this research, resulting in a complex structure. The process was divided into five stages, namely KNOWING, PACE, CRESCENDO, REFLECT AND RECOVER that inform, generate and advocate new approaches to solve a problem, creating opportunities conducive to innovation. Possible further case studies not discussed in this paper that include brand creation, development and application, are established in the fields of space engineering, education in space settlement and remote sensing. A next step and additional opportunity for the evaluation of research findings, may involve the presentation of the bespoke design process and findings to a creative agency in order to get alternative perspectives through feedback during interviews.

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References
Bason, C., 2015. Why the world’s leading organisations are looking to design. Design for Europe. 
Jamasmie, C., 2017. Luxembourg shoots for the stars with fresh space mining deal. MINING.COM. 

Superunion, 2018. *Creativity is a process, not a discipline.*


Designing for The Subjective Experience of Wearable Assistive Devices

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Abstract: The paper addresses the challenge of balancing the tension between a problem solving attitude in the design of assistive devices, with an ethical, aesthetic and cultural approach to design for people living with a temporary or permanent impairment. The topic is developed presenting two design cases. The first case is a suite of smart jewels tailored to the needs of people with hearing impairment (Marti & Recupero, 2019), (Quietude, 2019). The jewels sense environmental sounds (e.g. the doorbell, an alarm, someone calling, a car horn) and notify them to the wearer through different modalities (light patterns, vibrations, shape changes). An App completes the system allowing the deaf person to record personal meaningful sounds and set preferences for their notification. The second case is an orthodontic facemask for children designed as a 3D printed superhero mask made of biocompatible materials (Marti et al., in press), (SuperPowerMe, 2019). It is associated to a game where a superhero avatar wearing a similar facemask gains power by progressing in an adventure. The design cases represent examples of permanent and temporary impairment that share fundamental features of the user experience: the stigma associated to hearing aids and orthodontic facemasks alters self-image and self-esteem of people affecting all aspects of life. The cases show that design can promote a cultural shift by transforming assistive wearables into beautiful, playful, gender-appropriate accessories.

Keywords: Wearables, Assistive devices, Co-design, Disability, Impairment, Aesthetics

Introduction
There is a huge potential for innovation in the design of wearables for people with disability. Wearables are “any device worn or carried on the body capable of receiving input, processing information, and providing output to a user” (Gandy et al., 2008). Nowadays the spread of tiny sensors and microprocessors with increasing processing capabilities brings wearable computing closer to everyday use. Applications range from mobile communication devices, to physiological data monitoring systems (Majumder et al., 2017), to sensing/perception devices of the surrounding environment (Mateevitsi et al., 2013), to skin interfaces (Liu et al., 2013); (Hsin-Liu Kao et al., 2016) and smart textiles (Pailes-Friedman, 2016). Unfortunately, many wearable assistive devices remain highly stigmatizing in nature due to their medical-looking, poor aesthetic and no gendered body design. Furthermore, these devices are usually framed in terms of solving problems of people with impairment. This is of course a valid and important perspective. Yet other more open-minded frames are necessary to address the
complexity of the lived experience of wearing assistive devices, which demands for sense of style, self-expression and social acceptance beyond the functional support.

Most commercial assistive devices overlook the gendered body and pay little attention to aesthetics, if any. A nuanced choice of materials and forms, chosen by the wearer according to personal preferences and creativity, contexts of usage, and cultural habits are nowadays made almost impossible by the unavailability of alternatives on the market. People who wear an assistive device to compensate a temporary or permanent impairment have basically two choices to downplay the negative impact of the device: either giving up accessorising the body with style or adapting the device to suit the desire for style and image. More often the device is concealed, selectively used, or completely abandoned.

Therefore, a critical design perspective in the development of assistive wearable technology is necessary to achieve a sustainable convergence of humanistic and technological approaches.

In what follows, we first review recent attempts to theorise design and disability as two dynamic, interacting disciplines, which can influence and inspire each other. We do this by describing projects with an explicit focus on designing assistive devices beyond a problem-solving mindset. Later we present two of our design cases: the first addresses the culture around Deafness with a capital D to mean a human condition that is more than just hearing impairment; the second regards the design of a facemask for the correction of maxillofacial disorders in children viewed from a playful perspective.

In the conclusions, we draw some lessons learned and reflections to help designers embrace a broader, socially inspired and participatory culture of design engaging people who are experts of their disability as active and creative participants.

**Literature review**

Recently, designers involved in the creation of assistive wearables have started experimenting with new approaches and solutions to counteract the stigma of disability.

Profita, Roseway, & Czerwinski (2016) developed Lightwear, a series of gender-oriented garment designed to administer light therapy for on-the-go treatment of Seasonal Affective Disorder. The project explores the integration of light into fashion-forward wearable textiles combining style and aesthetics with efficacy, usability, and convenience.

A similar approach was adopted in Flutter, a fashionable smart garment for sensory enrichment of individuals with hearing impairments (Profita, Farrow, & Correll, 2015); and Swarm, a fashion-driven actuated scarf aimed at mediating affect for individuals with difficulty in recognizing and regulating emotions (Williams et al., 2015).

Eone’s founder, Hyungsoo Kim developed a stylish tactile watch for blind people.

Wear Sustain (2018) (Wearable technologists Engage with Artists for Responsible innovation) is a network funded by the European Commission Horizon 2020 Research and Innovation initiative, operating in 2017-2018. The network promoted collaborations between technologists and designers/artists to develop sustainable and ethic wearables. The network funded 46 projects in wearable technology design. 7 projects out of 46 specifically addressed disability and impairment with a focus on ethics, aesthetics and sustainability. More in detail, 5 projects developed assistive wearables for people with physical, cognitive or perceptual disability and 2 projects developed wearable designs for supporting rehabilitation (Wear Sustain, 2018):

Quietude (interactive jewels for enriching the experience of sound of deaf people), Future
Jewels (responsive, wearable objects that create playful interactions with people with sensory impairments), Beneficial Works (haptic navigation device targeted to blind and visually impaired people), Sensewear (smart garments for autistic people to reduce anxiety, stress, and panic attack), Flexability (a kit to create made-to-measure e-textile for people with physical disabilities), Zish (garment designed to support posture monitoring for the purposes of rehabilitation training), Constructing Connectivity (a stroke rehabilitation method based on textile making).

Fashion-driven assistive wearables have also been developed following a consumer-driven endeavor in the beautification of assistive devices. For instance, Sophie de Oliveira Barata promoted the Alternative Limb Project (2011) where she created highly stylised prostheses as art pieces, involving clients in brainstorming sessions and fine-tuning prototypes throughout the design process.

A number of maker-focused initiatives have been emerging also from the DIY practice of developing or modifying artefacts. e-NABLE (“Enabling The Future,” 2015), DIYAbility (“DIYAbility,” 2016) and Hackability (2016) are notable instances.

The books Design Meets Disability (Pullin, 2009) and Rhetorical Accessability (Melancon, 2014) offer theoretical lenses to think about the complex and dynamic relationship between disability, design and accessibility. Both scholars envision a future where assistive devices are demedicalized and destigmatized as it happened to eyeglasses transformed from medical aids into fashion accessories. However, they develop this argument from different theoretical viewpoints.

Pullin uses critical theory as a framework to make designers think as opposed to design that solves problems or finds answers, and calls for a new approach to design in the context of disability based on a “richer balance between problem solving and a more playful exploration” (Pullin, 2009 p. 121). Meloncon (2014) uses phenomenology to connect theory to practice as a way of underlining the ethical need to better consider disability and to reframe, repurpose, or remake both technology and the human body. By using the term Accessability she means “to emphasize the need to meet the abilities of users and audiences, no matter what those abilities are, while understanding the need to promote inclusive access for those same abilities” (Pag. 10).

All projects and theoretical approaches described above promote a cultural shift through a change in discursive and design practices associated with disability. Some of them emphasize person over product approach grounded in disability studies; some others take a product-centred view grounded in design research and practice.

In what follows we present two design cases developed at the University of Siena, Italy, in partnership with other public and private organisations. The projects explore human-centred design from the lens of co-design and participatory design. This way the dichotomy person-centred vs product-centred design is overcome by practising co-design with disabled people who are not just consulted but actively engaged in the creative process. Both cases regard the design of assistive wearables for disability and rehabilitation support, and highlight the importance of putting the lived experience of people with impairment at the forefront of the design process.
Case Study 1: Quietude

Hearing aids are highly stigmatising. Size and visibility are the main features associated with the reluctance to use them and with the stigma associated with them. A recent survey showed that the most common stereotypes associated with hearing aids are that they make the wearer look older, less communicatively effective, less sociable/friendly, looking disabled, weak, feeble, embarrassing, lonely, and less confident (David & Werner 2015). The effect of stigma on self-perception and social identity of people with hearing impairment represent a major threat to social identity and threatens the stability of social interaction.

Quietude is an ongoing project developing aesthetically rich, socially sustaining wearables for deaf people to counteract the social stigma while providing functional support.

The responsive fashionable jewelry system recognises meaningful incoming sounds (e.g. wearer’s name, the doorbell, a car horn, an alarm) and expressively notifies them to the wearer through light, vibration and shape change. The project received funding from the EU H2020 Wear Sustain Programme and was developed by an interdisciplinary team of deaf people, designers, technology experts, psychologists and an expert in ethics from the University of Siena, two private companies Glitch Factory and T4All, and Mason Perkins Deafness Funds Onlus specialised in providing services to the deaf community.

The jewels were designed to go beyond the functional goal of supporting hearing and aimed for fulfilment of emotional and sociocultural needs such as aesthetics, self-expression and identity of deaf persons. The system is modular to allow different types of formal configurations and personalisation of use (Figure 1). Modules embed sensors to detect specific sounds and actuators to notify sounds through light, vibration, and kinetic modifications (shape change). A video of the system’s behaviour can be watched at: www.quietude.it.

Figure 1: A necklace of the Quietude collection

The jewels are connected to a smartphone application (Figure 2) that permits customisation of both input (sounds of interest to be filtered and recognised) and output (notification through light, vibration or shape change). The person can create a personal library of sounds of interest by recording meaningful sounds through the microphone embedded in the jewels. The recorded sounds are then labelled and stored in the app, and “translated” into vibrations, light patterns or subtle movements of the accessories to advise the wearer when they occur in the surrounding environment. Preferences related to kinetics, intensity of vibrations and light patterns can be set and fine-tuned through the app for different contexts, moods and bodily sensitivities.
Case Study 2: SuperPowerMe

SuperPowerMe is a research project developed by a multidisciplinary team of orthodontist doctors, designers, and technology experts from the University of Siena and the University of Firenze (Italy), with the involvement of children affected by Class III malocclusion and their families (Marti et al., in press). Class III malocclusion is a craniofacial deformity characterized by concave profile that results from retrusion of the maxilla and prognathism of the mandible. At the dental level this skeletal relationship reflects into the prominence of the lower arch relative to the upper arch, or the inversion of the anterior bite. This type of malocclusion is treated using facemasks consisting of frontal and mental pads made from acrylic, connected by a midline stainless steel rod. In order to apply a forward traction to the maxilla, elastics are attached from an intraoral anchorage system to a cross bar extending in front of the mouth. The effectiveness of facemask therapy depends on patient’s compliance with the recommended wear time, possibly ranging between 14 - 24 hours a day, over at least 9 months. Commercial facemasks are unaesthetic, uncomfortable and may cause skin irritations due to uneven pressure by the standard anchorage pads. In a survey assessing acceptability of orthodontic appliances, facemask was rated as the least acceptable device (Abu Alhaija & Karajeh, 2013). The facemasks are only available in standardized shapes and in two sizes. There is no gendered body design. Beside poor aesthetics and ergonomics, children often complain about facemask bulkiness and instability, which may compromise the treatment. The design of commercial facemasks is solely focused on the functionality of the device without paying attention to other aspects of the child experience like social acceptance and motivating factors, which are fundamental to make the therapy effective.

SuperPowerMe aims at developing facemasks using 3D printed biocompatible materials and customized design both in the appearance (form and colour are selected according to the child’s preferences) and anatomy (the facemask is modelled following the child’s face morphology). Decoration and embellishments are co-designed with the children.

In order to improve acceptability and collaboration of the patients, SuperPowerMe adopts a gamification approach. An interactive game for smartphone and tablet is connected to the facemask and can be played only when the mask is worn by the child (Figure 3). The game is conceived as an adventure game where a super-hero avatar wears a facemask akin to the child’s one. The more the child wears the facemask, the more the super-hero avatar gains power and
progress in the adventure. The facemask wear time is monitored by pressure and temperature sensors embedded in the frontal and mental pads.

Figure 3: 3D printed customised facemask and the game app

A video concept of the project can be watched at https://vimeo.com/268795652. Currently the project has developed the first customised facemasks realised with 3D printed bio-compatible materials that will soon undergo clinical trials. Embedded electronics and the video game are still at an early design stage. The customised facemask has been patented.

Conclusions
The design cases described above represent the extremes of a continuum from permanent to temporary impairment. Notwithstanding the diversity of the cases, they share some important features of the user experience: the stigma associated to hearing aids and orthodontic facemasks currently available on the market considerably alters self-image and self-esteem of people affecting all aspects of life such as emotional and functional well-being, socialization and relationships in general. The design cannot ignore the potential psychological impact and social stigma associated to assistive wearables.

In designing aesthetically rich and socially sustaining solutions, we engaged disabled people as experts of their impairment in co-designing potential solutions, and actively and critically participate in the design process. As Balsamo (2011) argues, design involves not just the making of new products/services but also the creation of new cultural possibilities.

In our cases, people involved in the design of new assistive wearables were somehow also engaged in the process of designing and communicating a new culture of disability based on playfulness, gendered aesthetics, self-esteem and sense of style. Through several iterative and incremental co-design sessions, cultural beliefs were materially reproduced, identities were negotiated, and social relations were codified (Mainsah, & Morrison 2014). In this process, design made possible the expression of new meanings related to the demand for destigmatisation and demedicalisation of the assistive devices.

In our projects, the co-design process took several forms from observation to interviews, and participatory design workshops (Marti & Recupero, 2019).

In the first design case, deaf people participated in two workshops. Workshop 1 lasted 6 days and involved 4 deaf people, 1 designer, 2 design researchers, 1 psychologist, 1 ethicist, 6 makers/engineers, and 2 Italian sign language interpreters. Day 1 focused on feelings deaf participants have about not hearing or being heard; Day 2 focused on creating forms and selecting materials; Day 3 focused on developing concepts; Days 4–5 were devoted to
materialising ideas and developing low-fidelity prototypes; Day 6 focused on testing the prototypes, reflecting on the achievements and planning the next steps. These activities disclosed a number of complex needs/requirements of deaf people ranging from functional needs like the awareness about meaningful personal sounds (e.g. pet, doorbell, name, etc.) and public notifications (e.g. train delay); safety in emergency situations (e.g. alarms, announcements in public spaces, police whistles etc.); to needs related to the possibility to express individual preferences and sense of style; aesthetics of hearing aids; curiosity about the quality of sounds that could be experienced through other senses, (e.g. sight, touch) or through on-body vibrations. The second workshop involved 5 Deaf participants and a group of hearing participants composed of 1 psychologist, 1 designer and 2 design researchers supported by an Italian sign language interpreter. The aim of the workshop was to reflect on the needs and desires emerged during the first workshop, and to engage the participants in evaluating the prototypes developed after the first workshop. The workshop was organised in two parts: a card sorting activity to reflect on needs and expectations and a testing session of the prototypes. The deaf participants were excited about the possibility to explore the sonic qualities of environmental sounds and experience them through different sensorial modalities like the visual (light and shape change) and tactile (vibration) perception. This functionality convincingly addressed the deaf people’s curiosity about sound. The jewels were regarded as an example of universal design which does not stigmatize or define deafness in any negative way and scales the solution to a broader audience than deaf people.

In the second design cases, children were engaged in personalising the facemasks. The resulting prototypes highlighted that current facemasks are unattractive for both male and female targets. Gender appropriateness was clearly remarked as an issue.

In general, the participatory design activities carried out in the two case studies, made desires, uneasiness and disquiet emerge, pervading the entire design process. The activity was grounded in the lived experience of disable people and driven by their aspirations, beliefs and culture.

Results obtained so far show that individuals value participation in the design process and the opportunity of customising and transforming assistive devices. This is an important component to grant individuals’ agency, ownership, and pride in wearing a device commonly fraught with marginalization. The practice of co-design has the potential to increase confidence in use and hopefully generate greater societal acceptance and awareness toward disability.

References
Quietude (2019). http://www.quietude.it/
Designing Magika, A Multisensory and Multimodal Environment for A New Educational Approach

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Abstract: This paper describes Magika, a multisensory environment that enables new forms of playful interventions for children, especially those with disabilities. Multisensory approaches are grounded on the theories of embodied cognition and sensory integration that emphasizes the formative role of embodiment (the way an organism’s sensorimotor capacities enable it to successfully interact with the physical environment) in the development of cognitive skills such as mental imagery, working and implicit memory, reasoning and problem solving.

Differently from current solutions, Magika offers different customizable activities integrated in a synesthetic way; it incorporates digital worlds projected on the wall and on the floor with a large number of connected objects such as toys, ambient lights and materials that allow children to experience tactile, auditory, visual, and olfactory stimuli. The system was designed with the intention of improving “P3S”, a previous version focused on optimizing technology performances (e.g. diminishing connection lags, extend modularity and scalability, etc...). In order to guarantee a positive user experience our renovation started with a human centered design (HCD) approach and changed the role of final user from being rather marginal in “P3S” to be the core of a new accessible co-design process, considering all players’ characteristics and needs in their singularity and diversity.

We explain a process lasting about a year from a design point of view, placing two main objectives. On one hand humanizing technology behind the system starting from user research to define a connected interface for caregivers that give them a control at a level which is not allowed by any other existing tool, added to a procedure that allows an automatic personalization of the child’s experience. On the other hand the social impact represented by the democratization of the low-cost and open source technological system and the installation of the multisensory room in the suburbs, that imply a reduction in costs, optimization of local educational resources, higher inclusiveness, and less inconvenience for children and their families that supported by caregivers will experiment new educational and therapeutic approaches.

Thanks to a preliminary exploration in two schools we can say that Magika offers unique features that despite being explored initially have already shown their potential.

Keywords: Multisensory Environments, Special Education Needs, Multimodality, Adaptivity

Introduction

Nowadays, our society asks people with different abilities to adapt themselves to the social and physical environment and usually they are asked to make their selves suitable to a system. As Designers our aim is to build accessible systems that allow them to minimize their efforts. In particular we built an inclusive environment able to transform a traditional classroom in a magic room; We first analyze current multisensory solutions and then highlights the entire process of a multidisciplinary team.
The value of the sensory integration in a learning context

Today public school does not refer to a single method or theory. The new methodological and didactic tendencies, schools still collect the spirit of the 20th century innovations. It is in this period that the passage of pedagogy from philosophical discipline to education science in which the different knowledge cross. Among the educational methods, which are still widespread today, two of them have left an important mark in the field of pedagogy: Maria Montessori method (Montessori, M, 2013), present in Italy and in the world; and the educational approach developed by Rudolf Steiner (Steiner, R., 1996), more or less in the same period. Both methods consider the child in its complexity and completeness, with all his intellectual, physical and creative abilities. One of the inspirations behind comes from 1837, when Fredrich Frobel invented the "Kindergarten". This was a revolutionary approach, not only for childhood, but for descendants of all ages. This learning style helps to develop the creative skills needed in this rapidly evolving society.

Frobel took the distance from the traditional transmissive approach and opted for an interactive model, giving children the opportunity to collaborate with materials and objects called “gifts” and designed specifically in order to gives them the opportunity to develop a better knowledge of the world around them. While playing children learn how to elaborate their creative process, that can be describe as a “spiral of creative learning” (Resnick, M., 1998).

The “spiral of creative learning” is the engine of creative thinking. Nevertheless schools take the distance to this approach and they focus only on providing teaching through information. But play and movement are important aspects for children and in particular for children with disabilities that need different methods in order to learn and be include in the classroom.

These are essential aspects also for training sensory integration: another reason why children with disabilities, need enough time to design and experiment with new object and exercise their body. That’s why provide students with opportunities for sensory experience enhances the ability of the central nervous system to process and integrate sensory information, so Multi-sensoriality become more effective than traditional training patterns.

Multisensory system

A multisensory system is an inter-connected structure grounded on the theories of embodied cognition and sensory integration, on the development of cognitive skills such as mental imagery, working and implicit memory, reasoning and problem solving sometimes through the concept of “playful learning”. (Wilson, M., 2002).

Most multi-sensory approaches take shape in dedicated spaces called "Multi-Sensory Environments" (MSE) - rooms equipped with items that provide gentle stimulations of different senses while offering a nonthreatening, relaxing environment. Researches have already developed different solutions by, such as Snoezelen, MEDIATE, MapSense and SensoryPaint. Snoezelen offer a relaxed atmosphere with pleasant surroundings, soothing sounds, captivating aromas, tactile experiences, massage and vibration, vibrosonic sensations, and gentle movement. Interesting light effects and comfortable seating. MEDIATE stimulates children through visual, tactile and aural channels and allows them to express themselves through body movements, but does not support interaction with objects. MapSense is an interactive map that uses a touch-sensitive surface, tangibles, olfactory and gustatory stimuli. Finally, SensoryPaint allows users to paint on a large display using physical objects, gesture-based interactions, and interactive audio. Still, both MapSense and Sensory paint do not support full-body movement-based interaction. Th In our project we tried to combines and extends the features of existing multisensory digital systems in a unique way at a relatively affordable technological cost, proposing a pervasive inter-connected space where all children are involved in new forms of full-body, tangible, playful, multisensory, learning experiences.
Setting

We developed a technology (Figure 1) that integrates visual contents projected on the walls (A) and on the floor (B); ambient sound (C), smart physical objects (textured materials (D), stuffed toys (E)), connected appliances (bubbles makers (F) and fragrance emitters (G)), smart lights (wireless portable lamps (H) and bulbs (I)). These elements, controlled using a tablet and automated by a PC, react to children’s manipulation (tangible interaction) and body movements (touchless interaction provided by a Microsoft Kinect (L)) to offer visual, auditory, tactile, and olfactory stimuli in any sequence, combination and intensity.

Magika Design

Magika concept come from one of the winning projects of a competition financed with funds of 5 per thousand which promotes the development of scientific research with high social impact. The goal was to overcome the limitations of previous multisensory environments and use advanced digital technologies to transform a usual classrooms of two primary school into a multisensory interactive and smart space that allows children and children with disabilities to live a customized and immersive experience and to learn in an engaging and stimulating way. In order to do that we start our research with a Codesign process that allow us to define users’ needs and design children experience in the best way.

Codesign

Two workshops were held with teachers at the primary school. The aim was to share knowledge about the educational needs of children with disabilities, the problems related to educational interventions for these subjects, in the school and extra-scholastic environment, and about teachers’ technology knowledge level to understand how they could manage the room.
Before the first workshop in order to discuss about the previous points, a google form was sent to all users of the project. The most important results were the following:

- The activities be carried out mainly in a group of 4-5 children, in some cases there will be single subjects
- Group management during the session is both necessary and limiting.
- The devices to “program” the activities of the room are PC and tablet.
- The time of the activity will be 1 hour total, which includes movements from classroom to the room, the actual playing time will be 30 minutes

After having reviewed the previous points with them, the purpose of the workshop was to understand what teachers expect from the room and what is the ordinary process for children with disabilities enter in the school. In order to do that we used the User Journey Map tool that allowed us to visualize at a glance a series of processes that would otherwise have to be analyzed in their single parts. We outlined with them the main phases starting from the first entry to school, then entering into the specific expectation regarding activities that will take place in the room and what will happen at the end of every activity.

In anticipation of the second workshop we asked teachers their perception of the individual stimuli and objects in the room, so through a second google form based on the “Mapping The IoT Deck” (Vitali, I., & Arquilla, 2018). tool they gave us useful information to set up our work. The toolkit is composed by up of 70 cards that summarize the key aspects of smart products. The horizontal side of the card introduces a topic with one main question, while the vertical side deepens it with specific “what if” questions. The Deck provides a framework that may be used freely or for structured activities.

During the workshop we did a demo to make them understand the individual activities and to discuss the results obtained by the survey. Teachers helped us to understand what they could be useful at the educational level.

_Users’ needs_

Once defined different users’ needs we constructed the archetypes. Archetypes reflect the character, the necessity, personality and daily routine of different users. We outline our main users: Caregivers and Children. The greater the understanding of context where the child is inserted the more teachers and therapist are motivated. Total delegation of the results, instead, it causes pressure on the caregiver, who are therefore less motivated action. If the context in which the teacher work is not understood, their motivation decreases.

Children are the main protagonist of the multisensory room experience and in general their motivation is always high, however could happen that decrease over time. It is important to take in count their need in terms of engagement and accessibility, and to design an experience that keeps their interest alive.

_Experience development_

It was necessary to think about a way to make the transition between every activity more fluid and engaging for children. From this assumption we thought that storytelling could help us to have a coherence during children experience in the room. Starting from the concept that narrative is a visualization of related events, real or fictional, presented in a sequence of written or spoken words, or still or moving images, we design a StoryWorld (Pinardi & De Angelis, 2006) that underlie the activities to connect them in a natural way and to involve children during their experience in the room.

Before accessing the room, children are told the fabula: Magika was a colorful and harmonic planet. The inhabitants belong to 5 species (hereinafter Senzies, as in, referred to the 5 main senses): Gus (taste-ers), Olfo (smell-ers), Auri (hear-ers), Tati (touch-ers) and Vis (view-ers) living in 5 different continents (-lands). One day, the awkward Kaos caused a “BigBoom” and made Magika decomposing.
into millions of colored balls, scattered throughout the universe. Emi ("the sixth sense", emotion), the wise sage of Magika, decided then to send magical spheres around the universe to be helped in the reconstruction of Magika. Everytime a child will experience an activity in the room, she will collect a ball that, after being grouped with other children's experiences, will be sent to the Magika World. In order to let children feel part of Magika in small time we developed a preliminary phase called "Avateering" in which they create their own avatar through a dedicated interface. They can choose different features as hair, eyes, mouth and labeled t-shirt). This phase ends by giving children a personal Magika badge. Children's avatar and badge will accompany children across all Magika's experiences (Figure 2). With the intent of understanding children's sensory preferences and dislikes and personalize their experience we thought about an Onboarding phase that allow the system adapts it self to each child's needs by proposing perfectly tailored stimuli.

![Figure 2: Magika](image)

**Control interface**

In the literature of Multisensory Environments the configurability of the activities and the management of what children do within them is a topic that is not so considered and only few case studies can be taken into account. Given the complexity of the system and the variety of activities that the room can offer, it was fundamental to study a solution that allows teachers and therapists to use and control the room in an intuitive way through a simple and usable interface. We develop two main entities: Magika Experience Manager (MEM), responsible of managing the entire flow inside the room and Magika Control Interface (MCI) divided into three main sections: CREATE(A), PLAY(B) and LIVE(C). CREATE allows teachers to set new activities and experiences (set of activities) before accessing the room. PLAY, only used inside the room, lets teachers selecting activities and experiences according to what they configured before. LIVE, to control and visualize the flow of the activity in real time.(Figure 3).

Once defined the architecture information we started the design of the interface from wireframes, which allow to define the hierarchy of information and make it much easier decisions concerning the layout. We reviewed them with teachers and we reiterated until we found an efficient solution. After having defined the design system of the interface in all of its component (Typography, icons, palette..), we start to developed the UI following the guidelines of the Material Design, whose main components were identified as intuitive and easy to read.

The enabling platform relies on a software and hardware multi-layered and multi-modular architecture. The first layer of the software architecture contains the MEM which manages the experience flow,
providing a connection to the MCI, orchestrating the succession of activities and updating resources and activities. The Activity layer contains the execution logic of the tasks to be completed during the activity by sensing players’ body movements and providing meaningful behavior to Magika; as the base of this layer lies a game engine. The Middleware Layer is composed of an expansible set of independent software packages, each in charge of managing a different technology: smart lightning, smart objects, non-native smart devices, text to speech services, cameras and full-body motion sensors. Each module aggregates different similar products to make the Activity Layer agnostic to the technology changes. Below, in the Physical Layer, physical sensors and actuators are placed according to the specific devices present in the environment. Perpendicularly the Data Analysis Layer and the DB Layer store data, visualize information and grant scalability.

Figure 3: Control Interface

Usability test
We did a preliminary usability study with ten teachers with the aim of identify potential design concerns to be addressed in order to improve the efficiency, productivity, and end-user satisfaction. The test provided 30 printed task to complete and it last 30 minutes. (Figure 4) Participants took part in the usability test at the primary school and a tablet with the web interface and supporting software was used in the multisensory room. A video camera was set. The roles involved in a usability test were as follows:

- Trainer: provide training overview prior to usability testing
- Facilitator: provide training overview prior to usability testing; defines usability and purpose of usability testing to participants; assists in conduct of participant and observer debriefing sessions; responds to participant’s requests for assistance.
- Data Logger: data gathering control
- Test Observers: silent observer; assists the data logger in identifying problems, concerns, coding bugs, and procedural errors, serve as note takers.

After the test the participants are asked to compile SUS (System Usability Scale) questionnaire composed of 10 questions, concerning usability, which he must fill in independently. The SUS (Brooke, J., 2013). questionnaire is useful to understand the results and analyze if the proposed concept has a good usability level [3]. Through a specific calculation the result is a number that it goes from 5 to 100.

- If the result is greater than 80.3 means that the participants loved the concept,
- If it is greater than 68 means that the concept has been well appreciated but could be improved
- if it is less than 51 means usability it is substantially low and should be improved seriously.

This was followed by some brief question on the general trend of testing and conclusions that measured their likeability and collected their helpful comments.
Results and conclusion

In the SUS questionnaire answers no result is inferior of 60 and this confirms that the concept was appreciated by all of them. In six cases over 10 the result is even higher at 80.3, while only one case is lower than 68: this achievement makes us particularly proud of the work so far, in fact this was the first time they was ask to manage a multimodal system and the evaluation was made before teachers training. The notes collected during the test suggest both multiple changes to do in order to improve the project, both the merits thanks to the appreciations made by the participants. We are currently conducting the first experimentation with children and we notice a very good degree of engagement, soon we will analysed the data collected to improve our work on these. To our knowledge, Magika is unique: it supports a gamut of stimuli, interaction modes, and learning experiences that are not available all together in existing smart spaces for children, especially those with Special Education Needs. Because of these characteristics, Magika may pave the ground towards new didactic and therapeutic interventions for SEN children that we cannot even imagine at the moment.

References

Designing A Framework to Investigate Creativity Enablers and Inhibitors in The Digital Era

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Abstract: We are going through a digital transition century in which digital technologies are totally reshaping the way in which people live and learn, the way they work and socialize. Human being is living in an onlife reality, a new experience of a hyperconnected reality that is modelling our digital culture and affecting the social, behavioural and cognitive development of digitally enhanced individuals, who are growing up with digital habits (smartphones, tablets, video games, etc.). In this transition, creativity has been recognized as one of the most distinctive human skill, especially in the necessary collaboration between human and machine. A fundamental issue that arises from this context concern the impacts of the digital evolution on creativity skill especially for the new digital generation. The objective of this paper is to present a Creativity 4.0 Framework based on the creative design process that highlights the most crucial factors of creativity in the digital era supporting the identification of the enabling and inhibiting condition that the digital transition is bringing on human creativity.

Keywords: Creativity factors, creative design process, digital transition, enablers, inhibitors

Introduction

The digital transition we are going through, intended as “the societal process arising from the deployment and uptake of ICTs” (Information and Communication Technologies) (Floridi, 2015, p. 43), is totally reshaping the way in which people live and learn, the way they work and socialize. Human being is living in an onlife (Floridi, 2015) reality, a new experience of a hyperconnected reality that is modelling our digital culture and affecting the social, behavioral and cognitive development of digitally enhanced individuals (Prensky, 2001a), who are growing up with digital habits (smartphones, tablets, video games, etc.). Ubiquitous, invisible and affective computing, artificial intelligence, robotics, virtual/augmented reality and all the emerging technologies, are changing skills requirements and capacity building for the 21st-century digital economy. The digital transition involves a combination of transformative digital technologies, tools, processes and most importantly people, in term of culture, skills and mindset.

In particular, creativity has been recognized as one of the most important skills in the 21st century (The Partnership for 21st century skill, 2008) as well as one of the distinctive human capability, especially in the necessary collaboration between human and machine (Corazza, 2017). It represents the intangible substrate for innovation (Kozbelt, Beghetto, & Runco, 2010) facilitating in understanding and guiding the opportunities and challenges posed by disruptive technologies. It has become fundamental to understand what are the factors that can influence the creative potential and skills of an individual and how the digital transition is impacting on them. Therefore, it is important to systematize the knowledge about creativity with respect to the empowerment of the individual and the impact brought by the digital transition and its technologies. The objective of this paper is to introduce a framework that put
in relation the most relevant factors of creativity in the digital age with the design process that enable to highlight the positive and negative conditions (respectively enablers and inhibitors) brought by the digital transition. Understanding creativity and how to enhance creative performance is of great importance for the design disciplines. The framework becomes a strategic tool for understanding and analysing the impact of the digital transition on the individual creative potential in the design process as well as a training tool to develop a strategic creative approach to lead and master the development of new disruptive technologies.

What is needed to be creative? The Factors of Creativity

Creativity has been studied for a long time but due to its complexity and multidimensionality, its understanding is constantly changing according to the socio-cultural environment around us (Runco, 2012). Considering interest of the research, we decided to adopt a more extended and elaborated definition offered by Plucker, Beghetto, and Dow (2004, p90): “Creativity is the interaction among aptitude, process, and environment by which an individual or group produces a perceptible product that is both novel and useful as defined within a social context”. This definition entails that creativity depends on many factors both related to the person and to the surrounding social, physical and cultural environment. Those factors have been collected within the literature by reviewing the different perspectives that psychologists adopted to study creativity scientifically. Around the 50’s a first wave of psychologists started to investigate the traits of the creative personality: “creativity resides in the middle ground between ability and personality; it’s highly correlated with intelligence and yet it’s also associated with various personality traits” (Sawyer, 2012, p63-64). Perseverance, intellectual curiosity, openness to experience, risk-taking attitude, self-efficacy (Bandura, 1982; Carson, Peterson, & Higgins, 2005; King, Walker, & Broyles, 1996) have been recognized as fundamental attitudes to perform a creative activity and reaching original and novel results.

Around 1970, the behaviourism psychology was replaced by cognitive psychology (Feldman, Gardner, & Csikszentmihalyi, 1994) that started to analyse the cognitive structures and the mental mechanisms shared by all the individuals occurring when engaging in a creative activity. “Psychologists have been studied the creative process for decades, and they’ve observed that creativity tends to occur in a sequence of stages” (Sawyer, 2012, p.88). Indeed, process theories specify different stages of processing or particular mechanisms as the component of creative thought such as conceptual combination, analogic thinking, associative thinking, structured imagination, creative visualization (Wallas, 1926; Ward, Smith & Finke, 1999; Isaksen, Dorval & Treffinger, 2000). The two waves refer to an individualistic approach and are both needed in order to explain this complex phenomenon.

Around the 80’s a third wave of researches introduced a paradigm shift by adopting a new sociocultural approach to the study of creativity. They adopt a more holistic approach and studies creative people working together in a cultural and social system. The individual and social views are not mutually exclusive. As Glaveanu (2015) sustain the social paradigm include the individualistic theory as part of the creativity complexity. An interdisciplinary approach is useful for the explanation of creativity and some researchers started to ask themselves what is the mix of ingredients that makes a person more creative. Some theories called componential approaches (Amabile, 1983; Sternberg & Lubart, 1995; Botella et al., 2013) explains creativity from this perspective taking into account the interaction between the individual inner level and the surrounding social and cultural environment. One of the leading theories is the Componential Model of Creativity (Amabile, 1983; Amabile & Platt, 2016) that identified the major components necessary for individual or small group creativity in any particular
domain, considering also how each component might enter into the creative process. According to the model, creativity is influenced by three main individual components (i.e. constituents that control, determine, and enter into processes) each one including different factors (i.e. elements, circumstances, or conditions contributing to a process or outcome). These are: *domain-relevant skills* that includes factors such as domain knowledge, technical skills, special talents; *creativity-relevant processes* that includes factors related to both personal attitudes and cognitive processes; *intrinsic & synergistic extrinsic motivation* that includes the inner motivation and the external factors that influence it. The fourth component of the model is the *surrounding environment* that can extremely influence the individual components and includes social and material factors such as access to knowledge resources, space set up, technical and social support from others. The Amabile model has been considered as a scientific reference since it supports a holistic view of creativity merging both the individualistic and the socio-cultural perspectives and factors, that are totally fundamental to explain and study creativity in this era. Amabile (1983) also argued that “Although it is proposed that the three main components constitute a complete set of the general factors necessary for creativity, the listing of elements within each component can only be completed gradually, as progress is made in creativity research” (p. 362). Therefore, each component has been integrated with the factors identified from the review of the main waves of creativity studies only if explicitly demonstrate its relationship with the component. This allow to collect a wider overview on the impact of the digital transition on a single specific factor when possible or more broadly on the component. Figure 1 show the overall amounts of components and factors that could influences the human creative potential.

![Figure 1: Integrated Amabile’s Components of Creativity](image)

In the last decades, indeed with the advent of ICTs, the people and the society has started a process of transformation, changing their behavior becoming more and more interconnected. Fischer, Rohde,
and Wulf (2007) defined the term social creativity as working together to solve a problem with the help of computer media and technologies. Digital technologies are indeed bringing new opportunities to empower the creative potential. Therefore, a critical investigation is needed to effectively understand how the digital transition is positively or negatively influencing or transforming the ingredients that contributes to make a person more creative.

**Structuring a framework of the creative design process in the digital transition**

The components and relative factors identified, if developed and stimulated, can increase the degree of creativity throughout the different phases of the creative process. There is indeed a confluence between the factors and the creative process and highlighting their relationships enabled us to build an analytical framework which support the identification of how the digital transition can influence the human creative potential within the creative design process.

The literature already presents fragmented studies from different disciplines (e.g. design, psychology, computer science) analysing some of those influences. The aim of the framework is therefore to interconnect all this information and to map the state of the art of the positive and negative influences on creativity brought by this scenario of transition, in order to outline the boundaries on how to facilitate and support the creative expression of the digital generation within the creative process.

The aim of the framework is also to create a design-oriented overview on the impact of the digital transition on creativity. Indeed, for the design research, this investigation becomes strategic since it allows to understand the new opportunities to creatively lead and guide both the strategic adoption of digital technologies and the empowerment of the creative process.

The framework is composed by two main parts. One is the framework structure representing the creative design process, a cross-domain process model able to support the development of specific training methods to discipline the process leading to the generation of new ideas. The second part is represented by the collected factors of creativity, previously described, that are mapped throughout the creative design process in order to clarify the understanding of which factors intervene and enhance each step. In this way, the Creativity 4.0 framework integrates the creativity thinking style into the various steps of the creative design process, including the motivational, cognitive, and attitudinal, social and technological factors that influence the individual creative potential.

**Building the framework structure**

In order to comprise all the elements from design and creativity research, an integrated framework has been formulated. It captures the thinking styles that reflect the creative process steps of the various model that psychologists have been proposed, keeping an approach to creativity that is based in the real-world design processes. The framework has been built by reviewing different processes from design and creativity research (Amabile, 1983, 2012; Corazza & Agnoli, 2015; Isaksen, Dorval & Treffinger, 2000; Scott et al, 2004; Wallas, 1926; Mendel, 2012; Wynn & Clarkson, 2005; Design Council, 2007; Sawyer, 2012) to identify the steps of the process, what types of activities are carried out in each step and what is the mental thinking style on which each step is based. This approach of deconstructing the process in steps, activities and thinking style allowed to map the less rationale creativity factors emphasizing their interconnections and showing the impact of the digital transition on the activities, the creative factors and the overall design process.
The Creativity 4.0 Framework is based on a simplified yet exhaustive version of the creative design process, focusing on three main consequent stages and five explicit process steps with specific objectives, each one characterized by a thinking style that drives the generation of a specific output that represent the input of the consequent step. ENGAGE is the stage that sparks the entire creative design process and includes the first step Immerse that adopt a ‘visionary’ thinking style. Discover and Define, the second and third steps within the EXPLORE stage, adopt respectively a ‘diagnostic’ and a ‘strategic’ thinking style. This stage allows the creation of a basis from which a significant and potentially viable goal can be defined. The fourth and fifth steps are Ideate and Build to Think, within the GENERATE stage. They allow the generation and the prototyping of innovative ideas and require respectively an ‘ideational’ and ‘evaluative’ thinking style. Each step uses two main mental phases: a divergent phase which refers to the ‘creation’ or ‘widening’ of a field of possibilities and a convergent phase in which there is a narrowing of choices, based on criteria of what is useful and relevant (Tassoul & Buijs, 2011). The activities within each step are defined based on the divergent and convergent phases in order to provide a process for managing thinking and action, while avoiding premature or inappropriate judgement. Once the basic structure of the framework has been built it is easier to map the factors of creativity. For the sake of clarity, we decided to explain in the next section only the mapping of the factors that intervene on the first stage of the process, Engage, because the methodology is applied in the same way to the other stages.

Mapping the factors of creativity on Engage
Engage is the first stage of the process and include the entering step that has been called Immerse. The first activity is ‘identifying a vision to explore’ that aims at defining the focus area in which a new idea must be generated at abstract and/or at detailed level, articulating an image of what a person desire to create. Intrinsic motivation, defined as the kind of motivation connected to personal interest, enjoyment, challenge of the task itself, satisfaction, natural personal inclination (Amabile, 1983), is the main key factors that drives this activity, together with self-expression and activity meaningfulness. Motivational aspects are believed to be crucial also for keeping the active role over time and to persevere in overcoming the difficulties related to generate new ideas beyond the state of the art, self-organization, use of spare time, and social interactions in collaborations. The Creative self-efficacy, meaning a person belief that he or she is or not creative (Tierney&Farmer, 2002), is another fundamental factor to enter the process and to accomplish a task with successful results. Fundamental attitudes to start the process are also the risk-taking attitudes (Glover, 1977), that refer to the willingness of investing ourself in a creative process despite the uncertainty of the outcome, and perseverance fundamental achieve results despite difficulties. Positive affect (Amabile& Pratt, 2016) refer to positive emotions and feelings that support individual in acting and making decisions. The second activity is ‘set up the entire creative process’, which is not part of a natural thinking process occurring in the mind of a creator but emerges from an increased need of planning due to the complexity of contemporary design challenges. Organizing the process, has become therefore a preparatory activity before moving to the consequent Discover step, in order to get the best out of the process and the people involved. This activity indeed includes mainly the fundamental abilities needed during the entire process and that have to be ensured in order to obtain great results. Those are understanding the creative process, which is fundamental in order to consciously manage the several steps, communication abilities, collaboration and network building abilities. The framework enables to highlights the main enablers and inhibitors of the creativity factors and the process activities.
During the immerse step, human select a single refined focus area within the general one. As soon as the vision is defined, structures in our mind are immediately activated moving to a consequent Discover step. Discover and Immerse steps are indeed highly interlaced and a constant iterative process exists between the two steps.

**Table 1: ENGAGE stage, extracted from the overall Creativity 4.0 framework**

<table>
<thead>
<tr>
<th>Stages</th>
<th>Steps</th>
<th>Activities</th>
<th>Thinking style</th>
<th>Factors of creativity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engage</td>
<td>Immerse</td>
<td>Identify a vision to explore</td>
<td>Visionary thinking</td>
<td>Intrinsic motivation / Self-expression / Perseverance / Risk-taking attitude / Positive affect / Creative self-efficacy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Set up the process</td>
<td></td>
<td>Understanding the creative process / Communication abilities / Collaboration and network building abilities</td>
</tr>
</tbody>
</table>

Before highlighting some of the enablers and inhibitors that influence the factors within Engage and the entire stage, it is interesting to describe how the framework has been used.

**Outlining the impact of the digital transition on the factors of creativity**

From a deep investigation of the literature emerge that the digital transition is radically impacting the human condition in profound ways on different levels (Loh & Kanai, 2016, Floridi, 2015). From the inner, less visible, cognitive and emotional processes that concern individuals to the outer, more evident and articulated interactions with other people and between groups of people. Those levels obviously represent different aspects of a same unit, the human being, that interacts and influence each other. Given the impacts brought by the digital transition on the human being, the hypothesis emerged is that also the factors of creativity will suffer positive and negative influences, thus modifying consequently the degree of creativity within the creative design process.

These analyses allowed us to build The Creativity 4.0 model (Bruno and Canina, 2019) which represented the theoretical model that allowed to identify the enablers and inhibitors of creativity in the digital age. Through the model indeed, has been identified the impacts of the digital transition on human being that were putted in relation with the framework facilitating a structured exploration of the literature and the case studies. The model guided the several steps of iteration and refinement to verify the hypothesis and identifying the influences on the factors and more broadly on the components. Indeed, the analysis on of the factors has been structured according to three main investigation.

The first investigation, based on an extensive literature review, the framework was related to the positive and negative impacts that the digital transition has brought on the human being on each level, to understand how they can be influenced. From the alteration of cognitive structures involved in information processing and memory (Loh & Kanai, 2016), to the social hyperconnectivity and the creation of creative communities (Benkler & Nissenbaum, 2006). The second investigation, based on case studies analysis, aimed at identifying researches that explored the potential of specific digital technologies in the enhancement and stimulation of certain factors, verifying their influence on the creative process (Shneiderman et al, 2005; Wang et al, 2010). The third investigation, based on expert interviews, focused on confirming the enablers and inhibitors identified in the previous iterations and on understanding where and how the digital transition is shaping human capacity to generate original and effective ideas.
The analysis highlighted how the factors of creativity and the process steps are enabled or inhibited by digital transition due to both the behavioral and social changes taking place and the widespread adoption of digital tools.

**The Creativity 4.0 Framework. Enablers and Inhibitors of the Engage stage**

This section presents some of the enabler and inhibitors identified that influences the factors of creativity within the Engage stage, and the stage itself.

**Enabler. Providing opportunity and facilities for self-expression and self-discovery**

In contrast with the conception of consumers or more in general people to be passive receivers, the digital transition has its emphasis on ‘doing’ and the active roles. Today, in the digital transition, human beings have access to sophisticated digital tools for rich media content creation, sharing of ideas, discussion, and distribution. This is opening a new dimension in which human being can both self-discover its own creative attitude and self-express inner feelings, ideas, passions and visions, transforming and giving shape to whatever imagination can generate. The digital technology enables us to share the desirable world using prototyping tools such as video, apps, digital fabrication technologies, etc... Hatchuel et al. (2010) highlighted that exploration of the desirable world is an intrinsic motivator for innovators that can increase the meaningfulness of the activity itself. Digital technologies become a crucial enabler of self-expression in the digital era, factor capable of keeping high level of engagement and participation throughout the whole creative process. All humans are creative but most of us have lack of opportunities to find the right domain to express our inner ideas and exteriorize them through creative productions (Robinson, 2010). Digital technologies can be used as creative technologies (Zagalo & Branco, 2015) in the sense that they allow to identify a creative domain in which we feel more creative and developing high level of creative self-efficacy (i.e. a person belief that he or she is or not creative) (Tierney & Farmer, 2002) fundamental factor to enter the process and to accomplish a task with successful results.

**Enabler. Providing availability of unprecedent inspiring digital content, ideas and projects.**

The diffusion and the democratization of digital technologies have had consequences on the dissemination of the creative act, generating unprecedented number of elements in the digital realm available for creative action and reaction (Literat & Glaveanu, 2018). This enable an easily interaction with successful cases which produces a form of positive stimulation from a motivational point of view, an inspiration for the generation of new ideas, opportunities and visions therefore becoming an important enabler of the engage stage. People create remixing ideas of others, working with tools made by others, and sharing their creative work with a wide and diversified audience (Literat & Glaveanu, 2018). The result of the interaction with multiple people, possibly with different cultural backgrounds, can generate new ideas and focus areas at the initial stage of the process (Burt, 2004), favouring the so-called brokerage of knowledge (Corazza & Agnoli, 2015, p.4).

**Enabler. Requiring new skills for creative practice**

The increased complexity and uncertainty of the contemporary challenges require more often than ever to involve multidisciplinary team as well as digital tools and technologies in order to achieve results that human alone cannot do (Malone, 2018). From the analysis of the current scenario of transition emerge how fundamental is in the digital era to develop a digital literacy meaning both the acquisition of digital skills and the understanding of the potentialities of digital technologies in terms
of social and cultural opportunities. These competences allow to explore and anticipate opportunities and needs and adopting cutting-edge technologies at their service. Understanding the creative process is another fundamental factor that drives this activity allowing to exploit the potential of digital technologies to enhance the process. For example, professional will increasingly find themselves to design human-machine collaboration processes to achieve results they had never imagined before. New active digital technologies, such as the generative design, support the generation of multiple and unexpected solutions but requires a new kind of thinking and a deep understanding of the process to collaborate with other stakeholders with diversified technical skills.

**Inhibitor. Increasing distractibility and reduction of average attention span & focus.**

The presence of digital devices conducive to a multitasking behaviour as well as the always availability of solutions, stimuli and activities has decreasing the attention span of the humans (Loh & Kanai, 2016). Let’s think, for example, at the multitude of notifications we continuously receive from our phones, laptopt, social networks, e mails and that represents inputs for our brain, making us more unable to slow down. This can be very harmful for patient, determination and grit which are the ingredients of perseverance attitude that represents the foundation of creativity. Perseverance can be weakened by the digital transition and therefore need to be trained and stimulated. Researchers (Shapiro & Niederhauser 2004, Moos & Marroquin, 2010, Carrier et al. 2015; Rosen et al. 2011) have noted the importance of motivation, and positive affect in moderating the distractibility by the Internet technology.

**Conclusion**

The Creativity 4.0 framework integrates the creativity thinking style into the various steps of the design process, including the motivational, cognitive, and attitudinal, social and technological factors that influence the individual creative potential. This framework is not proposed to be exhaustive; it is a work in progress to outline the boundaries with respect to the impact that the digital transition is having on the creativity factors that intervenes in the design process. It becomes a conceptual basis for understanding, analysing, and designing ways to investigate the design process in the digital transition and also a tool to be later used as a paramount reference for training creativity skills. The research and the framework allow to organizing the fragmented data collected within the literature from different fields and disciplines and give them a new interpretation and a new meaning, providing members of different research discipline with a common language and a frame of reference for defining the boundaries of a complex phenomenon such as creativity in the digital age. The framework enables also practical application by aiding professional designers in making informed decisions when they orchestrate design processes, e.g. when they are asked to adopt or develop digital creativity tools to empower the creative challenge at hand. The limitation of this research is certainly given by the breadth of the topics dealt with and by the fluidity of research in creativity that are constantly remodelled in relation to the changes in the social and cultural context.

**References**


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Abstract:
In recent years, many large companies engage to develop intrepreneurs inside their own company with the intention of creating new businesses in another field of current business and industry they have performed. However, they are lacking in experience to imagine something that has not yet existed with no users and markets because they accustomed to derive ideas from the existing user behaviours and markets.

Examples of methodologies for exploring future needs of which ordinary consumers are not yet aware include “Lead User Method (LUM)” (Von Hippel, 1998) and “Extreme User Research” (Brown, 2008). LMU focuses attention to find the future needs of ordinary users from the standpoint of some Lead Users who have advanced ideas and extreme attitudes. On the other hand, Extreme User Research focuses on not only advanced users but also ones for extreme laggards opposite side of them. What we are concerned here is that both of them is based on the perspective of already assuming a “user” in the existing context. Furthermore, the question we ask is that these approaches could be not worked enough when we will think about “what has not yet existed” because there are no users in that situation yet.

Therefore, the purpose of this study is exploring how to find and define a quite novel sign of needs in the future from outside contexts of existing products and services. Firstly our experimental approach started to explore the sign from someone who is not only the advanced and/or extreme users within the context of the existing products and services but also people who have extreme attitude based on their own strong interests outside the context of those (We call the people TRIBE\(^1\)). TRIBE means a group of consumers who have extreme ideas and behaviours about abstract interests and themes such as “transportation”, “healthcare”, and “time-spending”, regardless of specific products and services. In addition, it enables us to understand easily “future problems” rather than “current problems” by synthesising the insights getting from analysing TRIBE and macro trend research from the viewpoint of STEEP (Social, Technological, Economical, Environmental, and Political). We arranged this design process as a sprint way incorporating TRIBE and STEEP and called “Future SEEking Program (FSP)\(^2\)”.

FSP brought us to catch some signs of changes in middle-long term future about the social, environment and culture. Expert designers have been responsible for finding problems which ordinary consumers are unconscious and creating new meanings until now. FSP could contribute to diffuse the design capability like that from expert designers to intrepreneurs who intend to explore the futuristic new meanings and needs.

Notes:
1) The concept of TRIBE has been advocated by SEEDATA Inc, a group company of Hakuhodo, which is a major Japanese advertising agency, for understanding upcoming insights of middle-long term futuristic lifestyle.

2) Future SEEking Program (FSP) is delivered on collaborative licensed by INFOBAHN Inc. and SEEDATA Inc.

References:

Keywords: TRIBE, STEEP, FSP, Lead User Method, Extreme User Research
Combination of New Age Design and Specific Functionality of Orthopedic Footwear

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Abstract: Rapidly developing 3D printing technologies enable different industries to individualize their product design, implement sophisticated geometry, accelerate production processes and reduce waste. Individual orthopedic footwear is designed for correcting deformed foot and reduces movement disorders. The traditional method of producing orthopedic footwear has many limitations, when it comes to matching specific design, which has to meet the requirements of the motion function and combine the various details of footwear production. Also very important its aesthetic appearance, design solutions according to the fashion trend. The aim of this research is to create aesthetic heels for orthopedic footwear using 3D printing technologies and to analyze product qualitative parameters. Data analysis and research results were obtained using the finite element method. Essential requirements for the design of the product have been identified, which can maintain the specific orthopedic functionality and original design.

Keywords: 3D printing, Shoes, Heels, Orthopedics, Design

Introduction

The alternative techniques of production draw more attention as there is an increasing demand for production. Currently, industrial companies aiming at the improvement of the product design and looking for the techniques to produce units, prototypes and complex knots faster, cheaper, extra work free and with less waste, can offer unique and individualized products to the consumer (Tuab et al., 2018). 3D printing is being included in more and more industries, and orthopaedics is not an exception, as this technology opens up new and creative possibilities and solutions in order to adapt orthopaedic products following patients’ needs better. One of the orthopaedic sectors is footwear, that is produced for people, whose feet are deformed and painful in order to aid at the recovery of different movement disorders (Van Netten et al., 2012). Design fits into all walks of life. Provides fullness and satisfaction, sometimes acting only through the senses let’s feel of happiness. With the development and development of new technologies such as 3D printing, there is an opportunity to integrate modern design solutions into areas such as orthopedic footwear, where the specificity of production and the particular susceptibility of aesthetics are in principle ignored. A model of custom-made footwear is an important element of manufacturing process, so many efforts are put into the product’s development in the area of making of orthopaedic shoes, when innovations are involved and traditional manufacturing limits are trespassed. The capacities provided by 3D printing technology allow creating heels of unusual and unique design, the geometry of which would be impossible if traditional manufacturing methods
were used. The entrance of this technology into the manufacturing process of orthopaedic footwear is changing design of footwear and user’s attitude. Fashionable shoes of exclusive design are becoming part of personal style and help the customer to get distinguished from the crowd. Making of personalized heels of a new design to the customer acquires a completely new meaning as these heels will help to implement personal solutions of the customer and to reflect the latest tendencies in footwear fashion. 3D printing and design are merged in order to grant complete distinction to the footwear.

Current working methods
Orthopedic footwear is produced manually using standardized wooden heels, which are adjusted manually every time the foot problem is changed, changing height, shape, tilt angle, so the design remains in the second plan, sometimes even using such tools impossible to achieve aesthetic image, the changes made are often seen with the naked eye, so does not only the fact that there is a foot problem, but also attracts the eye for archaic design (figure 1).

![Figure 1: Wooden heels: a) standard size heels; b) custom-made/individually made heel c) adhesive additional layers on the wooden heel to adjust the heel to the shoe; d) wooden heels in production; e) shoes with wooden heels](image)

Thus, it is underlying to analyze the possibilities and use of 3D printing, having combined 3D printing technology with traditional production of orthopaedic footwear, disclosing design solutions of orthopaedic footwear. Production process shown in figure 2. The article aim – applying technologies of 3D printing, to create footwear heels of original design and to research their qualitative parameters.

Usage of heels and its impact on feet
Female footwear heels play an important role in terms of design, aesthetics and comfort, and their role is significant in the design process as is their impact on walking that is widely analyzed in scientific research. It is important to understand what impact the high heels have for different body parts, to study different changes in walking, as it is important piece of information for footwear
designers. (Broega et al., 2017). Taking into account ergonomics, the scientists research the problems of footwear with heels (size, dimensions and shape) and physiology (Lien – Ya et al., 2015). The research conducted in different heel height in the scientific articles [Hessas et al., 2018; Valentini et al. 2009] determined that high heels may have positive impact on walking and posture. Not lower than 20mm heels have a protective impact on the muscles of the spinal part (Hessas et al., 2018). The high heels also have an efficacious effect on walking, restoring the speed of walking, standing the symmetry of walking and balance (Valentini et. al., 2009).

**Orthopaedic footwear**

Custom-made/individual orthopaedic footwear – an orthopaedic means aiding deformed feet to improve or compensate biomechanical movement disorders (Tuan et al., 2018). Orthopaedic footwear may be a solution and at the same time a part of the complex treatment for ones with congenital or acquired foot deformity. Its purpose is to ensure a regular position of foot, reduce tiredness and stop deformation. Custom-made/individual orthopaedic footwear solves greater problems and it is intended to the treatment of greater foot deformities, to reduce or eliminate the issues related to deformities as well as tiredness and other symptoms. Such orthopaedic footwear is produced individually, i.e. custom-made following specific patient’s cases and an orthopaedist’s recommendations/prescriptions. Custom-made/individual orthopaedic footwear is designed taking into account functional requirements, which are set for orthopaedics. The patients’ decision to use orthopaedic footwear is impacted by such factors as improvement of walking with no pain feeling, but also is important aesthetic image as for the patient it is important that his/her ailment view is not seen (Van – dragomir et al., 2016). Despite possible use of orthopaedic footwear, some patients decide not to use the orthopaedic footwear intended and produced to them due to the drawback of aesthetics, fashion, and style and design fulfillment.

**Heel modeling**

3D printing technology makes it easy to design the heels using 3D modeling software packages. Modeling can immediately assess the problem of the foot and make the necessary changes, it is quite easy to find heels design solutions, that disguise orthopedic issues, such as the unevenness of both legs, or other changes made. In this place you can take into account not only the functional problems that are solved by orthopedic footwear, but also the latest trends in orthopedic projects. One of the trends in footwear development is inspired by architectural motives. Shoe heel shapes resemble architectural details, building constructions. Created an experimental collection, also inspired by architectural elements – columns that gracefully hold the entire volume of the building (figure 3).

**Methods**
In order to research qualitative parameters of orthopaedic footwear heels, for the testing there was selected the finite element method (FEM) and software ANSYS Structural 17.1., producer (ANSYS Inc.). In the software FEM there are virtually imitated real exploitation conditions and there is carried out comparative testing, during which the heel geometry is partially changed in order to determine the use of geometric changes on the mechanical characteristics of the heel.

**Research object**

Orthopaedic footwear is produced of different styles and models; however, one of popular models, producing high heels is the application of wooden heels (Fig. 1 a, b). Taking into account the foot size and model, there are adjusted wooden heels of a standard type (Fig.1 a); however, in the presence of non-standard size and severe foot deformities, for exclusive design models, the wooden heels are made from the half-finished product manually, adjusting a wooden heel model and size in accordance with the patient’s foot measurements. (Fig. 1 b).

In order to identify qualitative parameters of the heels, printed applying 3D technologies for the research there are requested spacious models, which would conform to reality and for that, there was selected the software SolidWorks that aids at the conduct of three-dimensional design solutions. There was designed footwear heels of traditional and original design (Table 1) intended to compare them to wooden heels in the research, which are applied in the production of orthopaedic footwear.

<table>
<thead>
<tr>
<th>Table 1: Virtual samples</th>
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<tbody>
<tr>
<td>Heel height 2cm (Low)</td>
</tr>
<tr>
<td>LH-M0</td>
</tr>
<tr>
<td>LH-P0</td>
</tr>
<tr>
<td>LH-P1</td>
</tr>
<tr>
<td>Wood</td>
</tr>
<tr>
<td>Wood</td>
</tr>
<tr>
<td>Solid</td>
</tr>
<tr>
<td>Solid</td>
</tr>
<tr>
<td>Plastic</td>
</tr>
<tr>
<td>Plastic</td>
</tr>
<tr>
<td>* symmetric in terms of sagittal plane</td>
</tr>
</tbody>
</table>

Tow materials were selected for the research, this is tree – birch, the key material that is applied for the production of orthopaedic footwear heels and 3D printing laser technology of powder sintering (SLS), material for printing – plastic (Polyamide PA12) that is widely applied in industry and distinguishes by good mechanical characteristics (Table 2).

<table>
<thead>
<tr>
<th>Table 2: Applied materials and their characteristics*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Characteristic</td>
</tr>
<tr>
<td>Module of elasticity</td>
</tr>
<tr>
<td>Poisson coefficient</td>
</tr>
<tr>
<td>Density</td>
</tr>
<tr>
<td>Ultimate strength</td>
</tr>
<tr>
<td>Bearing/compression strength</td>
</tr>
</tbody>
</table>

*Source: All values indicates in the table are provided in the technical documentation by producers

**Virtual bearing/compression centre**
There were conducted two bearing/compression tests of heel configurations (compression tests were equally the same as during the testing of both low heel and high heel):

1. During the first test, the samples were turned into the angle of 20°, imitating the phase of support during walking (Fig. 4A), when the foot heel touches the ground first (heel support). During this phase, the force affecting the heel is 1.5 times greater than the body mass, in this case, there was applied the force of 1000N. (The date were selected following the article (Farzin et al., 2014), where there was conducted the research in walking and feet).

2. During the second test, the samples were put horizontally to the basis, imitating simple standing (Fig. 4 B). In this case there was also applied the force of 1000N. There were carried out 16 tests – 8 samples x 2 configurations of tests.

![Figure 4. Heel testing scheme](image)

**Results**

The highest strengths (158.12 MPa) formed in the low heel sample LH-P1, greatest displacements (0.99mm) formed in the low heel sample LH-P1. During the test of high heel sample, both the highest strengths and the displacements formed in the sample HH-P1. The distribution of total (von Mises) strengths in the sample LH-P1 are illustrated in Figure 5.

![Figure 5. Walking phases imitating test results a) von Mises stress, MPa; b) displacement, mm](image)

The configuration results of the second testing are illustrated in Figure 8. Both highest stretches (4.14 MPa) and displacements (0.033mm) were determined in the low heel sample LH-P1. In the high heel sample, both the highest stretches (22,665 MPa) and displacements (0.32mm) formed in the sample HH-P1. The distribution of total (von Mises) stretches and displacements in the samples HH-P1, HH-P3 is illustrated in Figures 6, 7, 9, 10.
Discussion of results

During the first configuration of tests, it was indicated that material type is tree or plastic, the heel is made from, and it does not have any impact on the heel strength, as both total (von Mises) inner stretches were equal in both samples - LH-M0 and LH-P0; however, the material type has impact on the heel rigidity – the plastic heel displacements reached 0.132mm, meanwhile wooden only 0.015mm (~10 times lower).
The conducted changes in low heel design (LH-P1 sample), had negative impact on the heel strength and rigidity, as total stretches increased from 47.441 MPa to 15.812 MPa, and displacements increased from 0.132mm to 0.99 mm.

In case of high heel there was observed the same trend – wooden heel (HH-M0) is more rigid than plastic (HH-P0) (displacements are lower 10 times), and the material has no impact on strength. The corrected design of the high heel had negative impact on both heel strength and rigidity as inner stretches increased from 72.209 MPa to 80.922 MPa, and displacements increased from 0.206mm to 0.35 mm.

Taking into account the+ distribution of total (von Mises) stretches, in cases of both high heel and low heel, they are concentrated in the place of force adding or in the place where there would be the area of contact during the phase of support. In case of low heel, the stretch values are exceeded 3 times for the material strength break point and in case of high heel – they are exceeded almost 2 times, as a result in these places of the heel there would be caused plastic deformations. The fact, that the tests were done without an additional layer of rubber that would be stuck to the heel and absorb most of the impact during the impact phase should be evaluated.

During the second configuration imitating simple standing test, it was determined that in cases of both low and high heel, it was noticed the same trend as during the first testing – wooden heel (HH-M0) is more rigid than plastic (HH-P0) (displacements are lower 10 times), and the material does not have impact on the strength. The conducted geometric changes of high heel have significant impact on the heel strength – total von Mises stretches increase by almost 7 times in comparison of HH-P0 with HH-P1 and on rigidity – displacements increase about 4 times in comparison of HH-P0 with HH-P1.

Total von Mises stretches are formed much lower than during the first testing and are significantly lower than the material strength breakpoint, so even the heel made from plastic with some elements of design, would conduct its functions and could be applied in the production of shoes, because reserve coefficient is only 2.12.\(^1\)

Conducting geometric changes of heel (including elements of the certain design), it is recommended to retain the symmetry of the heel geometry as taking into account the distribution of displacements (Fig. 10 HH-P1), the heel deviates to one side more.

**Application of experiment results**

Following the conducted research there were created and produced 2 models of female footwear, which were selected for further development and the production of an experimental product. For the implementation of experimental products, there were selected models with low and high heels, which were tested.

\(^1\) Reserve coefficient is estimated in accordance with the material strength break point and formed maximal inner stretches during load.
Having produced prototypes, it was proved that the heels printed using 3D technology, may be applied in a traditional production of footwear with no extra elements of adjustment. Having assessed the general footwear model, it can be noticed that in the heel models there are disclosed the peculiarities of footwear design.

**Conclusion**

The wooden heel is more rigid than plastic and displacements differ 10 times and as a result, the resistance of the plastic heel to the pressure force is weaker and it can stand fewer cycle loads.

The changes of heel design with cores had negative impact, so in the contact places there may emerge plastic deformations, there are requested design changes in the place of support. It is recommended to design in the place of phase with no cores as during walking, first the heel touches the ground and the force affecting the heel is higher.

During the creation of the heel design, during the design it is recommended to retain the symmetry of the heel geometry, as taking into account the distribution of displacements, there are possible unequal deformations and it is probable that the heel will deviate to one side.

**References**


A Proposal of User Interface for Next-generation Air Traffic Control Console

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Abstract: Air traffic control operations are expected to become even more busy in the future. Therefore, it is important for the air traffic control console system to be a more user-friendly user interface. In this paper, we explain an example of the development of an air traffic control console that incorporates the process of "Human-Centered Design".

Keywords: User Interface Design, Human-Centered Design, Air Traffic Control

Introduction

Background

Air traffic control is a task performed by air traffic controllers for supporting aircrafts from the ground so that they can be navigated safely from landing to takeoff. The air traffic control system used for air traffic control gives directions at any time to controllers utilizing various information such as congestion conditions and meteorological conditions in the routes, so as to secure safety distance of aircrafts, based on current positions and altitudes of the aircrafts, as well as flight plans including departure place and destination. This task is called air-traffic control. Among the air-traffic control works, tasks called air route traffic control are usually performed by 2 persons, one person is the radar air traffic controllers and the other one is the coordinators. The radar air traffic controller monitors safety distance of aircrafts based on radar information and gives directions such as location or altitude of the aircrafts in communication with pilots. The coordinator contacts controllers in charge of other airspace and coordinates the traffic referring to flight information of the aircrafts other than radar information (information required for aviation is inscribed) so that aircrafts can be navigated smoothly. The radar air traffic controller monitors all aircrafts flying in the airspace that they are in charge of and gives directions at need. The radar air traffic controller controls more than 20 aircrafts maximum at the same time. Although it is expected that the tasks of controllers will be even heavier in the future, smooth and safe navigation must be continuously secured. Therefore, it is important to obtain user interface which is easy for controllers to use for securing safe and smooth navigation.

As one of the methods to consider usability of user interface of an air control system used for air traffic control tasks with high specialty, utilization of human-centered designing is expected. "Human-centered design" is a series of activity processes that provide products and services with high user satisfaction. The process of "Human-Centered Design" is to ensure that the user's characteristics and usage are understood and design in conjunction with user ratings so that they can be shared with development stakeholders.
The process of “Human-Centered Design” for user interface of information equipment is generally the process of analyzing problems on user interface rather than user usage and creating solutions for improvement and conducting evaluation.

Using “Human-Centered Design” to develop the user interface of the air traffic control console system can be expected to create an easy-to-use user interface for the controllers.

**Purpose of research**

The purpose of this research is to show in detail the practical case of user interface development of an air traffic control console system utilizing the process of “Human-Centered Design” for creating an easy-to-use user interface for the controllers.

**Research method**

In this research, we refer to “A STUDY ON TASK ANALYSIS FOR DEVELOPMENT OF AIR TRAFFIC CONTROL SYSTEM” that utilizes human-centered design process for air traffic control console system. The above research is based on the process of “Human-Centered Design” to grasp the use situation of air traffic control work and to extract the problem of the work. In this paper, we conduct developing the idea of the user interface of the air traffic control console system based on the features and problems of the air traffic control work extracted in the above research, simple evaluation of the user interface idea, prototyping and user evaluation. In this paper, we first show the flow of user interface development of an air traffic control console using human-centered design, and describe the priority of features of air traffic control operations. Next, we will discuss the development of ideas for the user interface of the air traffic control console system and the simple evaluation of the ideas. After that, we describe the functions of the prototype of the user interface of the air traffic control console system to be created, and describe the user evaluation results and considerations by the former controllers for the prototype. Finally, the summary of this research is described.

**Flow of user interface development of air traffic control console system utilizing “Human-Centered Design”**

This chapter shows the flow of user interface development of an air traffic control console system using "Human-Centered Design" and the overview of the development.

The flow of user interface development of an air traffic control console system utilizing "Human-Centered Design" was constructed with reference to two references. The first is "The basic of HCD Library Volume 1". In this reference, basic processes in "Human-Centered Design" and methods in each process are described. The basic flow in "Human-Centered Design" is asked to do it that the cycle of the four major processes of "understanding the usage situation", "clarification of user requirements", "creation of solution by design" and "evaluation of design". In the development of user interface, it is necessary to extract how users handle information equipment and have problems such as in information equipment. In addition, we think that the development of the user interface should be promoted with the cooperation of the user as to how to solve the extracted problems. Therefore, we think that it is effective for the user interface development of the air traffic control console system to conduct the process that is conducted “observation survey”, “task analysis”, “develop of user interface idea”, "simple evaluation of idea", "prototype of user interface" and "user evaluation of prototype".

The second is “A STUDY ON TASK ANALYSIS FOR DEVELOPMENT OF AIR TRAFFIC CONTROL SYSTEM”. This prior document is an article based on the process of "Human-Centered Design", in which the
analysis method of analysis is improved so that the designer can easily understand air traffic control operations. In this prior art document, the characteristics and problems of air traffic control operations are extracted by conducting observation surveys and task analysis on the user interface of the air traffic control console system.

In this research, it is thought that it is effective to create the idea of a user interface by referring to the features of the air traffic control work, because the object of the research is the user interface of the same air traffic control console system.

From the two references, it is considered effective to proceed with the process of "Human-Centered Design" aimed at making the user interface of the air traffic control console system easy to use as follows as shown in “Figure 1”.

The following chapters describe in detail the activities following “Priority of features of the air traffic control operations”.

1 Observation survey
2 Task analysis for air traffic control console development
3 Priority of features of the air traffic control operations
4 User interface idea development
5 Simple evaluation of user interface
6 Making of prototype user interface
7 Evaluation of Prototype

![Figure 1: Flow of user interface development of air traffic control console system utilizing “Human-Centered Design”](image)

**Priority of features of the air traffic control operations**

Characteristics of the control duties referenced from "A STUDY ON TASK ANALYSIS FOR DEVELOPMENT OF AIR TRAFFIC CONTROL SYSTEM” were prioritized in Electronic Navigation Research Institute on August 24, 2012, so as to determine directionality of the idea development of the user interface, with cooperation from staff members qualified as a controller. The prioritization was performed from the viewpoint of importance of the characteristics of control duties. As a result of the prioritization, characteristics that need to be improved by air traffic control table were categorized as A, characteristics that would be better if they were improved were categorized as B and those not needing to be improved as C. The characteristics that need to be improved by the air traffic control table were assumed as "There is an aircraft which the controller must mind as a target that they need to give directions immediately" (Table 4), since it is important to think about the timing for giving next order when an aircraft that enters the airspace appears on the display in terms of performing effective control duties. For idea development and simple evaluation of the user interface, the idea for user interface to solve the prioritized problems is developed. Moreover, a simple evaluation is performed for the purpose of judging if the idea is effective for the air-traffic control duties. In the simple
evaluation, sympathy degrees for the scenario are evaluated for the purpose of verifying whether the idea is effective for perspective of the idea. In prototype making, the idea is brushed up for prototype making based on the result of the scenario sympathy evaluation. In order to verify if the prototype is effective for the controllers, a user evaluation is performed for the prototype with cooperation from staff members qualified as a controller as shown in “Table 1”.

Table 1: Priority of features of the air traffic control operations.

<table>
<thead>
<tr>
<th>Prioritization</th>
<th>Grouping of characteristics</th>
<th>Characteristics of control duties</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>There is an aircraft which the controller must mind as a target that they need to give directions immediately</td>
<td>When confirming AAR102 and KUDOS11, other directions are given more easily by deciding clear directions when dodging by altitude directions first. Confirm fix after the aircraft enters the restricted area to some extent. It is difficult to give new directions to the following aircraft unless directions to the preceding aircraft is completed. Need to arrange the operation by predicting arrival orders of AFR278, DUH710 and UAL888 separating operation display and arrival prediction Trying to make aircrafts cross giving different altitudes. Need to think about structure of future directions for operating the aircrafts of the same destination.</td>
</tr>
<tr>
<td>B</td>
<td>The number of times of directions is increased by guiding the aircrafts</td>
<td>Overall directions are influenced by changed separation. The controller does not want to change flight plan Make aircrafts detour to make it converge with others.</td>
</tr>
<tr>
<td>C</td>
<td>The following aircrafts are influenced by lowering the speed</td>
<td>When the distance between two aircrafts is close, the operation will be smoother by giving directions to the preceding one. Lowering speed causes risks to the following aircraft. The controller wants to transfer under a sufficiently safe situation though it’s not allowed to do so. The following aircrafts are influenced by the undecided orders of them. Lowering speed causes risks to the following aircraft. Maintain separation by uniformizing speed.</td>
</tr>
<tr>
<td>C</td>
<td>The following aircrafts are influenced by lowering the speed</td>
<td>Directions are limited by restricted area.</td>
</tr>
<tr>
<td>C</td>
<td>Need to think about directions in consideration of wind effect</td>
<td>When status changes under the influence of wind, the priority of the aircrafts changes.</td>
</tr>
<tr>
<td>C</td>
<td>The map displays are almost not used</td>
<td>The controller confirms the map display first it but does not almost use it after that</td>
</tr>
</tbody>
</table>

User interface idea development

In idea development of user interface, from the result of prioritization of the characteristics of air-traffic control, idea for the user interface to improve the characteristic "There is an aircraft which the
controller must mind as a target that they need to give directions immediately", which is the highest priority, was developed. For idea of user interface, 10 ideas including a function that enables the user to know how each aircraft will move or a function to notify the timing for giving directions were developed as shown in “Figure 2”.

**Simple evaluation of user interface**

The simple evaluation for idea of user interface was performed with cooperation from staff members qualified as a controller. The simple evaluation is performed to verify if the idea of user interface to improve characteristics of air-traffic control duties is a function effective for the controller. Moreover, a scenario sympathy evaluation was performed as a simple evaluation. "Scenario sympathy degree sheet" and "evaluation sheet" used for the scenario sympathy evaluation are described below. The scenario sympathy degree sheet is the sheet that evaluator confirms the idea of user interface with. The items are "name of the idea", "content of the idea", "flow of the use of idea" and "status of the scene". The evaluation sheet is the sheet for evaluating the idea while evaluator confirms the scenario sympathy degree sheet. The evaluation items are "if the controller can sympathize with problematic scenes in air-traffic control duties" and "if the controller wishes to use the proposed idea for the subject problematic scenes" for judging whether the idea is effective in actual air-traffic control duties. For each evaluation item, evaluation was performed based on four steps. Moreover, comments on each idea for user interface were obtained from interviews. Outline of the evaluation is described below. The evaluation was performed at Electronic Navigation Research Institute on July 20 and August 16, 2012. The time required for the evaluation was four hours (30-minute break included). The evaluation enforcers are two students having basic knowledge of air-traffic control duties. The evaluator of the ideas is one researcher at Electronic Navigation Research Institute, who is qualified as a controller. The instruments used for the evaluation were video from the observational research, tags, idea description sheet and scenario sympathy evaluation sheet.

**Making of prototype user interface**

In the making of prototype user interface, for example, prototype of user interface corresponding to "time management" which enables to confirm future information forecast including passage time was...
made as an operation concept of air traffic control 20 years later, based on the concept provided by Electronic Navigation Research Institute as shown in “Figure 3”. The prototypes made in this study is described below.

The user interface prototypes made in this study were discussed for the new functions such as "predict time" which allows to predict time to give directions in future, "predict capture" which allows to confirm change in the future airspace, "touch input" which performs input by touch operation effectively and "focus input" which performs input for specific aircrafts, based on the analysis results. "predict time" is the function made based on the future concept from Electronic Navigation Research Institute. It is a function that a radar control table predicts and displays aircraft’s passage. Functions of each user interface based on the idea that solved problems of control duties extracted from the task analysis in air-traffic control duties are described below. "predict capture" is a function that displays predicted future flight paths of aircrafts flying in airspace that the controller is in charge of. In the case that flight paths of two aircrafts may converge in the future, the system predicts converging points and displays them. This function is user interface to solve "there is an aircraft that the controller at the air search give directions to immediately and there is an aircraft that the controller must mind as a target that they need to give directions immediately", which are the problems on the air-traffic control duties as shown in “Figure 4”.

![Figure 4: Usage example of "predict capture" function](image)

"touch input" is a function that allows easy input operation by touch interface. Altitude, heading and velocity are easily input. This function solves one of the problems on the air-traffic control duties, "I want to input effectively when there are many input items as shown in “Figure 5”.

![Figure 5: Usage example of "touch input"](image)
"focus input" allows to confirm detail of the aircrafts' status in the case that their locations are close. Moreover, it is a function that performs inputs for those aircrafts effectively. When selecting crowded airspace where plural aircrafts fly, input interface for for altitude, velocity and heading of the aircrafts and detail of the airspace flying the airspace are displayed. Positional relationships of the aircrafts can be confirmed by zooming the display area. This function solves one of the problems on the air-traffic control duties, "I want to input effectively when there are many input items" as shown in “Figure 6”.

![Example: Since the aircrafts IBX3174, DAL275 and UAL888 are close and it is difficult to input for them, zoom part of the airspace by "Focus input" for input operation.](image)

**Figure 6: Usage example of "focus input"**

**Evaluation of Prototype**

Four prototype user interfaces installed in the air traffic control table developed in this study were evaluated. The evaluation of prototype user interface was performed in Classroom 1205 at Level 12 of Tsudanuma Campus Building No. 1, Chiba Institute of Technology on December 15, 2012 (Yamasaki laboratory). The time required for the evaluation was 5 minutes for introduction (description of evaluation purpose, agreement for cooperation for evaluation), 10 minute for prior interview (property of the evaluator, general question), 10 minutes for description of the air traffic control table assumed for 20 years later (descriptions of future concepts, requirement definition based on analysis and requirement definition as a future operation method setting), 10 minutes for description of proposed functions (description of operation along the scenario and functional description by the evaluator), 60 minutes for observation of task execution based on scenario and 15 minutes for subsequent interview (impression on the use of all six functions proposed, advantages, disadvantages and motivation for recycling). The total time for the evaluation was 110 minutes. The evaluators were two staff members from Electronic Navigation Research Institute who were qualified as a controller. The followings are the evaluation method. As an evaluation method, the evaluators were asked to operate four user interfaces developed in this study based on scenarios. The evaluators evaluated the interfaces after operating them from the viewpoint of "efficiency", "operation flow" and "motivation for recycling" of the user interfaces, based on a four-step scale (4 = Highly rated, 1 = Low rated). Since "Predict capture" was highest rated from any of the three viewpoints, with more than 3 points for each viewpoint, the authors believe that it is effective for the air traffic control table of 20 years later. Average score of "Predict time" and "Touch input" were around 3 points. However, that of "Focus input" was around 2 points, and therefore it is not suited for the user interface of the air traffic control table of 20 years later as shown in “Table 2”. Three prototypes except "Focus input" are user interfaces
effective for air traffic controllers, we presume. Some characteristic parts obtained from evaluation results for each function are shown below. Since the comment "I want to know the exact passage time since before the aircraft enters the airspace, not after it enters the airspace" had been obtained, "Predict time" was modified so that passage time can be predicted before an aircraft enters the airspace. Since the comments "an area to be predicted has to be operated by dragging but I want it to be displayed by one click" and "I want to know the condition before crossing" had been obtained, "Predict capture" was modified as requested. Two opposite opinions were obtained for "Touch input", which are "It is good input operation is done by touch operation directly" and "operation mistake may occur when touching". The comment "it is more effective to move tags by myself to make them look clearer, rather than partial zooming was obtained, and therefore "Focus input" was low rated. Therefore, it has been revealed that it is an unnecessary function in terms of moving tags effectively.

Table 2: Evaluation result of prototype.

<table>
<thead>
<tr>
<th>User Interface</th>
<th>Subject</th>
<th>Efficiency</th>
<th>Operation Flow</th>
<th>Motivation for Reuse</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Score</td>
<td>Score</td>
<td>Score</td>
</tr>
<tr>
<td>PREDICT FIX</td>
<td>[Sub1]</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>[Sub2]</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>SCREEN CAPTURE</td>
<td>[Sub1]</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>[Sub2]</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>TOUCH INPUT</td>
<td>[Sub1]</td>
<td>2</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>[Sub2]</td>
<td>3</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>FOCUS INPUT</td>
<td>[Sub1]</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>[Sub2]</td>
<td>2</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>

Consideration-Verification of user interface development of air traffic control console system utilizing “Human-Centered Design”

This chapter describes the findings obtained through the use of “Human-Centered Design” processes in the development of the user interface of the air traffic control console system.

In this paper, we developed the user interface of the air traffic control console using “Human-Centered Design” process with the aim of creating the user interface of the air traffic control console system that is easy for the controller to use. It was verified using the results of “Efficiency”, “Operation flow” and “Motivation for reuse” in Table 2 whether the functions of the user interface designed are as user-friendly as intended. As shown in Table 2, the four proposed functions have a comprehensive average of 3.0 (= function is valid), 3.5 (= flow of operation is good) and 3.25 (= reuse), from the results of 2 subjects. From these evaluation results, it is considered that incorporated the process of “Human-Centered Design” into the development of the user interface control of the air traffic control console system leads to the creation of the air traffic control console system that is easy for the controller to
use. The reason why we used the process for “Human-Centered Design” to develop the user interface for the air traffic control console system to create the user interface for the air traffic control console system that is easy for the controller to use that we think that the idea of the user interface was developed from the features and problems of the air traffic control operations extracted by observation survey and task analysis. In general, designers often carry out user interface idea development while considering the ease of use of controllers. In addition, the designer may not fully consider what functions should be made through the usage situation of the controllers. Therefore, it is important to consider the user interface of the air traffic control console in consideration of the actual experience of using the controller. Therefore, considering the user interface of the air traffic control console in consideration of the actual experience of the use of the traffic control controller is considered to be effective in creating a user interface of the air traffic control console system that is easy for the traffic control controllers to use.

Conclusion
This paper describes in detail the practical case of the user interface development of the air traffic control console utilizing the process of “Human-Centered Design”, in order to create an easy-to-use user interface for the controller for the on-screen user interface of the air traffic control console. The characteristics of air traffic control operations could be prioritized by the characteristics of air traffic control operations extracted from the "A STUDY ON TASK ANALYSIS FOR DEVELOPMENT TRAFFIC CONTROL SYSTEM" of the prior art document. This paper describes design of the user interface of the air control console system for the features of high priority air traffic control operations, simple evaluation, making of prototyping and user evaluation results. From the user evaluation results, the incorporating "Human-Centered Design" processes into air traffic control user interface development is effective to development user interface of the air traffic control console system. In the future, we would like to be able to improve the process of "Human-Centered Design" so that it can be generally used for product development for business use as well as for air traffic control console system development.

References
Hajime Hirako (2019), A STUDY ON TASK ANALYSIS FOR DEVELOPMENT OF AIR TRAFFIC CONTROL SYSTEM “unpublished”,IASDR2019
Toshiki Yamaoka (2000), Comparison of three points task analysis and protocol analysis (1), Japan Ergonomics Research Society.
Midori Fukaya (2003), Measures for usability in the field of home electric appliances, The Information Processing Society of Japan.
Kazunori Imoto (2005), Usability evaluation of voice interaction function in recording and playing operation of TV program, The Information Processing Society of Japan.
Toshiki Yamaoka (2003), Introduction to human technology, Morikita Shuppan.
Annett, J. & Stanton (2000), Task Analysis, N.A.
Arisa Sakamoto (2012), Design and implementation of visualization mechanism of undo operation based on display change on desktop, The Information Processing Society of Japan.
Masaaki Kurosu (2003), Usability testing, Kyoritsu Shuppan.
Tarumoto Tetsuya (2005), Usability engineering, Ohmsha.
Identity Salience and Diversity in The Process of Innovation of Meaning

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Abstract: As successive design practices have unfolded in recent years, innovation studies have focused on the inside-out process as a practice of professional, experienced designers. However, extant studies have ignored how managers encourage individuals to enhance their creativity using no collaboration with external resources. Thus, this paper aims to explore the necessary antecedents for taking advantage of the inside-out process. The present research found that the inside-out process requires the salience of personal or other social categories’ identities in the organisation. When they deeply internalise organisational goals and values, individuals create visions in accordance with organisational expectations. The deviant, who brings their own aesthetics to the organisation, is a key resource for the inside-out process. The salience of personal or other social categories’ identities results in a diversity of identity in the organisation. Separate research traditions have investigated both positive and negative effects of diversity. The ‘information/decision-making’ perspective emphasises the positive effects, which improve the quality of decision-making. The ‘social categorisation’ perspective underscores diversity’s negative effects. Diversity produces sub-groups within a group, and problematic inter-subgroup relations can occur in the categorisation processes. However, homogeneous subgroups result in high performance.
Subsequently, the inside-out process criticises ideas formulated by pairs once individual work has taken place. The criticism process may result in failure, as threats or challenges to identity inspire intergroup bias. This can occur when the two individuals are dissimilar, and fall within different subgroups. Pairs with similar directions and high levels of value consensus have decreased levels of relationship conflict. Pairs with similar directions also obtain benefits from different functional backgrounds, as task-relevant conflict occurs.
This paper has a few theoretical implications. First, the salience of personal identity or other social categories’ identities is antecedent to innovators’ immersion in the inside-out process. Second, the concept of pair-work includes both the positive and negative effects of diversity. The managerial implication of this paper is that deviants are the key resource in the inside-out process. In this process, managers encourage individuals to think outside of organisational identity.

Keywords: Design thinking, Inside-out, Identity, Diversity

Introduction

As successive design practices have unfolded in recent years, studies have focused on applying them to the innovation process. The research is divided into two streams: the inside-out and outside-in approaches. Innovation of Meaning (IoM) has emerged as a representative innovation approach to the inside-out process (Verganti, 2009; Rampino, 2011; Verganti, 2017; Goto, 2017). The IoM concept...
proposes ‘innovation that radically redefines what a product means for a customer’ (Verganti, 2008: p. 437). This model is based not on user observation, but on an innovator’s vision and analysis of prospective sociocultural evolution. Such visions are realised by networked laboratories of professional interpreters (Verganti, 2008). Additionally, key interpreters utilise the sociocultural model as a means of guiding innovators’ visions to fit potential future sociocultural evolution. In other words, they aspire to radically revolutionise a product’s meaning.

Meanwhile, user-centred design (UCD) represents the outside-in process. UCD was first promoted as a generalised managerial tool by the design consultant IDEO and Stanford University’s ‘d-school’ (Kelley, 2001; Brown, 2008; Seidel and Fixson, 2013; Liedtka, 2015; Carlgren, Elmquist, and Rauth, 2016). The UCD concept originates from a problem that users experience both implicitly and explicitly. This process is described as ‘need finding, brain storming, and prototyping’ (Seidel and Fixson, 2013). It enables the team to learn through failures and mistakes with rapid cycles and lower costs (Carlgren, Elmquist, and Rauth, 2016). UCD encourages innovators to ‘think outside of the box’ (An and Youn, 2018).

Thinking inside the box fosters a decision attitude which maintains low-risk, low-cost strategies (Boland and Collopy, 2004). Management attitude prompts innovators to continue following conventional routines in order to ‘stay within the frame’ (Dorst, 2013: p. 122). Additionally, particular types of expertise discourage individuals from creating novel ideas (Perra, Sidhu and Volber, 2017). The outside-in process aims at shattering decision attitudes, and generating ideas beyond innovators’ knowledge. Such collaboration depends upon external resources, as UCD relies on users (Langner and Seidel, 2015; Kristensson, Gustafsson, and Archer, 2004; Poetz and Schreier, 2012). In contrast, the inside-out process relies on innovators as internal resources. This poses a challenge for researchers, stimulating them to further understand the inside-out process. Studies must address how, in the absence of collaboration with external resources, managers encourage innovators to transcend routine thinking and enhance creativity.

To understand antecedents of the inside-out process, we are particularly interested in investigating innovators’ identities. Recent research has addressed the role of identity in innovation (e.g. Glynn, Kazanjian and Drazin, 2010; Lifshitz-Assaf, 2018; Litchfield et al., 2018). Langner and Seidel (2015) attempted to understand dual social identities among external resources using firm-hosted online communities. However, little is known about the role of identity in the inside-out process. Meanwhile, research has described professional, experienced designers as establishing their own unique working principles. The principles are based on their identities and personal concerns, developed over the course of their careers across the industries (Adam et al., 2011; McDonnell, 2011). However, most innovators immerse themselves in specific industries and organisations. When innovators extremely internalise organisational goals and values, they dismiss both their personal identities, as well as other categories’ identities (Janssen and Huang, 2008). Team identification encourages innovators to engage in conventional routines, and discourages them from engaging in innovative behaviour (Litchfield et al., 2018).

We also consider the diversity of innovators’ identities. The inside-out process requires the salience of personal (and other social categories’) identities in the organisation. Diverse identities seem to improve not only decision-making qualities, but also problematic inter-subgroup relations. The current paper shows that the inside-out process proposed by Verganti (2017) involves the strategy for these positive and negative effects.

This paper is organised as follows. The next section reviews the inside-out process of design thinking, allowing us to understand the role of designers’ unique working principles. As mentioned, these
philosophies arise from designers’ individual identities. Subsequently, an overview of organisational identification research is presented. The salience of personal identity (and other social categories’ identities) in the inside-out process is examined. Subsequently, the relationship between diverse identities and the inside-out process is discussed. Finally, academic and managerial implications are detailed.

The Inside-Out Process in Design Thinking

Verganti (2017) indicated that most emergent idea generation methods emphasise the role of external players. Examples are user-centred innovation, crowdsourcing, and open innovation. In such instances, we are referring to innovation from the outside-in. Some literature has indicated that the user-centred approach enables individuals in an organisation to change their mindsets (Carlgren, Elmquist, and Rauth, 2016) and reduce cognitive bias (Liedtka, 2015). Moreover, Paton and Dorst (2011) noted that the user-centred approach reveals situations in which one can immerse oneself, rather than conforming to a list of functional requirements.

Verganti (2008: p. 437) suggests that ‘the investigation of user-centred design and analysis of its success cases have helped surpass the classic and common interpretation of design as style…Yet this is only one piece of the puzzle’. Although the UCD approach does involve problem-solving, it focuses excessively on problems themselves. Such limited thinking tends to trap designers into making only incremental improvements (Verganti, 2008). Donald Norman, a key UCD researcher, noted that he ‘was unable to find any example of radical innovation that resulted from the UCD process’ (Norman & Verganti, 2014: p. 79).

On the other hand, professional, experienced designers create ideas using their own personal lens (Adams et al., 2011). For example, designers interpret things based on 1) the *guiding principle* (Lawson, 1980); 2) the *organising principle* (Rowe, 1987); the role of the *primary generator* (Darke, 1989); and 4) *style* (McDonnell, 2011). These factors are established by individual concerns which designers have acquired through multiple projects (McDonnell, 2011). Paton and Dorst (2011) indicated that designers apply their own principles (cultivated through personal experience) to innovative projects. In such cases, we are referring to innovation from the inside-out.

Recent research focuses on deviants as a means of creating novel ideas (Hatchuel et al., 2010). A strong sense of individuality drives production of new concepts (Janssen and Huang, 2008). As artistic intervention research indicating (Strauß, 2018), the different orders of worth with conventional routines enable organizations and innovators to change their goals and values. Artists and designers (when offered the freedom to handle design tasks) explore novel problems to tackle for achieving their desirable world. For them, the ambiguity in problem spaces is key to defining the problem. Artists and designers, as deviants, bring their own aesthetics to an organisation.

Moreover, exploration of the desirable world (based on one’s aesthetic view of existence) is an intrinsic motivator for innovators (Hatchuel et al., 2010; Rampa, Abrassart and Agogué, 2017). Amabile (1996) has indicated that motivation is one of the factors influencing creativity. Motivation is important because of the discourse that deviant individuals present in their aesthetics of existence. Essentially, their viewpoints differ from the dominant discourse in which managers are involved (Heracleous, 2006). The novel ideas gained through deviant discourse may lack authoritative power. Consequently, motivation is crucial in overcoming organisational conflict.

Thus, managers must keep deviant individuals in the organisation in order to support the inside-out process. This study addresses managerial problems from the perspective of organisational
Identification (OI). OI allows us to understand how individuals assimilate or dissimilate their identities with organisational identities. Moreover, it assesses how they internalise organisational goals and values, or externalise personal ones.

Organisational Identification and Identity Salience

Identification is defined as ‘the perception of oneness or belongingness to some human aggregate’ (Ashforth and Mael, 1989: 21). OI research has aimed to understand how individuals’ attitudes and behaviours are managed to fit organisational expectations (thereby influencing the organisation’s effectiveness) (Ashforth and Mael, 1989; Edwards, 2005). Scholars described deviants, who are key resources for the inside-out process, as undesirable for management (Kreiner and Ashforth, 2004). This undesirable identification is termed as ‘organisational disidentification’, ‘ambivalent identification’, and ‘narcissistic organisational identification’.

Individuals with organisational disidentification have negative emotions toward an organisation and, consequently, dissociate from it (Elsbach and Bhattacharaya, 2001). Organisational disidentification allows them to act against the organisation, and publicly criticise it (Elsbach and Bhattacharaya, 2001). However, as deviants, they may become innovation resources (Kreiner and Ashforth, 2004). This status is engendered by their counter-discourse with the organisation’s dominant discourse (Heracleous, 2006).

Ambivalent identification describes conditions under which individuals have both positive and negative views of another entity over time (Thompson and Holmes, 1996). The current organisation is complex and equivocal; thus, individuals’ identities are not synthesised but instead coexist. Compared to organisational disidentification, ambivalent identification is not harmful to the organisation. However, this mixed association with the organisation prevents individuals from going ‘beyond the required level of job performance’ (Kreiner and Ashforth, 2004).

Narcissistic organisational identification refers to individuals who regard the organisation as an extension of the self, externalising their goals and values for the sake of personal gain (Galvin, Lange and Ashforth, 2015). This concept was built to describe the failure of top management as the ‘face’ of an organisation. In contrast to organisational disidentification and ambivalent identification, individuals with narcissistic organisational identification do not have negative feelings toward the organisation. Rather, they have positive sentiments toward the organisation, viewing themselves as a figurehead (Galvin, Lange and Ashforth, 2015).

Nevertheless, further study is required to describe the deviant’s identification type in the inside-out process. Firstly, individuals in the inside-out process perceive a oneness with the organisation, basically internalising its goals and values. However, the inside-out process also requires the externalisation of individual goals and values in order to achieve organisational goals (innovations). In contrast, individuals with narcissistic organisational identification externalise their goals and values for personal gain. Second, in contrast to narcissistic organisational identification, the inside-out process is not top-down (starting from top management). Rather, it is bottom-up, (starting from individuals’ visions and involving their values and goals). Third, individuals in the inside-out process are driven to innovate by intrinsic motivation (Rampa, Abrassart and Agogué, 2017). Conversely, people with ambivalent identification or organisational disidentification are demotivated by their negative views toward the organisation. Personal and other social categories’ identities are temporally salient during the inside-out process. They can thus create innovations for the organisation while seeking self-realisation ‘through the shaping of new desirable worlds’ (Hatchuel et al., 2010, 14).
Identity salience refers to a situation in which an individual’s identity is perceived as the operational basis (Randel, 2002; Mitchell and Boyle, 2015). Individuals’ self-concepts are comprised of personal and social identities, including both organisational and non-organisational identities (Ashforth and Mael, 1989). Moreover, in an organisation, individuals have not only super-ordinate identities, but also identities situated in sub-units (Rousseau, 1998). Clearly, identity salience is not static. Rather, it is a dynamic process predicated on the organisational contexts in which individuals are immersed.

If individuals have strong levels of organisational identification, and deeply internalise the organisation’s values and goals, organisational identity remains salient (Dutton et al., 1994). Subsequently, they dismiss individual values and goals, ultimately failing to conceptualise their own desirable worlds.

Galvin, Lange and Ashforth (2015) described organisational identification involving extreme internalization as ‘overidentification’. Overidentification disables individuals’ ability to start from the inside. The inside-out process first requires the salience of a personal or other social identity within an organisation. Such diversification of identity is defined in this study as dual social identity (Langner and Seidel, 2015). A dual social identity enables individuals to remain deviant, thus bringing diversified working principles to an organisation.

**Diversity Research and Pair Work**

Diversity research is quite broad. Most research has investigated demographic factors (race, age, or gender) and non-demographic factors (functional or educational background) (van Knippenberg, De Dreu and Homan, 2004). However, personality differences are also included in diversity research and comprise such characteristics as 1) cognitive style; 2) affective disposition; 3) motivational factors; and 4) differences in social and network ties (e.g., work-related ties, friendship ties, community ties, or in-group memberships) (Mannix and Neale, 2005). Bassett-Jones (2005; p. 170) indicated that “‘diversity’ in the workplace includes more than employees’ diverse demographic backgrounds, and takes in differences in culture and intellectual’.

Positive and negative effects of diversity are indicated in separate research traditions (Williams, 1998; van Knippenberg, De Dreu and Homan, 2004). First, the ‘information/decision-making’ perspective emphasises diversity’s positive effects. This perspective is based on the diversity of individuals’ functional backgrounds. In this formulation, diversity leads to work group conflicts (Randel, 2002) which improve the quality of decision-making by incorporating different professional perspectives (Jehn, 1995). Second, the ‘social categorization’ perspective underscores diversity’s negative effects. The diversity of individuals’ identity salience produces sub-groups within a group, with categorisation processes of sub-groups giving ‘rise to problematic inter-subgroup relations’ (van Knippenberg, De Dreu and Homan, 2004, p. 1009). However, homogeneous subgroups result in high performance (Jehn et al., 1999).

By contrast, the inside-out process criticises ideas created by pairs following individual work (Verganti, 2017). In criticism, Verganti indicated that ‘pairs are two individuals who have envisioned similar directions’. Members of a pair must trust and respect each other in order to ‘go deeper in their reflections’ (Verganti, 2017, p. 17). Once salience of personal or other social category’s identity has been established, the criticism process undertaken by pairs may result in failure. If the two individuals are dissimilar, yet fall within the same subgroup, threats or challenges to identity may inspire intergroup bias (van Knippenberg, De Dreu and Homan, 2004). Pairs with similar direction and a high level of value consensus have decreased relationship conflict (Jehn and Mannix, 2001).
There are other reasons why pairs are important. Pairs who have similar directions inspire elaboration, which is defined as ‘the exchange of information and perspectives, individual-level processing of the information and perspectives, the process of feeding back the results of this individual-level processing into the group, and discussion and integration of its implications’ (van Knippenberg, De Dreu and Homan, 2004, p.1011). Similar directions are determined not by professional identities, but by one’s personal or other social group identities. Thus, in pairs with similar directions, task-relevant conflict is not influenced (and relationship conflict is decreased). To emphasise, from the information/decision-making perspective, elaboration is crucial in obtaining benefits from individuals of different functional backgrounds (van Knippenberg, De Dreu and Homan, 2004).

Moreover, as van Knippenberg, De Dreu and Homan (2004) proposed, motivation is the core moderator of diversity’s positive effects. As discussed in the previous section, the inside-out process elicits high motivation, as it allows definition of the desirable world based on one’s own aesthetics of existence (Hatchuel et al., 2010). In conclusion, pair-work in the inside-out process benefits from the information/decision-making perspective cooperative elaboration, and an absence of identity threats ameliorate the negative effects from the social categorization perspective.

**Conclusion**

Innovation requires enhancement of employees’ creativity. Most extant studies have highlighted interactions between others’ knowledge, expertise, and skills. Research on innovation and identity has also focused on cross-functional teams, and interactions between internal and external resources (e.g. Glynn, Kazanjian and Drazin, 2010; Langner and Seidel, 2015; Litchfield et al., 2018). Thus, the issue of individuals having multiple identities has been ignored. This study views the inside-out process as the way to innovation, utilising individuals’ multiple identities. This perspective allows us to consider how managers can encourage individuals to discover their personal identities, as well as their identities as members of other social categories.

This paper has a few theoretical implications. First, the salience of one’s personal identity or other social identities is antecedent to innovators’ immersion in the inside-out process. Extant studies have overlooked which attitudes enable individuals to create visions. This study indicates that individuals may fail to create visions if they extremely internalise the organisational goals and values. Second, the concept of pair work that Verganti (2017) termed ‘sparring’ includes positive and negative effects of diversity. This paper concludes that the inside-out process paves the way to innovation, based on the diversity of identity.

The managerial implication of this paper is that creative deviants are the key resource to the inside-out process. For managers, individuals who identify with an organisation and internalise its goals and values are desirable (as they follow organisational expectations) (Ashforth and Mael, 1989; Edwards, 2005). This is suitable for solution development and low-risk, low-cost strategies. However, in the inside-out process, managers encourage individuals to think outside of the organisational identity. Diverse identities have both positive and negative effects on organisations. This paper is a guideline to managing those effects.
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References


Humanizing Automation in The Design of The Industrial Kitchen of The Future  
-Strategies and Insights for Deploying Interactive Technologies in The European Luxury Dining Sector- 

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Abstract: With a rising tendency for eating out, today’s consumers are increasingly seeking unique food experiences through luxury dining. The Industrial Kitchen (IK) sector is a growing industry, where star chefs with highly customised food preparation processes are sought after professionals, offering market differentiation to specialty restaurants. In the European luxury dining sector, more attention should be brought into the IK staff workflow optimisation and comfort, a sector which currently is receiving growing interest from academia [1]. This research is directed towards integrating sensors as an automation strategy for optimising appliance performance and food preparation process with the aim of improving the staff workflow and pleasurability in an IK. Evidence captured by the researchers through chefs audio-video interviews in the European luxury dining sector demonstrated acceptance towards automation integration, which is also supported by existing literature evidencing acceptance of chefs towards Modernist Techniques and Equipment (MTE) [2]. Food preparation in European luxury dining is by its very nature highly artistic – involving dish decoration, sauce preparation, and ingredient arrangement – leading to a perception of possible conflict between the creative goal, which underlines the chefs’ identity, and the automation goal, which underpins itself on efficiency and standardization of output. In addition, when designing more automated cooking processes, the chef’s creative goals should remain at the center of the futuristic cooking experience [3]. This paper will discuss deployment strategies for automation and food preparation interactive technologies for next generation IK’s in a manner for them to be the least intrusive and most assistive to the creative goals of the gastronomy professionals. The background of this research emerges from the ongoing Future Industrial Kitchen project financed by the Madeira Autonomous Region (RAM) government, Portugal. 

Keywords: Interactive technologies; Future Industrial Kitchen; Internet of Things (IoT); Food Preparation Process;  

Exploratory Research on Cognition of Autonomous Vehicles
- From Perspective of Actor-network Theory -

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Abstract: The purpose of this study was to explore methods by which a relationship among technology, form and social structure in the autopilot industry can be identified. Accidents occasionally occur due to a misunderstanding between customers' perception and the reality of autonomous cars. Therefore, the focus of this study is on understanding technology.
Several studies have attempted to identify a way to examine users’ understanding of technology. The social construction of technology (SCOT) could be considered as a theory that can help effectively analyze the development of technology. Furthermore, form papers in the field of design management research are theoretically considered structural factors. However, it seems that there is still a lack of perspective on how to analyze it as a method until we use the actor - network theory (ANT).
This overall objective of this study aims to explore the Technology Acceptance Model (TAM). For now, the first stage of technology is in process. This can be achieved by developing a framework that connects key elements of technology, form, and social structure of the autonomous driving industry. This method is based on a novel ANT perspective.
Keywords: Self-driving car, Actor-Network Theory, Form, Technology Development

Introduction
Nowadays, there is a gap between users’ understanding of technology and current state of the autonomous driving industry. According to the Society of Automotive Engineers (SAE) and the U.S. Department of Transportation’s National Highway Traffic Safety Administration (NHTSA), the development of autonomous vehicles measured in stages indicated from level 0 to level 5. However, users’ cognition may be staged as level 4, while the reality is that the industry is staged at level 2. As a result, of this cognitive gap, accidents sometimes occur. So why is there a cognitive gap? The problem is that the information available on a company’s technological innovation is not accurately communicated to consumers. Explaining and interpreting technology do not yield expected businesses outcomes. Thus, it is important to clarify which factors could influence consumer interpretation, including product appearance and advertising,
government-led social experimentation, and legal factors. Several studies have attempted to identify a method by which consumers’ technical understanding can be examined. This study seeks to identify a method based on a review of research on social technology construction (SCOT) (Pinch and Bijker, 1984; Douglas, 1990; Winner, 1993; Williams & Edge, 1996; Debra, Nathalie & Melanie, 2004; Ramos and Berry, 2005; Rowland, 2005; Lee, 2005; Elle & Hansen, 2010; Burns & Corte, 2015; Sara, 2017) and Form (Peter, 1995; Smyth, 2000; Crilly, Moultrie & Clarkson, 2004; Shieh, 2008; Hsiao, 2010). However, studies on SCOT cognition and appearance have not been able to analyze structural factors, such as social culture and technology. Furthermore, we found that cognitive methods are still not sufficiently clear. Therefore, after consideration, actor-network theory (ANT) (Latour, 1996; Walsham, 1997; Couldry, 2008; Law, 2008; Latour, 2009), which is suitable for analysis based on all factors, was chosen. This study uses ANT as an approach to analyze data and text. Network creation, facilitates the ability to outline clear connections between factors such as technology, social or cultural structure, product appearance, and consumer interpretation. This short paper outlines research on SCOT, form and ANT and presents the primary research question, several initial findings from text mining, and a potential new analytic framework.

In summary, this study aims to present a framework of consumers’ technological cognition. This can be achieved by creating a framework that connects the technologies, forms, and social structures of the autonomous driving industry.

Literature Review and Research Question

This section reviews the relevant studies in the fields of the Social Construction of Technology (SCOT), Form (which contains in Design Management (DM)), and Actor-Network Theory (ANT).

Social Construction of Technology (SCOT)

For the past ten years, researchers have attempted to evaluate consumers’ understanding of technology. Sara (2017) indicated that: “In the construction of the technology determinism theory, there is this believes that technology determines human action (Leonardi and Barely, 2010; Burns et al, 2016) and technology is a product of the social, political, economic, and cultural environment in which it is situated (Humphreys, 2005). Supporters of this approach, referred to as social constructivists, believe that without the understanding of the social context, a technology cannot be understood (Burr, 2015)” (Sara, 2017, p. 33).

Furthermore, researchers have also attempted to explore more fields that are specifically related to the social construction of technology (SCOT) (Pinch and Bijker, 1984; Douglas, 1990; Winner, 1993; Williams & Edge, 1996; Debra, Nathalie & Melanie, 2004; Ramos and Berry, 2005; Rowland, 2005; Lee, 2005; Elle & Hansen, 2010; Burns & Corte, 2015; Sara, 2017). Sara (2017) offered a specific definition of SCOT theory: “Social Construction of Technology (SCOT) argues that human action shapes technology, this theory is a response to the technological determinism that
identifies the technology as the determiner of human acts” (Sara, 2017, p.33). It is thought SCOT was founded by Trevor J. Pinch and Wiebe E. Bijker in 1984, with four primary concepts defined as Social Groups, Interpretative Flexibility, Closure, and Stabilization (Pinch and Bijker, 1984). Ramos and Berry (2005) indicated that as new technology is adopted, the social factor cannot be ignored in decision-making and exemplified this conclusion using the case of an automobile company (Ramos and Berry, 2005). In the same year, Rowland (2005) also wrote that SCOT could be regarded as a new form of technological determinism, which should be considered more closely when corporations make decisions and introduce new concepts (Rowland, 2005). However, Douglas points out that “SCOT ignores the political economy and ideology of technology innovation”; Winner writes that “SCOT also ignores the moral and political values with which people judge technology, and disregards the structural relationships which influence technological change” (Lee, 2005, p.232). Meanwhile, “the SCOT approach tends to have difficulty in accounting for closure. The possibilities of 'interpretative flexibility' (i.e., of 'choice') seem endless” (Williams and Edge, 1996, p.870).

Research on Form
Since SCOT overemphasizes human interpretation, it does not consider how appearance affects the perception of technology. Therefore, this study examined how recognition of appearance occurs. How may this understanding change if we treat technology artifacts as a kind of product? Several years prior, Shieh (2008) explained that “the appearance of a product is one of the most important factors affecting a consumer’s purchasing decision. It is reasonable to assume that consumer preference for a product is mainly based on the form features (design). Moreover, consumers may choose their preferred products and classify them into categories” (Shieh, 2008, p.1).

On one side, Smyth (2000) found an Industrial Design Cycle system, which “can be generally described as a system that supports the rapid alternation between digital and physical representations of product geometry” (Smyth, 2000). On the other side, in the field of design management (DM), various studies have discussed form (Peter, 1995; Smyth, 2000; Crilly, Moultrie & Clarkson, 2004; Shieh, 2008; Hsiao, 2010) and cognition. Peter (1995) indicated that product visual form is “the physical form or design of a product is an unquestioned determinant of its marketplace success. A good design attracts consumers to a product, communicates to them, and adds value to the product by increasing the quality of the usage experiences associated with it.” (Peter, 1995, p.16).

Ranscombe, Hicks and Mullineux (2012) provided several cases of microwave, smartphone and vehicle fascia to facilitate the objective evaluation of products’ appearance (Ranscombe, Hicks and Mullineux, 2012). Reinders and Akkerman (2005) provided an example of a solar racing car to prove that form follows function (Reinders and Akkerman, 2005). Gamman, Thorpe, and Willcocks (2004) attempted to identify a way that can inspire design responses though the visual
electronic parking system of public bicycles (Gamman, Thorpe & Willcocks, 2004).

Peter (1995) also attempted to seek an ideal form that considered both product design and consumer response. The model connects product form, psychological responses to product form, and behavioral responses, identifies two responses: cognitive and affective (Peter, 1995). More details are provided in Figure 1.

![Figure 1: Model of Consumer Responses to Product Form. (Peter, 1995)](image)

Based on the importance of product form, Crilly, Moultri, and Clarkson (2004) identified a new framework that established a relationship between producers (including the design team and product), the environment (including products and senses), and consumers (including senses and response) (Crilly, Moultri & Clarkson, 2004) (See Figure 2).

![Figure 2: Framework for consumer response to the visual domain in product design.](image)

However, there are some criticisms of this framework. Some effective factors are still unclear, as Hsiao (2010) indicated that “in the traditional product development process, the product-
form design was usually depended on the abilities and the experiences of the designer to get good design results, which was usually performed in a black box” (Hsiao, 2010, p.1).

**Actor-Network Theory (ANT)**

Research on the perception of product form theoretically indicates the influence of technical and socio-cultural factors on cognition, but a method for analyzing a wide range of factors has not yet been developed. If all factors, such as technology, human, structure and form, are considered of equal importance, then utilizing the perspective of actor network theory (ANT) may be effective (Latour, 1996; Walsham, 1997; Couldry, 2008; Law, 2008; Latour, 2009). Couldry (2008) provided an explanation of ANT: “Actor Network Theory (ANT) is a highly influential account within the sociology of science that seeks to explain social order not through an essentialized notion of “the social” but through the networks of connections among human agents, technologies, and objects.” (Couldry, 2008, p.93).

Latour (2009) also classified the fundamental interactive insight of ANT through the following example: “When holding a gun, then you are different with the gun in your hand. At the same time, the gun is different with you holding it. Also, you are another subject because you hold the gun. At the same time, the gun is another object because it has entered into a relationship with you” (Latour, 2009, p.179).

After discussing four key aspects: “Society as Heterogeneous Network,” “Agency as Network,” “Punctualisation and Resourcing,” and “Translation: Social Ordering as Precarious Process”, Law (2008) argued more findings with regard to “The Strategies of Translation”. These include the following: “1. Some materials are more durable than others and so maintain their relational patterns for longer; 2. If durability is about ordering through time, then mobility is about ordering through space. In particular, it is about ways of acting at a distance; 3. Translation is more effective if it anticipates the responses and reactions of the materials to be translated; 4. Finally there is the issue of the scope of ordering. I have been pressing the view that this is local; 5. Note that if these exist they are more or less implicit -- for explicit strategic calculation is only possible if there is already a centre of translation” (Law, 1992, pp. 6-7).

Therefore, ANT may be an applicable tool. Walsham (1997) reported that ANT may function as an analytical tool that provides the theoretical and methodological underpinning for the study of these dynamic relationships.

**Research Question**

SCOT can be included in the scope of management of technology (MOT), and form cognition can also be used to draw conclusions in design management (DM). From a MOT perspective, technology is considered to be the core, and may not be cognition of form. From a DM perspective, the consumer’s perspective is emphasized, thus form is regarded as the focal point, but there may be no cognition of technology.
Subsequently, an approach by which the cognitive gap between level 2 and level 4 may be addressed is not yet clear. Reviewing previous research reveals that ANT may be a suitable approach for this study.

This research seeks to solve the cognition gap between level 2 and level 4. Moreover, this study attempted to determine and clarify the relationship between various factors, such as technology, form, human and social structures of the autonomous driving industry from a new perspective of ANT.

**Research Design**

This study aims to explore the framework of technological cognition and attempts to identify a way to solve the cognitive gap between the company and the consumer. In this instance we should ascertain where the customer receives information about the new technology. One source of information is the company websites and other industry-specific news sites. The text of such websites may be treated as a kind of data, thus the research method of this study is to analyze the text that is presented to the customer.

Nikkei BP could be considered as one of the primary business websites in Japan, aimed at disseminating the most recent business information. Thus, we decided to derive our text for analysis from the Nikkei BP website. Moreover, KH Coder software was chosen as our analytic tool, because it may facilitate ANT analysis. This section details the text mining procedures and results derived from the Nikkei BP website.

**Text Mining Steps**

There are 2848 Japanese journals and articles (As of May 16, 2019) on the Nikkei BP website, which are mostly related to Automotive and Business. Text analysis was conducted using the following way.

First, the texts were downloaded and saved into Microsoft Excel and KH Coder software. Second, the texts were cleaned, and any unnecessary parts were deleted; the files were then separated by year. Third, an initial analysis of key words and texts was conducted, and the output included a ranked list of keywords (separated by year), co-occurrence network figures (separated by year), and various other figures and charts.

**Text Analysis and results**

Keywords have been gathered for analysis. The chart below presents a list of keywords related to "automotive" found on the Nikkei BP website — prior to 2003, 2016, and 2018.
The data were divided according to main years. Prior to 2003, there were no keywords relating to autonomous vehicles or AI, and only terms generally related to cars, communication, or other related services were found. From 2004 to 2015, the keywords were mainly related to technological development until 2016, which is considered to be the start of new era of AI and automatic driving. As year of 2017, keywords such as big data, information, AI, and automatic operation begin to appear. In 2018, all the keywords began to be connected, and the term appeared in relation to these terms. This chart could be considered as the summary of text mining.

**Data Analysis and Discussion**

In this section, we summarize and discuss the text mining results.

**Data Analysis**

The results of the text mining are shown in Figure 3. This represents the complete image of all 2848 journals and articles searched on the Nikkei BP website.
As shown, the terms development, system, run, function, realization, car, automobile, and technology are associated with autonomous vehicles. All other keywords revolve around these concepts and comprise multiple categories. For example, development further relates to system, company, maker, and automatic; run relates to car, camera, recognition, learning, AI, data, and information. From 2004 to 2015, keywords were mainly related to technological development. However, from 2016, which is considered the new beginning of the era of artificial intelligence (AI) and automatic driving, the keywords tended to shift.
As Figure 4 shows, the main relationships are *development, systems, run, function, maker, car, automobile, and technology* associated with autonomous vehicles. There are few changes aside from functionally related parts. It appears obvious that more factors have appeared in the discourse, such as utilization, machine, learning, etc. This indicates that function development is continuously progressing. In 2017, keywords such as *big data, information, AI, and automatic operation* appeared. Then, in 2018, all keywords began to connect. Details are provided in Figure 5.

![Figure 5: Main image of text mining, 2018.](image)

All actants and actors are related. These help companies understand how to transfer information to customers. A discussion from the perspective of ANT is outlined in the next section.

**Discussion**

The factors may be considered to be different but equivalent. If we enter the keywords of technology, structure, human, and form as the four main elements of the same importance in a black box, an image map may be created.
All factors may be considered to be actors, and this image map is actually at least three-dimensions rather than a static flat image. The image maps are all created based on text mining, and the image of factors in this study could be found as well. This framework attempted to connect the company/designer with consumers via the black box, treating factors such as design and technology as input and factors such as cognition as output. Since the image map is not a plane, all points in Figure 6 could be considered to be actants or actors. Once we understand this, we can explore the first part of the image map. The details of technology based on text mining, and the image map of the sample factors could be connected or related.

According to the actor-network theory, all actants and actors are related. What will occur if the engineers or designers of various companies consider this network when designing an artifacts or products? These may help to understand what information the companies transferred to customers.

**Conclusion**

This study was motivated by a desire to understand SCOT, form including DM, and ANT. We attempted to address the research question through text mining and framework creation. Finally, we created and discussed image maps. Although our findings yield both theoretical and practical implications, its limitations must also be addressed.

**Implication**

This research may have the following implications for both academic and practical futures:

1. For researchers, this study may have progressed the discussion of factor interconnectivity and
consumer understanding of technology while providing new research ideas. Since SCOT is included in the scope of MOT, form identification can also be concluded in the field of DM. Theoretically, DM can affect structure, form, and technology. However, the analytical method by which this relationship can be analyzed is unclear. To address this, ANT was used as an analytical method. Therefore, this research attempted to solve cognitive gaps, thus emphasizing the academic significance of this study.

2. This study may have several implications for management strategy, as it provides a new perspective for engineers and designers from autonomous technology companies. Specifically, factors such as appearance, perception, and technology can significantly affect the perceptions of consumers. Meanwhile, when making strategic decisions, more factors may be considered with the same importance. Consequently, figures and image maps in this study will also be useful for reference. In summary, the managerial implication of this research is that it contributes a new perspective by which the relationships among technology, form, structure and social dimensions may be analyzed, which may benefit companies when developing strategies.

Limitations
This research only focuses on the company, and does not identify or analyze consumers. While this research attempts to identify form and the relation among various factors based on ANT, we have only entered the first stage of searching the technological network. Furthermore, factors associated with each component (technology, form, structure and human) are endless. As a result, this study could only provide a limited view of factors for reference. Therefore, there is a need for future investigation that considers a wider variety of factors.

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Reference
Mirkka Rekola., Tarja Makelainen., Tarja Hakkinen. 2012. The role of design management in the
sustainable building process. *ARCHITECTURAL ENGINEERING AND DESIGN MANAGEMENT.*


TRACK 3: Meanings of Design in Business Development

Topic 3.1: Designing Tradition in Global Markets
A Commonality of Business Idea Productions: A Co-occurrence Network Analysis

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Abstract: Regardless of whatever an entrepreneurial career would be chosen, a business idea production became to be common. A corporation recruits new business ideas from both inside and outside a company and hold business idea competitions. However, a mechanism of business idea production has been neglected for long years. Business ideas are traditionally developed by working experience and expert’s mentoring without scientific evidences. This study tries to provide useful information to understand cognitive tendencies of generating business ideas. Questionnaires asked participants open-ended questions to describe new business ideas related to coffee shops and instant noodles. College students and corporate employees were gathered. They have few experiences to produce business ideas. 146 ideas (coffee shop 76, instant noodle 70) were collected. These ideas were analyzed by a co-occurrence network approach using RMeCab packages of R 3.6.0. As a result of analyses, extracted norms (coffee shop 213, instant noodle 350) were categorized into five factors: target, product, topic, brand, and strategy. First, target means information to identify markets, segments and customers. For example, representative words are elderly persons, social members, and Asia-pacific. Second, product includes functions of products and services. For instance, ingredients of instant noodle and business hours of coffee shop are picked up. Third, brand is a name of famous companies such as Starbucks and Nissin. Forth, topic involves words which repeats questions like as coffee shop and instant noodle. Fifth, strategy contains words which evokes Michael Porter’s theory: differentiation, cost leadership and focus strategy. These results bring out essentials of business idea production. Especially, this study hires ordinary persons who have few experiences of making business ideas. If college students are ordered to make a business idea for business competitions, they can easily think about their target and market, function of products, famous brand name, and classical business strategies. However, they tend to lack analytic views such as pricing, competitors, and growth strategies. In addition, this study finds a level of difficulties for idea production. People can easily pop up business ideas for elderly persons and healthy instant noodles. These common ideas are produced in spite that participants are required to think up of something new. In order to increase the originality of ideas, they need to receive a training for idea production.

Keywords: Entrepreneurship, Innovation, Text mining, co-occurrence network
Protecting The Memory of Objects from Nostalgia

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Abstract: In Das gewöhnliches, Bazon Brock features vulgar objects, inexpensive things used in our everyday lives. Such as Pompey’s artifacts were pivotal to understand life after a historical loss, so do normal objects, our tangible legacy, and our connection with them may very well be what defines our humanity. They not only represent but are also as much cause as they are the consequence of the way we live, contributing to the definition of that lifestyle and thus becoming essential in enhancing social values.

Every object has a meaning beyond its materiality, and the shape envisioned by its project promotes a reflection about the way we subsist, depends on our habits, suggests how we can live both individually and collectively, and encompasses a political vision or a rejection of the social organization. Design’s participation in social construction becomes particularly acute in a time that so easily displays the erosion of ethical values, escalating the devaluation of truth, the institutionalization of hate speech, and the increasing assemblage of walls. Although history may not repeat itself exactly in the same manner, the warnings should not be ignored, and Design must not withdraw from action.

The role of Design in this crossroad becomes particularly emphasized in association with concepts such as memory. If Design’s tolerance is not questioned when considering the respect for culture, the defense of collective knowledge by designers, the familiarity with products with which we have lived throughout generations, it may also become permeable because of that retrospective.

Memory seems to entail an inevitable sense of place. When our projects envision evolution but remain a reference to what we know, reminding us of our ancestors’ homes through recognition and emotional value, those objects will inevitably distinguish themselves from others. It is necessary to protect that memory, but the homage to what is local and national is precisely what may become the source of the rhetorical foundation which helps to sustain nationalist discourses.

Therefore, the distinction between the notion of memory within Design and ideas such as nostalgia and selective memory becomes imperative, since those are the concepts which may truly feed intolerance. Nevertheless, it is also crucial to demonstrate Design’s intercultural nature, its openness, as well as its contribution to the obliteration of borders and to the absence of possible conflicts between an international perspective and the (conscious or unconscious) resource to the past and to our shared inherited knowledge.

Keywords: product design, politics, tolerance, normal
Nostalgia

3D Print technologies and their potential for creating a Third Industrial Revolution (The Economist, 2012) in which almost any product could be fully produced by one machine and adapted to individual wishes, coupled with the democratization of online sales, appear to have transformed market into markets (Bohm, 2005). Decentralization and the end of a Fordist "one fits all" sense, poorly suited for today's desires, have given rise to production on a smaller scale, bringing the character of each product closer to the more exclusive handcrafted artifact and recalling Jasper Morrison's observation about the connection between the scale of production and the visibility of authorship (Morrison, 2006). This approach to craftsmanship seems to have installed a nostalgic moment within design, a moment in which the idyllic valorization of the past may not be exempt from consciously or unconsciously serving a nationalist and populist discourse. In fact, the redesign of objects and the recovery of shapes that refer to the past seems to inevitably evoke a specific type of local memory, intertwined with our ancestors' houses, and immersed in emotional value. Therefore, the consideration of memory's permeability to nostalgia sets the tone for our intended analysis, which questions its impact on people's perception of objects and, with it, the individual and collective experience(s) they convey.

For instance: when a collective of Swedish designers projected a set of pieces to be produced according to the national craft tradition, although there was never an intention to create an interior Scandinavian-looking, Kristina Rapacki questioned whether this was A National Design? (Rapacki, 2019). More than just preserving culture, they seem to risk carrying a nostalgic load, conveying a reductive image of former simplicity and contributing to a paranoid fantasy (O'Toole, 2018) about a golden past (Shafak, 2019), something that John Hersey (1946) describes as a selective memory which recalls the idyllic past but forgets Hiroshima.

Concepts for memory against nostalgia

The shortest, obvious solution to eliminate nostalgia may seem to simply erase any reference to the past and create a new world. However, that would only repeat a conflict which is about a hundred years old, alluding to a time when design serves the ideas of Modernism, celebrating the pursuit of progress through technical innovation (Parsons, 2009). Within this context and frame of mind, faith in the machine emerged as a vehicle for social change and response to universal needs (Raizman, 2003), accentuating the separation between present and past, and breaking the connection to previous references and general memory. John Thackara (1988) thinks that this criticism is not directed at Modernism, but rather at its late practice, i.e., at the reaction to historicism contained in the functionalism of Ludwig Mies van der Rohe and Walter Gropius, generating a style as a unique path for rationality, and therefore criticized for treating all places and people in the same way and placing expert analysis over everyday experience. We, on the other hand, are in no way suggesting a cut with the past, since that would eliminate culture, the knowledge accumulated throughout generations (Fukasawa & Morrison, 2007), ignoring our own nature and evolution. Memory is a crucial concept to design. However, it has to be protected from appropriation by immobility and retrograde agendas. We need the past, but one that projects the future, allowing novelty and difference, and promoting internationality, integration and tolerance.
The idea of tolerance, of resorting to memory without serving nostalgia, can not just work as a slogan. There does not seem to exist any movement or theory today able to clearly reflect this approach, but a recent event can serve as a starting point. Takashi Okutani found it *Super Normal* (Fukasawa & Morrison, 2007) that, at the launch of Naoto Fukasawa’s *Déjà Vu* stool (F.1), at Magis’ booth in the 2005’s *Salone*, the product was instantly adopted and used by visitors, rather than admired on a pedestal. The notion — *Super Normal* — served as a pretext for an exhibition and a book in which Naoto Fukasawa and Jasper Morrison, who accompanied Okutani on his visit to the *Salone*, reflect on the urgency of modesty and normality of design by displaying products which, in their perspective, are able to convey these values. This case becomes relevant because Fukasawa and Morrison base the idea of Super Normal precisely on memory and, although it precedes the vulgarization of the term Populism, they seem to be able to refer to the concept without serving a discourse that may be associated with an acritical reconstruction of the past.

Jasper Morrison refers to evolutionary design, suggesting that we project by improving what we know, and supporting a connection to objects as part of an accumulated coexistence. He proposes "the evolutionary step instead of the creative leap" (Fukasawa & Morrison, 2007). This idea is supported by the notion according to which it would only make sense to produce something new if you improve what already exists, what you intend to replace. The most direct strategy is to keep the recognized form, to make small interventions and improvements, dealing with the culture in hand (Hara, 2007), and rejecting the association of the term *design* with a culture of repeated change of typology. This refers us to the idea of familiarity, to the comfort we feel when we live with an object and how success in repeated interaction is fundamental to create the emotional attachment that will allow it to last. Morrison exemplifies how the stem in the Goblet wine glass carries the atmosphere of a table, even if it does not improve the implied functionality (Morrison, 1999). For him, the success in its continued use is the recognition of a product’s beauty, a beauty that is not instantaneous, that grows and settles in our lives (Fukasawa & Morrison, 2007).

In Naoto Fukasawa’s design, as in his speech, formal recognition is less direct. The shape, when repeatedly associated with an action, leads us to an unconscious gesture, *without thought* (Fukasawa, 2007). According to Masato Sasaki (Fukasawa, 2007), Fukasawa seems to explore the notion of *Affordance* as coined by James J. Gibson, who appropriates the verb to *afford* to describe how things can communicate possibilities of action, applying it to products with totally different functions. Fukasawa believes that this gesture often "exists deep under our consciousness and it is genetically inherited" (Fukasawa, 2010), also referring to Carl Gustav Jung’s original notion of Archetype (Jung, 1972), which defines the collective unconscious as being transmitted from generation to generation, and therefore becomes shared by all, regardless of individual experiences. Through the adaptation of Jung’s term to design, applying it to images such as the simplification of a camera or a telephone (installed in our unconscious by the repetition and success of a typology for only a few dozen years, clearly not long enough to have been transmitted to us genetically), the term archetype becomes utilitarian, translating the simplification of an idea. Whether in the immediate recognition of the shape of Morrison’s *Socrates* corkscrew (F.2), in the invitation to a gesture evoked by the industrial fan and replicated in Fukasawa’s *CD-Player* (F.3) or in any Archetype (F.4), memory is always presented as a key element for acceptance. Kenya Hara (2007) refers to dealing with shared values, stable and
mature products. Enzo Mari (Fukasawa & Morrison, 2007) to the role of designer as guardian of collective knowledge.

There is an aspect that becomes central, allowing memory not to carry an heavy nostalgic load: the design promoted in Super Normal (even if the same does not apply to all the creations of its authors) is fundamentally based on contemporary objects. No matter how distant their formal origin is, it refers to objects that have always been evolving in gradual steps (Fukasawa & Morrison, 2007), and do not belong to a distant past that someone wants to rebuild. Although the designer’s intervention has different degrees of visibility, the product is always new, designed for our days and needs, no matter how much the understanding of contemporaneity may differ. The idea refers to both the existing and the new product. It refers to the coexistence of products from different periods. Since Déjà Vu, the object that generated the exhibition, the old coexists with the new, the material merges with a recognized shape validating the project today, allowing the image to no longer belong to, or be imprisoned by, the past.

This combination of cultures, ensured by memory, with the contemporary approach that protects the product from nostalgia, becomes fundamental for the construction of a design that respects the past without participating in an unhealthy nationalist (Bremmer, 2018) discourse. Merging rationality and freedom, ornament and utility, past and present, and connecting previously contradictory approaches (Kries, 2011), Super Normal created a unique concept defined by the fusion of functional and extraordinary in the creation of normal, useful things, combining parameters similar to Memphis with a formal approach closer to Modernism (Sudjic, 2009). The concept does not generally refer to a local or national culture, being almost always universally recognizable and promoting an international spirit. Its principles can be recognized in countless contemporary projects. In Ovale (F.5), Ronan & Erwan Bouroullec resort to a familiar material, slightly changing the shape of the plate’s archetype, making it evolve, making it new. They seem to explore the idea of formal imperfection, playing with the ordered geometry, the relationship of similarity between the forms, and the disorder suggested in the asymmetry and manipulation of proportions and sizes. With this approach, by generating small differences that mimic the pre-industrial irregularity, they contribute to change the industry’s image of rationality and cleanliness that had been kept since Fordism. In spite of referring to the past, it is still actual and universal. The language is soft, tension free, smooth, without abrupt accelerations or angular forms, alluding to the neo-primitive (Koivu & Bouroullec, 2012) between the artisan and the industrial, and approaching liquid modernity (Bauman, 2001; Bouroullec et al., 2003), although perhaps not yet anticipating the entire scope of its interpretation. Mateo Kries, director of the Design Museum in Weil am Rhein, considered Super Normal to be the most important recent moment for design (Kries, 2011).

**Blur**

However, this idea is also exposed to contradictions. One of the objects which illustrates the notion of familiarity, Jasper Morrison’s Sofa (F.6), as universal as it may be or aspire to be, still aludes to the Chesterfield model, reminiscent of childhood (Morrison, 2006) and possibly more familiar in a local context. Resorting to local memory is not a problem per se, particularly if connected with the idea of sharing, trying to commercialize it around the world in spite of having been produced by a German brand. Nevertheless, a more limited approach to memory seems
to invite the expansion of the idea, in our current context. *Milk NA1*’s lamp (F.7), a project made by Norm Architects studio to the english brand &Tradition, reminds us of the Scandinavian milking bench. Although the memory and reference to existing products, often imposed as a marketing resource, seem to have occupied a significant part of design’s universe and discourse, becoming almost an obsession in certain cases, in this specific situation localness ends up being softened by the adjustment of shape to new functions, the base to a lamp, crossing it with the more universally recognizable shape of the lampshade. This crossing between cultures not only generates new possibilities and combinations, but also reflects the way the world progressed and developed throughout several decades of relative prosperity, a more diverse society and a broader range of cultural references. To Hal Foster (2011), the mixing and non definition of boundaries are a staple of today’s culture. Michael Graves (Graves *et al.*, 1994) predicted that, after Memphis, there would be black, white, all the grays and lots of color, already anticipating the diversity that followed the domain of late Modernism, defined by a clear separation between opposite black and white ideas. No one knows the exact reach of Michael Grave’s reference, but his affirmations seems to convey more than the mere suggestion of that diversity’s coexistence. Today, design’s evolution is done through mixing, opening, universal evolution, and that is the source of its richness — more than searching for design’s evolution through local culture (Bey & Bouroullec, 2010). In *Ori* (F.8), salt and pepper shakers idealized by the independent collective project Foodwork, and destined to be exhibited in Japan, are characterized by the attempt to create Norwegian products relevant to the Japanese way of life (FoodWork, 2012), since Japan was the country where they have gathered the Origami experiment which originated the objects’ final shape (Voll, 2014). Even in Danish Sam Legald’s *Ikono* (F.9), clearly inspired in *PH* models (F.10) (classics of Danish Poul Henningsen’s approach to design of author), national culture is mitigated by the fact that it no longer is just a national ikon, having become internationally familiar.

**Objects that define life**

If objects suggest the way we live, helping to define how we relate to each other, designers have a fundamental role in the construction of our world. Design’s part may not be particularly evident or intentional, but it necessarily entails an assessment about the way society organizes itself. More or less aware, it is always political (Parsons, 2009), it is always part of the equation. Just as Pompeii’s ordinary artifacts were crucial to understand its time (Fukasawa & Morrison, 2007), the products we use reflect how we live today. It seems impossible to analyze the nature of objects without questioning human nature, because without people they do not exist or make sense; on that same note, what makes us human is the fact that we create objects and have a relationship with them. In a way, “the world of man consists of things” (Schwartz-Clauss, M., & von Vegesack, 2010).

Louise Schouwenberg (Schouwenberg & Jongerius, 2018) proposes that choices were largely determined by class. When she remembers the buying of a cabinet for the house where she grew up in, as well as the importance of that process to her parents, she signals how they chose it considering not only their social life and their future needs, but also other people’s possible judgement and considerations. Schouwenberg mentions how this experience was important to enable her to understand objects’ political implications, the market’s influence in people’s lives, and how objects are pregnant with meanings and projections. Objects always reflect and define how we live. Smartphones determine contemporary relationships, *Braun*’s products prescribed
a rational phase and luxury objects (may) comprehend exclusion. If we think about Museum der Dinge, in Berlin, particularly everyday objects from post-WW2 Germany, East and West, we can easily understand how objects reflect not only economic conditions, but also a life style. They will not be as explicit as Art promoted by the Nazi regime while suggesting a rustic life, but they can also convey a message of exclusion.

If design wishes to remain a constructive discipline, serving both evolution and civilization without invading individual freedom or imposing doctrines, schools have an obligation to include tolerance values in design’s teaching and research, never interpreting this area as a sequence of tasks, nor the designer (who projects the world) as a technician held by purely commercial decisions. Thus, it is not evident that design’s teaching and research have, for the moment, full awareness of their part in the promotion of tolerance. A careful reading of Portuguese governmental data base on Design PhD’s (DGEEC, 2019), made within the programme Design Obs. — Design’s National Observatory — by theme, keywords and abstract analysis, even if not yet definitive, allows us to conclude that, from a universe of 200 works, only a very low percentage is directly related with the connection between design and the way we live. Case studies and historical researches constitute the majority of the works, with 41,5% focused in specific authors and places. Operative works about working processes, design management, and industry, technique or technology, as well as about the promotion of design or details such as color, constitute 14,5% of the data base. Very specific works about areas such as illustration or interaction, represent 10%. The few research — 9% — devoted to the relationship between design and the world surrounding it seem to have been guided toward sustainability and inclusive design. These contributions are obviously legitimate and highly useful, but the reduced number of works devoted to everyday product’s influence in our way of life seems to reveal an also limited notion of design’s importance to the construction of society, which transcends its market presence. Social awareness, apart from occasional media attention, does not seem to be a dominant presence in design thought. On the contrary, design appears to lack a broad awareness of its responsibility, a notion that should begin by being correctly introduced and fully transmitted by design schools, instead of promoting it as a sequence of tasks and a participative addition to market society. Fortunately, it is much richer than that.

Urgency

In today’s context, characterized by the rapid advance of populism, protecting diversity has become paramount. The term, although typically presented without explanation, as if everyone could already define it (Baker, 2019), refers to the exploitation of everyman long term resentments, stirred by charismatic politicians with impossible promises (according to Barack Obama), an overused epithet for multiple manifestations of political anger (Steinmetz-Jenkins & Jäger, 2019), of emotional and oversimplified discourse. Present as much in the left as it is in the right, populism obscures more than it illuminates and, according to Cas Mudde (Baker, 2019), it is not a totally formed ideology such as socialism or liberalism. It is probably more akin to a method, antagonizing “the people”, fundamentally good, and the corrupt “elite” (Baker, 2019). In the majority of the cases, it resorts to a religious discourse, reacting to secular government, even in countries without a particular religious tradition, forging an unholy alliance with religion as a promise to recover moral values (Steinmetz-Jenkins & Jäger, 2019), reminiscent of an idilic past. Although we may accept that history does not repeat itself exactly
in the same way, there are aspects that can serve as a cautionary example and therefore should not be ignored (Wachsmann, 2017). This battle for design is, as stated about Brexit, also “a battle against intolerance, prejudice, xenophobia and the manufacture of distrust and disunity” (Brown, 2019).

The intimate connection assumed here between object and human awakens us, unavoidably, to the way they specularly reflect each other. The evolution of objects can be observed within a logic of continuity or disruption with the history and progression of its shape — both possibilities are a projection of the human, evoking its context and space-time horizon. Therefore, we must not alienate memory nor exclude it as an intrinsic component to the creation of objects, since it is also an intrinsic element to the creation of people. Its intervention may be the result of more or less awareness, but memory in nonetheless an unavoidable element in the definition of individual and collective production, subsequently becoming decisive to the definition of an individual and collective sense of identity. This is what makes it problematic, because that affinity with the way we are and see ourselves can not be alienated from who we were nor from who we want to be, pointing choices and paths. Nostalgia is one of those paths, emerging from a tendency which is also an option: the option to connote certain objects with a specific set of symbolic layers, creating an universe of meaning which contaminates not only them, but also the set of experiences they define and allow. We may question if people are the ones to search for that meaning in objects, projecting it after the emotional fabric that is consequence of the way we live and see the world, or if objects are the ones to install that way of seeing and feeling in individuals and societies. Both premises are equally valid. Therefore, we must remember that, under the attempt to normalize the object, lays the unavoidable normalization of our relationship with the object — as well as the understanding of what this can signify within the broader context of a value system which can pave the way and define possibilities to a much needed design culture.

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References
Shafak, E. 2019. Form Spain to Turkey, the rise of the far-right is a clash of cultures not civilizations – The Guardian. in https://www.theguardian.com/commentisfree/2019/may/06/spain-turkey-far-right-vox-culture-war?.
A Perspective of Globalization in The Pharmaceutical Industry

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Abstract: Although it is generally agreed that the pharmaceutical industry is globalizing rapidly, there is no clear answer on the current state of globalization because there are various definitions of globalization across studies about globalization. Moreover, the studies neither focus on the pharmaceutical industry nor evaluate the effectiveness of globalization with a control. Therefore, we investigate the current state of globalization with a sample of the largest 30 pharmaceutical companies and the effectiveness of globalization compared to a control. In our research, we defined globalization as a balanced geographic distribution of sales across regions according to the definition that Oh and Rugman (2014), and analysed the data that we hand-collected from each company’s annual reports and financial reports such as Form 10-K. The results show that many companies are not global, although some have been shifting from their home-region orientation during 2010-2017. Surprisingly, we did not see any effectiveness of globalization in terms of total sales, sales and marketing productivity, and research and development productivity. Our study provides a skeptical perspective of globalization in the pharmaceutical industry, and indicates that globalization is not always an effective strategy for pharmaceutical companies. The result suggests the difficulty to deal with global integration and local adaptation with good balance in this industry. Further studies are necessary to have a deeper understanding about the process of globalization in the pharmaceutical industry and to have a suggestion to overcome its difficulty.

Keywords: Pharmaceutical industry, Globalization, Effectiveness, Sales
Interview Survey Method to Extract Cultural Trait Applicable to Concept Design

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\textbf{Abstract:} In recent years, the number of foreign tourists visiting Japan has increased. It is considered necessary to develop a payment application for foreigners so that foreigners can enjoy cashless travel when they visit Japan. Therefore, it is necessary to design a payment application that takes into account the cultural traits of users with different cultures. In this study, we proposed an interview survey method to extract cultural traits applicable to conceptual design, using a payment application for users with different cultures as an example. The proposed interview survey method was examined and the results of applying the interview survey method were described. In order to extract cultural traits applicable to concept design, we used life story interviews and image interviews for Japanese and Mongolians. We focused on common points in order to create a concept design that users with different cultures perceive as value. And we extracted the value of the way of thinking, feeling and acting on the money that Japanese and Mongolians can’t see. The common points that can be used in concept design have also been clarified. Therefore, it was shown that it was very effective in extracting cultural traits applicable to concept design.

\textbf{Keywords:} Cultural Trait, Interview Survey Method, Concept Design

\section*{Introduction}

\textbf{Background}
In recent years, Japanese culture and products have attracted attention, and the number of foreign tourists visiting Japan is increasing. Among them, the foreign tourists surveyed by the Japan Tourism Agency answered that they were troubled during the trip, saying “exchange” and “use of credit card” in the fifth place. Therefore, it is considered necessary to develop a payment application for foreigners so that they can enjoy cashless travel with foreigners when they visit Japan. Therefore, it is necessary to design a payment application that takes into account the cultural traits of users with different cultures. Considering cultural traits will improve app usability. The user can operate without hesitation and easily achieve the purpose. As a result, user satisfaction with the application will be increased. If you pile up, the app continuation rate will go up.

What are the most important actions for designing with cultural traits in mind? The human-centered design process (ISO9241-210) states that “products, systems, and services are designed to take into account the people who use them and the parties that are affected by their use” (Human-centered design for interactive systems, 2010). Who will use the service and how to consider cultural traits. In other words, it is important to clarify the cultural traits of the target user. Therefore, it is necessary to conduct a local user survey to clarify the cultural traits of users with different cultures. That is a very
important role. But designers and developers can spend a lot of time in the research phase. There is a need for a quick and efficient user survey. Therefore, it is considered that it is one of the most appropriate methods from the interview survey method. This is because things that are difficult to catch by direct observation can be obtained efficiently through conversations with the parties concerned.

In this study, we thought that it was necessary to extract cultural traits in a shorter time and efficiently when designing an application for users with different cultures. The purpose is to propose an interview survey method to extract cultural traits applicable to the concept design using payment applications as an example.

In proceeding with this research, we will define cultural traits. Cultural traits are values that are invisible to people who share that culture, such as ways of thinking, feeling, and behavior. It can be said that it is worth deciding how to think and act. And it focuses on the cultural traits of each person in the areas of region, family and human relations. In order to clarify the cultural traits, it is necessary to extract common points and differences when comparing the cultures of two or more countries and regions.

The concept design shows the value provided to users. Therefore, we need to create a concept design that feels valuable to users with different cultures, so we will focus on the common points.

Previous Research
Whitney Quensenbery, Daniel Szucs “Global UX” book is listed (Whitney Quensenbery and Daniel Scuz, 2012). The Global UX book describes how to think about user experience from a global perspective. In order to clarify cultural traits, it is important to focus on the common points and differences between countries and regions.

From this, it was found that the traits of cultures can be clarified by extracting commonalities and differences when comparing the cultures of two or more countries and regions.

Marieke de Mooij’s “Global Marketing Advertising: Understanding Cultural Pradoxes” book describes cultural influences in cross-country marketing, branding, and advertising strategies (Marieke de Mooij, 2013). Value is something that is absolutely taught at an early age. People are aware of their values and act unconsciously like automatic operations. Value is implicit, not conscious of children. There is one thing to learn first. Developmental psychologists have stated that most children by the age of 10 have a basic value system.

It turned out that it was necessary to emphasize the memories of childhood in order to extract the value of sharing culture.

Atsushi Sakurai and Takako Kobayashi’s “Introduction to Life Story Interview Qualitative Research” book is written about the life story interview, which is an oral narrative about individual life (life, disability, life, and way of life). By interviewing experiences of life and past events, you can understand people’s identities, the world of life, and local culture and society. The Life Story Interview is a semi-structured interview that is used as a research method in the fields of sociology and psychology (Atsushi Sakurai and Takako Kobayashi, 2005).

The Life Story Interview is a study to interview the experiences of events related to the whole life based on personal life. It was found that it is easy to extract the cultural traits of each person in the area of region, family and human relations. However, because life story interviews are mainly used as research methods in the fields of sociology and psychology, there are few examples used in design studies. I found out that there was no research method that had been established. Therefore, I understood that it was necessary to conduct an original life story interview method. Life story interviews place more
importance on story relevance than facts. I understood that it was time series from the starting point where the event happened.

Keiko Ueno’s book “Techniques for Finding Tips for Solving Marketing Interview Problems” is a book about business skills, product development, and interview skills to draw out hints for marketing (Keiko Ueno, 2004). There, a person has an image of a group consisting of several concepts, experiences, and stories. The image is an individual's sensory and emotional thing that cannot be expressed in words. In order to explore specific and detailed images, surveys by interviews are more suitable than questionnaire surveys.

In order to clarify the brand image, analog thinking is used. It is a method that allows both adults and children to have intuitive metaphors instead of making sense. By expressing metaphorically, it is easy to talk about personal feelings, such as the value for one's mood and emotion (emotion benefits).

From this, the image is the sensory and emotional of the individual. It is necessary to express metaphors to clarify the image. It is easy to extract value for your mood and feelings. I also found it easy to talk about my personal thoughts. It can be thought of as extracting cultural traits for emotions.

Proposed Design Approach

The purpose of this study is to propose an interview survey method for extracting cultural traits applicable to conceptual design, using a payment application for users with different cultures as an example. Based on the findings of previous research, life story interviews and image interviews are used to extract cultural traits. Life Story Interview is used to understand the value that cannot be seen, such as how to think about money and how to act. Use an image interview to understand the value of how you feel about money.

The original life story interview places importance on storylines. Therefore, it is a method of interviewing events and experiences experienced individually or in time series. On the other hand, lifestyle interviews proposed in this study place importance on past events and experiences in order to extract invisible values. The life story interview is based on the memories of childhood. The reason is that by the time the value is ten years old, most children have a basic value system.

Interviews about images are used as an analogy-thinking method that allows them to express metaphors. Since this study focuses on money, questions about the five senses are made to clarify the image of money.

The outline of the interview survey method to extract the cultural traits applicable to the concept design is as follows.

1) The life story interview to extract cultural traits hears experiences that have been experienced in thinking and how to use money. Furthermore, we will dig deeper into the story of childhood and conduct an interview. Try to have a relatively free conversation while keeping in mind not to disturb the narrator's speech.

2) Interviews on images to extract cultural traits ask for images of money. Listen to the image of money as if it were a color, shape, taste, smell or sound. Intuitively come to mind. Interview the reasons for the thoughts.


**Experiment for Proposed Design Approach**

*Summary of evaluation experiment*

In this study, we proposed an interview survey method to extract cultural traits applicable to conceptual design using life story interviews and image interviews. An evaluation experiment was conducted to determine whether cultural traits can be extracted efficiently in a short time by using the proposed interview survey method.

The evaluation experiment was conducted on Japanese and Mongolians. We conducted an interview survey for about 90 minutes through video calls. The subject was selected as a woman in her 20s who lived and worked in the city and paid using a smartphone. Five women in their 20s from Japan (subjects: A, B, C, D, E) and five women in their 20s from Mongolia (subjects: F, G, H, I, J). First, we conducted a life story interview about how to think and use money. After that, I interviewed about an image of money. Finally, I wrote down the contents of the interview. The text (interview data) was categorized and arranged as it was spoken.

The questions in each interview are as follows.

1) The Life Story Interview will ask you about the current use of money and payment methods as an ice break. I went deeper and interviewed about money-related events in childhood. Figure 1 shows the interview questions.

2) The interview about the image had an intuitive metaphor for the image of money through the five senses. We interviewed the explanation of the answer. Figure 1 shows the interview questions.

<table>
<thead>
<tr>
<th><strong>Life Story Interview Questions</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Please tell me how you currently use and pay</td>
</tr>
<tr>
<td>Tell me about your memory of childhood money</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Image interview questions</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>What color image does money compare to color?</td>
</tr>
<tr>
<td>What is the image of money in terms of shape?</td>
</tr>
<tr>
<td>If you compare money with taste, what kind of taste is it?</td>
</tr>
<tr>
<td>What kind of scent is the image of money?</td>
</tr>
<tr>
<td>What sounds and rhythms are like when you compare money with sounds and rhythms?</td>
</tr>
</tbody>
</table>

*Figure 1: Life story interviews and image interview questions.*

**Results of evaluation experiments using the Life Story Interview Survey Method**

The results of the life story interview are as follows. The following points are common to Japanese and Mongolians. Subjects A, B, C, D, E, G, H, J answered that they had saved money as a child. Subjects A, B, D, and E are saving New Year's Gift from parents and relatives during the New Year. They found out that they had to save some of the money they had received. In addition, many respondents said that they were worried that they would not save money, and that money was saved when needed. Seeking security for money. The subjects feel value in saving money for things with high uncertainty since they were children. On the other hand, subjects G, H, and I save money from their usual pocket money to save their friends' birthday and play. Subjects feel value in saving with purpose. Also, in interviews with
subjects A, C, E, F, I, and J, the word “mother” often appeared. Many respondents said that they had received money from their mothers and gave them money to their mothers, and that they said, “It is better to have free money.” So mother is an important person at home. The subject’s mother had a household account book and found that she was raising children. For this reason, both Japanese and Mongolian subjects are clearly divided in the role of gender in social life. I understood that the subjects were born and raised in a society characterized by masculinity.

The following are the differences between Japanese. Japanese subjects A, B, C, and D had received regular pocket money from their parents when they were elementary school students (6 to 7 years old) and managed them themselves. For this reason, Japanese households have a period and amount of money to spend. I found out that the subjects were spending money based on the rules. It is thought that the children can learn how to manage money by giving their pocket money under the rules and controlling their own desires. In addition, it leaves the children to spend money. I understood that the subjects were treated as adults from an early stage. Therefore, it was found that the subjects acquired a sense of money from their childhood and were independent from their parents. Alternatively, subjects A, B, C, and D are working part-time from high school students and are experiencing their own money. Subjects are out of parental control with increasing age. The subjects feel value in spending money based on their own will and desire. Subjects A, B, C, and E frequently responded that they were using their pocket money for comics, sweets, games, food and drinks, and karaoke with friends. Individual preference is strong, and subjects feel value in consuming for themselves.

The following are the differences between Mongolians. Subjects F, G, H, and I have never received money from elementary and junior high schools. Many respondents said they received their first pocket money when they were high school students. It is thought that if you have a lot of money, you will be unhappy, will fit theft. In Mongolia, giving money to a child has a bad effect on the child. For this reason, it seems that they were from high school students who gave money to their parents and treated them as adults. Therefore, Mongolian subjects are independent or slow from their parents. It seems that he has received financial assistance from his parents for a long time. On the other hand, it was found that family ties strongly valued relationships with parents. In addition, subjects F, G, H, and many responded that they spend money to celebrate the birth of their friends. I found out that my friendship is important.

Results of evaluation experiments using the Image Interview Survey Method

The results of the interview on the image are as follows. Table 1 shows the results of the interview survey on image interview methods.

I found the following points in common between Japanese and Mongolians. The images of subjects B, C, D, E, F, G, and I in the form of money were round. In Japan, round coins are often used in daily life. Therefore, the image of money shape is considered to be an image from an object. However, since Mongolia only uses banknotes, the image of the form of money is thought to be based on the idea of a mechanism for turning money. In common, the images of subjects B, C, E, G, I, and J on the taste of money had a bitter taste. It is thought that the Japanese imaged copper from coins, and the Mongolian imaged from banknotes.

The following points were found as differences between Japanese. Japanese subjects A, C, D, and E had a yellow image and subject B had an orange image. I found out that it has a warm, bright and cheerful image. In addition, subjects A, D, and E were images of the sound of money clinking. I understood that Japan is a word often used as a coin change sound.
The following points were found as differences between Mongolians. Mongolian subjects G, H, and J had a green image of money. I found that it has a neutral, natural and calm image. Also, subjects G, H, I, and J were found to have an image of the sound of money, an image with a sense of rhythm, and an image with movement, such as a sound with ups and downs.

Table 1: Interview results of image interview survey methods.

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>yellow</td>
<td>orange</td>
<td>yellow</td>
<td>yellow</td>
<td>yellow</td>
<td>red</td>
<td>green</td>
<td>green</td>
<td>gray (can be good or bad)</td>
<td>green</td>
</tr>
<tr>
<td>Shape</td>
<td>square</td>
<td>circle</td>
<td>circle</td>
<td>circle</td>
<td>circle</td>
<td>circle</td>
<td>circle</td>
<td>square</td>
<td>circle</td>
<td>square</td>
</tr>
<tr>
<td>Taste</td>
<td>salty</td>
<td>bitter</td>
<td>copper, 10 yen</td>
<td>bitter</td>
<td>salty</td>
<td>bitter</td>
<td>sour and sweet</td>
<td>bitter</td>
<td>bitter</td>
<td>bitter</td>
</tr>
<tr>
<td>Smell</td>
<td>smell of paper</td>
<td>charcoal and burnt smell</td>
<td>10 yen smell</td>
<td>metal smell</td>
<td>odor</td>
<td>good smell</td>
<td>odorless</td>
<td>smelly and dusty</td>
<td>I have no idea</td>
<td>odorless</td>
</tr>
<tr>
<td>Sound</td>
<td>click</td>
<td>palpation / light sound</td>
<td>electronic sound, mechanical sound</td>
<td>click</td>
<td>click</td>
<td>rhythm sound</td>
<td>high volume and slow tempo</td>
<td>sound of paper</td>
<td>sound with ups and downs</td>
<td>rhythm sound</td>
</tr>
</tbody>
</table>

Consideration of evaluation experiment

Based on the above results, cultural characteristics were extracted efficiently in a short time through the life story interview and image interview. I was able to clarify the similarities and differences between Japanese and Mongolians. The people who share the culture have been able to understand the value of money, how to think about it, how to think about it, and how to act. And by extracting the common values of those countries and regions, we were able to extract the cultural traits applicable to the concept design. Common values that can be applied to conceptual design are:

- As a common point between Japanese and Mongolians, the subject feels value in saving money. The subject felt it was worth saving, but the reason for saving was different. Japanese people are looking for a sense of security in savings, and feel the value of saving money for highly uncertainties. On the other hand, we found that Mongolian subjects felt the value of saving with purpose.

- It was also found that both Japanese and Mongolians were born and raised in a society characterized by masculinity because the roles of men and women at home were clearly separated. In a society characterized by masculinity, women tend to prefer money over leisure, emphasizing income and promotion, women should be kind and considerate.

- Finally, the image of money shape is a common round shape. However, the explanation for the round image was different. There was an image of Japanese money, and a feeling based on the coins used in everyday life. Therefore, money is considered an object. In the case of Mongolians, money was an image based on the idea that money always moves around. For this reason, money is not an object,
but an idea of energy and belief. In this way, we extracted the value that can be understood only by people who share the culture.

**Conclusion**
In this study, we proposed an interview survey method to extract cultural traits applicable to conceptual design, using a payment application for users with different cultures as an example. The proposed interview survey method was examined and the results of applying the interview survey method were described.
In order to extract cultural traits applicable to concept design, we used life story interviews and image interviews for Japanese and Mongolians. We focused on common points in order to create a concept design that users with different cultures perceive as value. And we extracted the value of the way of thinking, feeling and acting on the money that Japanese and Mongolians can't see. The common points that can be used in concept design have also been clarified. Therefore, it was shown that it was very effective in extracting cultural traits applicable to concept design. Using this result, we will conduct an evaluation experiment to incorporate the payment application UI design.

**References**
Atsushi Sakurai, Takako Kobayashi, 2005. Life Story Interview-Introduction to Qualitative Research.
TRACK 3: Meanings of Design in Business Development

Topic 3.2: Design for Business in the Post-human Era
Design to Interpret, Express, Protect and Transfer Innovation - Business Tools in Italy for The Academic and Professional Sectors.

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Abstract: The protection of Design, or the registration of a drawing, model or brand, is a practice that is not very common among students, researchers and professionals for some issues mainly related to training systems and local culture, which favour patent applications (1).
In fact, the protection of Design has allowed growth and guaranteed investments of the most famous "made in Italy" companies, especially in the furnishing, fashion, textile and car industry sectors.
Design allows for two-way processes, it is capable of imagining and introducing new scenarios and triggering or requiring technological and social breakthroughs, but at the same time makes it possible to adopt and manage the same innovations achieved at the level applied research. By protecting Design we protect one or more variants, expressions of innovation.
In fact «[...] opting for a new technique can therefore give rise to a new protected work only if it is likely to reverberate significantly even on an aesthetic level». (C. Galli, 2017)
Technological development is very often interrupted since we produce «[...] research results, for which there is not yet a direct and explicit demand from companies and for which further substantial investments and qualified development actions are needed to achieve the realisation of working prototypes». (Piccaluga & Conti, 2017)
Here the role of Design is at stake since the latter should facilitate the transfer of innovation: «Design is able to look at the world and recognize its most original parts, then develop them into shapes and images capable of offering new cultural references that can lead to improvements on those of the past». (Galimberti, 2017)
The patent application is a first step in the process of the valorisation of innovation, but various technological transfer initiatives, still to be optimised, also through methodologies and tools of the Design involved in the various stages of input-output, must then follow (e.g. Product, Strategic, Graphic or Web Design).
Design strategically enters the said process for the growth of economic systems, embraces and links multidisciplinary, scientific and technological contributions, through well-established and culturally independent technical skills, and not least, ensures attention for making the daily life of both individuals and communities easier in the post-modern and digital civilisation.
We will highlight organizations, tools and training paths that are able to support, within academic and professional contexts, innovation enhancement processes and technology transfer of research results.

**Keywords:** Design & Innovation, Research & Technology Readiness Level (TRL), Industrial Property Rights, Technology Transfer (TT)

The Open Issue

Innovation can originate in different contexts such as research institutions, universities, companies and professional offices. The protection of innovation is an initial act mainly oriented towards: enhancing it to understand its social and cultural aims; sharing technical progress and enabling sustainable development; allowing investments to be regained in a convincing, defined and localized time frame.

Therefore, protection is a necessary first step, which simultaneously opens the way to a whole series of technology transfer initiatives to develop and use innovation itself.

Nevertheless, the same methods of protection should be renewed, overcome the usual company structural limits and facilitate "open innovation" dynamics to acquire new ideas, involve new more collaborators and foreshadow alternative market applications.

In fact, the industrial world usually protects their innovation directly in many ways (e.g. patents, trademarks, designs, models, industrial secrets, know-how), by acquiring it as a property or as a license, keeping and developing the ability to self-transferring, with a spontaneous approach inherent to their core business.

Roles belonging to other non-industrial contexts instead (i.e. academic and professional), need to be supported and assisted to protect their own innovation and to start the technology transfer throughout the productive world. A context that in Italy is mostly characterized by micro and small-medium enterprises (around 90%) that have to deal with major competitors, must diversify and constantly specialize in order to find its place in the market and resist in it, also alongside multinational industrial groups.

Many initial questions arise from everything said before.

How can the academic and professional world be helped to protect their innovation and transfer it?

How can micro and small-medium enterprises be involved?

What tools are already available? Which ones can be suggested?

Purpose

The purpose of the following document is to identify a methodology to enhance, protect and transfer the innovation that could be supported by Design discipline. This would certainly allow us to analyse both the facts and the meaning of the actions of all actors involved both quantitatively and qualitatively.

This refers to our need to highlight procedures, project ideas, tools, structures and training paths to achieve realistic results in the short or long term in different academic, productive and professional areas.

The importance of outlining the key role of Design, which has been called upon to comply with the next post-human era as an interpreter of progress, and pioneer of new languages and meanings, must therefore be emphasized.
**Method and expected results**

After a first step of analysis of the state of the art in Italy that investigates the different aspects and needs to enhance innovation and transfer it, the most significant institutional initiatives undertaken at national and Community level have been looked for and selected.

From the basis of scientific literature, it was also possible to extrapolate functions that Design is able to manage, by assimilating and coordinating experiences gained in different sectors (e.g. IT, chemistry, sociology, ... etc.). Some recent theories have been strengthened, in order to boost up new approaches to cooperate and protect the results.

Subsequently, the tools already used or usable in organized, centralized, academic and professional structures, have been outlined to take advantage of the projects already developed and of the patents granted. Furthermore, technical and professional profiles have been specified with expertise in managing industrial property and that would be able to support research, assess evolutionary trends and facilitate intermediation with the production world.

Finally, three current examples of innovation in the fashion sector have been identified to better understand the meaning of protection, design, research of shapes and of unconventional and sustainable materials.

**State of the art in Italy**

Italy's creative and innovative abilities have historically been acknowledged in various scientific and productive sectors such as manufacturing, mechanics, fashion, furniture, biotechnology, astrophysics, ... etc..

Italy's contributions are numerous and excellent, even at international level, but unlike other countries, including European ones (2), there is a significant delay in the introduction of methodologies and tools to enhance innovation and transfer it.

It would be enough to say that only over the last 15 years have research Institutions (3) founded the first Research Value Enhancement and Technology Transfer Offices (TTO or KTO) dedicated to the centralized management of Intellectual Property Rights (IPR), together with the preparation of specific regulations, procedures and organizations. At the moment, unfortunately, similar organizations are not yet present within various professional categories (e.g. architects, engineers, agronomists, designers ... etc.), as if it were an individual matter and not a social aim.

The economic and financial structures and tools that invest in innovation should be developed (e.g. proof of concept fund, seed fund, pre-seed fund, corporate capital venture, angels, joint ventures, etc.), and they must be able to bear the costs to reach high Technology Readiness Level (TRL) to start an initial production process (4). Most of them use a difficult and fortuitous system of self-financing or micro-financing bottom-up resorting to different crowdfunding platforms. A few sporadic cases that use funds managed by Asset Management Companies and support the development of products are exceptions (e.g. Principia S.p.A. of National Research Council, National Innovation Fund of the Ministry of Economic Development).

Even technological or patent brokerage actions are not systematic in Italy, but punctual and sporadic. This hampers the identification of emerging technologies, it does not help companies to interpret the value of these technologies and their related services.

First of all, there is a need to create and spread a culture of intellectual property, mainly of industrial property, which no longer has to be limited to those few people involved or to a few confined contexts,
but it must be extended to those who are innovative or want to actively contribute to the enhancement processes.

It is vital to plan a basic education, from secondary schools to university courses, to gain awareness of all those potential opportunities that are at stake and to understand how to interact in the best way. This said, up to high-level training courses with more specialized skills, the ones for PhD students (5), professionals and businesses, which could be arranged in various work sectors.

On the other hand, the need to create networks for cooperation at all stages, from the creative process to the realization process is increasingly evident: in research, in financial participation, in design, in engineering and in production, in distribution and in trade, in asset management, in customer care and satisfaction.

The magic word "Cooperation-for-something" (Co-X) becomes more and more not only a technical instrument but, above all, economic and social. It reduces the distances that industrialization first and then computerization generated, it allows the opening of systems that are closed and rigid, as well as the implementation in progress and a continuous positive comparison. An example of this is the network of “clusters”, of laboratories or of research centres and services, mostly academic, of “fab labs” extended to the public throughout the territory, in which responsibilities and principles (6) are set up to respect and protect every single contribution of individuals.

Institutional initiatives

In the last two years, in fact, there has been more and more commitment and awareness that there are many steps forward to take and that Government Institutions themselves must decisively offer tools and new opportunities.

Italian initiatives

This year, for the 500th anniversary of Leonardo da Vinci’s death, the Ministry of Education, University and Research (MIUR) launched the initiative "InnovAgorà, the first place for patents and Italian innovation" (7) to make known and appreciated those patents and technologies resulting from research in public contexts with the contribution of about 60 participating structures.

The event was organized by the National Research Council (CNR), in collaboration with the Leonardo da Vinci National Museum of Science and Technology in Milan. The researchers, assisted by the Managers of their TTOs, presented their technology, exhibited their prototypes, took part in the B2B meetings with investors and companies interested.

Very recently, the Ministry of Economic Development (MiSE) has issued the Growth Decree (Legislative Decree no. 34 of 30 April 2019), which contains various measures concerning intellectual property aimed at supporting, with “3i Vouchers”, startups and small and medium-sized companies in the registration of patents, trademarks and design. This would make it easier for them access to the “Patent Box” tax regime, also facilitating the fight against “Italian Sounding” practices, protecting historic brands of national interest and allowing those enterprises to achieve an Italian patent directly through an international application “Patent Cooperation Treaty” (PCT).

This year again, the Directorate General for the fight against counterfeiting and the Italian Patent and Trademark Office (DGLC-UIBM) of MiSE, have organized, in collaboration with “Netval” (8), the first edition of the "Intellectual Property Award 2019" competition aimed at encouraging innovation and economic creativity among inventors. The industrial property rights involved are the patents available on the “Knowledge-share platform” (9) belonging to two macro categories: ICT, artificial intelligence,
IoT, big data, logistics and construction; life science, including medical devices and chemistry. The first inventors who manage to qualify in each category will be given a contribution to improve the economic value of their patent.

The same DGLC & UIBM on previous years have outlined and proposed to micro and small-medium enterprises the measures of the "innovation package" (e.g. National Innovation Fund, Patents+, Drawings+, Trademark+). The goal is to create a context that allows companies to leverage competitive advantages in terms of innovation, projects and design, in order to favor qualitative and commodity diversification processes, boost innovation and technology transfer and to offer to smaller sized enterprises incentive tools that are targeted and easily accessible.

Research structures, on the other hand, since 2002, due to an initial proposal of the Polytechnic University of Milan, have been reorganized into a “Netval” network, for the enhancement of public research and this happened in relation to the economic and entrepreneurial system: public bodies and institutions, business associations and companies, capitalist ventures and financial institutions. Initially it could only be defined as an unofficial network, which in 2007 became an association and is now able to claim the participation of other non-university structures. The aim is to share experiences and tested solutions, make principles, tools and actions more homogeneous and strengthen licensing opportunities, the creation of spin-offs and start-ups and the services of business incubators.

European Community Initiatives

In order to facilitate economic and commercial relations between member countries, the procedure to register a Community trademark has been activated since 1996 and the procedure to register Community Design and Model has been activated since 2003. These procedures, which refer to the Office of the European Union for Intellectual Property (EUIPO), allow applicants to acquire a valid right simultaneously in all member states in a single application and with one fee. From this year, the centralized procedure for filing the European Unitary Patent has also been prepared and therefore, for any disputes, it will be possible to refer to the Unified Patent Court (UPC).

In 2010, basing on an initiative of the European Commission, “European Innovation Partnerships” (10) have been introduced in the agricultural & food sector and guidelines on “innovation brokers” have been stated. Innovation in this sector is a key factor in facing future challenges in terms of increased productivity, efficiency and sustainability. The broker's outlined task is to facilitate the establishment of operational groups by promoting bottom-up initiatives, helping to refine innovative ideas, providing support for finding partners, for funding and preparing project proposals.

In 2012, the European Commission produced a document “Design for Growth and Prosperity”, published by DG Enterprise and Industry, in which it is clarified how innovation driven by Design represents one of the levers for Europe to support competitiveness and development.

The said document supports the more strategic dimension reached by Design, and has been applied to the European research, development and training programs: H2020, COSME, Creative Europe, Erasmus, ... etc.

The role of Design

In this situation, we have not yet become aware of the key and strategic role of Design as a sort of coordinating discipline “with a synthesis function” (11), aimed at managing and relating different interdisciplinary contributions that take part in the realization, as well as the effective marketing and spreading of innovation (12).
Design in the future, holder of transversal skills aimed mainly at technique, function, aesthetics and communication, which responsibly aims at a better world.

A Design, which in Italy traditionally moves away from a defined group of users, in analogy with the architectural vision which is more extended to the city and the world, and goes beyond the concept of problem solving, more like an engineering vision.

It is no coincidence that very often purchases are directed towards objects that are not needed or that offer something more than basic needs, such as the productions of some of our historical companies (e.g. Edra, B&B Italia, Alessi, Artemide, ... etc.).

However, theories of innovation should be a positive opportunity to solve problems, make the most appropriate choices and offer the added value that satisfies and gratifies.

As stated by Roberto Verganti (13):

If you look at Italian design, see that it is particularly strong in the food, clothing and house care sectors, which are right there, at the bottom of Maslow’s pyramid, they are primary needs. [...].

Perhaps people love Made in Italy and Italian lifestyle because we are good at bringing products, which are generally placed at the lowest levels, up to the highest levels. In everyday life you want to make sense. (Zurlo, 2016, p.3)

On the other hand, in Italy, unlike the other technological and scientific sectors, Design has always gone against the trend, thus importing international brains and exporting products.

The ability to innovate is based on new interpreters of the three evolutions: socio-cultural models, the meaning of products and markets.

Historically, it was found that the production and transformation of new materials, despite having unlimited development potential, must take into account the evolution and complexity of current systems, and it needs time to assess the importance of wide-spreading, of the differentiation and the enhancement of the applications. For example, “Aerogel”, a very light material, initially used in the aerospace industry to capture star dust in orbit, was transferred to the building sector for its excellent insulating performance and later on in the clothing sector to make anoraks as well.

As Campogrande already argued (2005):

The transfer of materials and technology between sectors means that innovation takes place rather creatively, connecting different professions and experiences and widening the field of knowledge in an absolutely transversal way: it is a seed planted in fertile soil to let new design and production strategies develop and grow. (p. 34)

Design, in the process of enhancing innovation, makes a series of contributions through studies, research and synthesizable services with respect to three main areas.

The first, of a design nature, as it coordinates the different contributions, enhances the technical, functional, ergonomic, material and aesthetic characteristics of the products, such as for medical devices, diagnostic kits, mechanical and structural elements. It sketches out a suit made to measure to express and summarise the innovation itself.

The second, of an evaluative nature, within the Institutions responsible for enhancement (such as ministerial commissions or research structures), as it verifies the potential of the proposals to select, motivate and direct towards strategic or even alternative paths: patent applications, research, development, cooperation, financing and business start-up.

The third, linked to a strategic communication, as it relates demand to supply, using different wide-spreading tools, through advertising, post-social campaigns, newsletters, exhibition spaces, websites, corporate identity, ... etc..
Considering «that particular design ability that the designer has for imagining new products, interpreting and guiding innovation» (Lucibello & La Rocca, 2015, p. 45), which is comparable to a probe, to an initial thermometer that interprets dreams, desires, needs, problems to improve the processes in progress, it is clearly too reductive to confine it to the sole function of elaborating the final form.

It should be emphasized that the designer is also involved in the processes of human-machine interaction, development of complex devices capable of sensitiveness, thus their behaviour is turning into an even more empathic one. The man-machine cooperation will influence the future identity of Design and its creative processes.

**Patent & Co approach**

The Design finds a certain uneasiness in using the protection tools of the industrial property, conceived for practicality in compartments and that protect the innovation of the shape, of the function and of the concept, up to the solution of the technical problem. (Figure A, Figure B)

Opting for the filing of a patent for an invention or for a utility model - the latter intended as a small invention that improves the functionality of what already exists - means that the shape is not protected, as the drawing shown is only an example of the concept.

On the other hand, only the shape is protected, not the concept of technological or functional innovation, and this happens when a drawing (2d) or model (3d) is registered as a design.

Many inventors, in fact, prefer not to describe in-depth the full details relating to materials, technology and production processes since they may vary over time.

Therefore, at least initially, for each project or group of related projects, it would be advisable to strategically use multiple industrial property rights simultaneously as follows: (i) patenting of invention or utility model, for purely technical or functional aspects; (ii) registration of the design, drawing (2d) or model (3d), even multiple, to protect all possible configurations (within a single application); (iii) registration of one or more brands, to strengthen the identity of the company, the production line or a single product.

The deposit and registration of industrial property titles imply a limited initial cost, at least in Italy, but this makes it possible to present, make known and produce innovation with less fears that rights will be infringed. At the same time, there are no obligations to keep property rights, in the sense that, at the time of the renewal of the different titles, even with different deadlines (14), it is possible to give them up in complete freedom, if they have not been used or no economic return has been achieved.

**Co-Patent & Open-Patent approach**

Nowadays we are able to foresee some theories that are intended to stimulate evolution and make the cooperation of instruments and actions more accessible and rapid.

The idea of protecting innovation, with all the "open" procedures and platforms currently in use (open source, open design, open materials, slow design, ... etc.), seems almost a contradiction.

Recently, Google has launched the “Open Patent-Non-Assertion Pledge” (OPN) initiative, thus paving the way for sharing the codes and content of patents that link to the community's initiative. The commitment undertaken by patent owners is not to exercise their rights within the specific project, except in case of possible attacks from outside.

The model proposed by Google, that can also be defined as “Co-Patent & Share-Patent”, allows future phased implementations and the sharing of results (15), thus it could be extended to other areas to facilitate new, more ethical and participatory forms of innovation.
A new target is desirable as proposed by Langella (2014):
New forms of open patent that do not require prior registration and can be proof of intellectual paternity in the event of disputes. Finally, it would be useful if the protection and opening systems conceived in the near future could be: modular, in order to be implemented gradually; flexible, to be able to fulfil different needs; updatable, to allow an easy upgrade, and adaptable to the complexity of the world of contemporary artefacts and new project, representation and production modes. (p. 37)
Giving up industrial property rights in the traditional sense, today means exposing oneself to the risk of counterfeiting, but this is balanced by visibility, the possibility of interacting with different skills and accelerating evolution itself. Therefore, it is necessary to experiment more ways to guarantee intellectual paternity and the relative profit. The Design finds a cert

**Some Tools & Structures**

The main tools and structures useful to cooperate and to wide-spread innovation could be initially summarized as follows.
1. Taking part in international contests with different aims and areas of application. For example, competitions such as ADI Design Index, Well Tech Award, Good Design, Red Dot Design Award, ... ect.
2. Taking part in international awards that make patents known. An example is the "Bernardo Nobile" Degree Award, for the degree theses that highlight the use of patents as a source of information. This is promoted in the Area Science Park of Trieste, the first scientific technological park in Italy.
3. The build-up of online Showcases for patents on the websites of the same Institutes, Universities and organizations, and from which it is possible to download bilingual technical data sheets and graphs concerning essential characteristics.
4. Registration on technology transfer platforms for patents of public and private organizations (e.g. www.knowledge-share.eu).
5. The setting-up of information centres “Info-Patents” on the procedures for enhancing innovation value distributed throughout the territory, within research institutes, university departments, fab labs and co-working (e.g. PatLib, PIP at MiSE).
6. The setting-up of centralized databases or “Project-Banks” able to collect projects, divided into thematic areas, reserved and available to companies and investors.
7. The setting-up of experimental laboratories to recover the relationship between Design, Science, Technology and ICT. Examples are the “Design&Science” Center of the Federico II University of Naples and the Center “Saperi&Co” at the "Sapienza" University of Rome. The latter are directed by Design professors and it would be interesting to interview them to open new scenarios for cooperation.
8. The activation of advanced training courses, specialization courses, master’s degrees in industrial property management set up at University (16) facilities also in collaboration with Industrial Property Consulting.

The primary aim is to give young graduates more opportunities to enter the working context by improving and integrating their preparation on intellectual property topics.
At a higher level, the aim is to provide professionals working in Research & Development (R&D), within technical and scientific sectors, with a good overview of the Italian and European patent laws, as well as of the ones stated by the main industrialized countries, of the procedures of submitting applications, of the strategies to be taken in the patent field. All of this has the purpose of improving and completing
their training in order to undertake an interfacing role between the company in which they operate and TTO of several research or professional structures.

Finally, on a more specialized level, the purpose is to provide the essential cultural and technical bases for undertaking the profession of analyst-documentalist or consultant (17) in patents, trademarks, designs and models.

Examples of innovation

**Strengthening the identity of a company through a combination of 2d-3d brands and original protected shapes**

From 2012, the Florentine company “Gabs” (18) has established itself on the market for the production of "G3 & G3 plus", their flagship product. A convertible bag that is made of leather and that takes on three or more different configurations, from a flat bag for shopping to become a practical top box bag. A single product that allows several original shapes, various uses and behaviours such as a message of their brand would imply "Gabs Firenze I love change". The distinctive corporate sign is also transferred to the product. In fact, the circular turquoise two-dimensional figurative brand is turned into a three-dimensional brand used as a button applied to all company products (bags, wallets, backpacks, ... etc.) both to allow the recognition of the product and to validate its originality. It should be emphasized that both the shapes and the brand have been registered within the EU Community. The businessman, Franco Gabrielli, has invested to achieve a product of unique design, which stands out and surprisingly ironizes on counterfeiters with mocking sentences combined with sales tags. (Figure 1).

**Protection of local plant variety and half-finished products to protect the environment and workers**

Vegetable Gold is a collection of very light, hypoallergenic and sustainable jewels and accessories obtained from processing a vegetable fibre "Capim Dourado" (*Synghonantus nitens*) that spontaneously grows in a Brazilian desert region. Its harvested stems have an intense colour similar to ancient gold, they look almost as bright as metal, they last over the years and remain unaltered when in contact with water. The plant is rare and protected by Brazilian legislation. In fact, taking it outside both its natural habitat and region, is considered illegal so as not to allow the exploitation of workers or environmental neglect. It is cultivated and processed with care and wisdom by Indios artisans in order to produce quality, original and refined typical products (baskets, hats, bags and jewellery). In Italy some half-finished products are transformed by the "Campin d'oro" (19) artisan laboratory to allow them to be placed on new markets. (Figure 2)

**Protection of unconventional material to enhance Verona’s hinterland and the fashion collection**

Marble fashion. Alice Zantedeschi, with her thesis in Fashion Design, at the Polytechnic of Milan, realizes the patented “Veromarmo” project (“Vero” is an abbreviation for City of Verona), a wearable microfilm produced using local marble dust. The membrane is waterproof, windproof, breathable, thermoregulating, flame retardant, and combined with other fabrics – from lycra to organza – made the first collection of his company “Fili Pari” (20) possible, which was started together with his friend Francesca Pievani.
Through research and technology, three aspects are highlighted: (i) the life cycle of the original stone becomes longer; (ii) colour variations are possible depending on the selected waste (anthracite from Black Ebony, Pink from Verona Red, beige from Mori Yellow); (iii) given the slow aging characteristics of the microfilm, it can also be used in other sectors such as furnishing and the car industry. (Figure 3)

Conclusions

Therefore, based on the examined scenario, no doubt there is a will to promote and strengthen the meeting between the world of research and the business world, in addition to highlight with greater awareness the vital contribution of Design as a strategic tool to enhance and protect innovation.

Knowing how to exploit already developed projects or granted patents, if still useful and not outmatched, becomes a priority. It is also essential to acquire a strategy to evaluate, depending on the specific case, whether to use multiple combined tools to protect innovation or to make use of more limited ways of protection allowed to unregistered Community designs and models (21). Perhaps this would be useful for products which are likely to undergo quick modifications.

In the mentioned examples of innovation used to give helpful directions on how to protect at the same time shapes, nature and the environment, the role of Design and its innovative contribution is evident. The paradoxical trend that we are asked to face in the near future, will most likely be to reduce complexity, have less variety and less choices to make, as they will probably have already been optimized. The challenge moves, and various authors talk about it from Barry Schwartz (2004) to Simon Sinek (2009), from a field of finding solutions to a stage of understanding what the correct questions are.

Though the initial problems remain open, the main intention was to offer hints to unleash our thinking, to continue to investigate and foresee new methods and tools.

References


Zurlo, F. 2017. Intervista Roberto Verganti, MaDe In Lab, Politecnico di Milano. Design Management. 1|Parte Due Gestire il processo di design. Retrieved June 26, 2019 from
Notes

(1) Legislative Decree n. 30 of 10 February 2006 (including its subsequent amendments and additions), states that in Italy there are two types of patents, one for the invention and the other for the utility model. A new invention must not be included in the current state of technique (it does not exclude a substance or a composition of substances, already included in the state of the technique, with a function for a new use). Utility models, on the other hand, are able to confer efficiency, ease of application and use, of machines, tools, objects. The said models consist of particular conformations, arrangements, configurations and combinations of parts.

(2) From the 2019 Report, produced by the Simbola and Dolitte Foundation, we understand that Italy ranks first among the EU countries for the density of companies active in the design sector, but it occupies the third place in terms of turnover after the United Kingdom and Germany.

(3) From the 2015 Report Osservatorio Università-Impresa, published by the CRUI Foundation for dialogue and cooperation between universities and businesses, we understand that, between 2001 and 2008, most Universities set up a specific TTO, with a boom in the years from 2004 to 2006, a period during which about half of the Universities were able to take advantage of specific state contributions.

(4) The University Technology Transfer Companies are an effective organizational example: Oxford University Innovation; Yissum Research Development Company of the Hebrew University of Jerusalem, Ramot; The Technology Transfer Arm of Tel Aviv University Ltd.

(5) In the D.M. 8 February 2013, n. 45 (article 4, paragraph 1, letter f) training activities on the subjects of technology transfer are indicated as obligatory for the doctorate courses.

(7) http://www.innovagora.it/


(8) https://netval.it/

(9) Online platform created by DGLC, Netval and Turin Polytechnic: https://www.knowledge-share.eu/

(10) EIP-AGRI Agriculture & Innovation website: https://ec.europa.eu/eip/agriculture/en

(11) In 2015, in an interview on Techonomy, published on LinkedIn by David Kirkpatrick, Paola Antonelli, curator of the Architecture and Design Department of MoMa, talks about the role and the importance of design in innovation: http://www.tiragraffi.it/2016/04/senza-design-non-ce-innovazione-dice-paola-antonelli/

(12) The so-called "Time to Market" (TTM) is an expression that indicates the time that elapses from the conception of a product to its actual marketing.


(14) Renewal fees and duration of industrial property rights in Italy: Trademark, renewal every 10 years, unlimited validity; Drawing 2d / 3D model, renewal every 5 years, it expires after 25 years; Utility model, renewal every 5 years, it expires after 10 years; Invention, as from the fourth year onwards, renewed every year, expires after 20 years.

(15) Similarly to what has been done by the universal encyclopedia Wikipedia.

(16) University of Milan, Milan Polytechnic Foundation, Città di Prato University Campus, Bologna Business School, ... etc.

(17) In order to be able to undertake these professional positions you should acquire a European QPIP certification (https://qpip.org/) or register with the Association of Patent Consultants (https://www.ordine-brevetti.it/).

(18) Company website: https://www.gabs.it/ga_it/

(19) Company website: https://capimdoro.com/

(20) Company website: https://filipari.com/it/
(21) Since 2002, the author of an unregistered Community design or model, the latter having the requirements for a valid registration, has an exclusive right over it for a period of three years from the date of its first disclosure to the public within the Community.

Appendix

INTELLECTUAL PROPERTY

<table>
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<tr>
<th>INDUSTRIAL PROPERTY</th>
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<tr>
<td>INVENTIONS</td>
<td>DISTINCTIVE MARKS</td>
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<tr>
<td>UTILITY MODELS</td>
<td>CONFIDENTIAL BUSINESS INFORMATION</td>
</tr>
<tr>
<td>NEW PLANT VARIETIES</td>
<td>GEOGRAPHICAL INDICATIONS</td>
</tr>
<tr>
<td></td>
<td>DESIGNATIONS OF ORIGIN</td>
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<tr>
<td></td>
<td>SOFTWARE</td>
</tr>
</tbody>
</table>

>>> Industrial property rights are acquired through: Patenting | Registration | Other methods.

Figure A: IPRs scheme.

Figure B: Examples of IPRs.
Figure 3: “G3 plus” bag.
A combination of 2d and 3d trademark.
Source: https://www.gabs.it/ga_it/

Figure 4: Products made with “Campim Dourado”.
Only some half-finished products are exported and transformed.
Source: https://capimdoro.com/

Figure 5: Collection in “Veromarmo”.
Patented material that allows it to be licensed for applications different those of its owner.
Source: https://filipari.com/it/
The Teaching Experiment from Design Thinking and Board Games Creativity Made by Makers College Students

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Abstract: The purpose of this study was to investigate the teaching experimental difference of design thinking and board games creativity between Makers College Students who received different teaching design curriculum. The quasi-experimental research method with the Nonequivalent Pretest-Posttest Designs was employed in this study. There were 132 college students selected as the participants in the experimental group, control group A, and control group B within the duration of 6 weeks of teaching experiments. The participants in the experimental group were served by the "CEO-iM²E²-SF" design thinking teaching curriculum. This study was based on the Analysis of Covariance (ANCOVA) and the case analysis of works. The study conclusions were as the followings: 1. The CEO-iM²E²-SF, maker design model was adopted in the experimental group. It showed there was more significant influence of board games imaginative creative works in the experimental group than that in the control group A and control B with the general instructional design. 2. In the self-assessment scales for board games imaginative creative works, the scores in the experimental group and control group A were significantly better than the scores in the control group B in functional creativity. 3. In the case analysis of works via observation, most of the board games imaginative creative works had escaped the existing traditional board games, integrated into the real life with interest, interaction, technology, and reflective meaning to become alternative board games. However, the works were still towards functional creativity. Escaping the limitation and elaborating the future imagination were suggested.

Keywords: Design Thinking, Makers, Board Games, Instruction, Creativity
Abstract: Reeling from the geopolitical movements of 2017, the retail sector remains a challenging environment with a number of leading mid-market players struggling to remain relevant in an increasingly crowded retail market. (Sender.T.2017) In the US alone a quarter of all US malls are predicted to close by 2022, whilst in the UK the challenging retail conditions is leading to an unprecedented number of store closures. (Walker, D. 2018) Against this backdrop of shifting consumer expectations, and a transforming business environment, innovation has never mattered more to business than it does today, however traditional business thinking and tools do not help business to innovate very well (Liedtka, J .2016) Consequently, leaving the retail sector in a state of flux. Therefore, the purpose of the study was to examine if the integration of a strategic design thinking model could be used within large retail organisations to drive innovation and organisational change. The study included examples of direct to consumer brands such as Glossier who have taken a consumer centric approach to their retail strategy in order to tap into the fundamental needs of their core consumers millennials. Whilst at Lululemon Lab in Vancouver a dedicated team collect live product feedback from consumers to design teams in order to develop the next version of a product range. The ‘Community Paris’ is also an example of a brand that is actively creating new alliances and coalitions across a broad spectrum of partners. The multidisciplinary art and design platform and collaborative space provides an opportunity for creative fields, including art, fashion, sculpture, music, publishing and photography to meet.

Findings
The finding from the study provided evidence that by taking the lead from entrepreneurs and smaller more agile brands, large retailers may be able to build a new framework that takes into consideration a design thinking approach to business that will drive innovation and opportunity creation.

Outcome
A toolkit for retailers that is underpinned by the principles of a new strategic design thinking model has been developed for the purpose of this study. The new model has been designed to allow businesses to follow a step by step process that I believe can transform the way organisations develop process, strategies and services.

Keywords: Design Thinking, Entrepreneurship, Innovation, Business, Retail

References:
The Hidden Values Related to The Variety of Design Thinking Models

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Abstract: Design Thinking (DT) is spreading in business community as a relevant innovation practice to change product and services. The term is more and more used and discussed, so this article – leveraging a literature review of 15 years – aims to find and to show the explicit value generated by the different DT patterns as recognized by literature and – going through a more deepening and complementary literature analysis – it expresses some hidden values associated to the four main patterns of DT.
A growing stream of literature in last years - on one hand - deepened the underpinning constructs and the founding principles of DT intended in a first frame as a “Creative Problem Solving” approach – on the other hand - it stretched the application of DT to novel scopes and fields embracing novel principles and practices. Creative problem solving – for instance – is mostly recognized for the value of “ideating”, recognizing the variety and the number of different ideas to solve a user problem. On the other hand, the principles embedded in it – as abductive reasoning, “reframing”, quick prototyping – seem to recall the same principles of “lean entrepreneurship”. Moreover, the emerging need related to digital environments to quickly test and grasping feedbacks from the user induced a new way to apply DT mostly pushing on the execution phase. “Sprint” is a process-oriented to produce insights from mapping and analyzing user behaviours, to take a fast decision about new interactive concepts and rapidly build “Minimum Viable Products” to accumulate learning and iteratively change the outcomes. Even this aspect seems to be connected and strengthen the lean entrepreneurial literature stream. DT, furthermore – leveraging people creativity – needs to continuously engage employees and stakeholders in compelling and motivating ways. Given that everyone assumes a personalized role in contributing to the creative process, an emerging challenge of DT consists to increase the “creative confidence” of individual and teams. At this level, DT seems to be more internally oriented – nurturing the knowledge and human capital of organizations – instead of placing novel solutions on the marketplace.
Keywords: Design thinking; Design for entrepreneurship; Creative confidence; Digital execution

Introduction
A controversial and growing debate about design thinking is taking place both among the practitioners’ context as for the academic one. This is impacting the boundaries of design discipline itself and the relationship with other domains as entrepreneurship and innovation management.
During the last two decades, design thinking has been critically analysed by both scholars from design and business and management disciplines. Most of the recent literature consolidated the positive
implications of design thinking for innovation, strategic options generation and management education (Beckman & Barry, 2007; Glen et al., 2014; Garbuio et al., 2015).
This growth of interest around design approach, methods and tools raise from the evolution of design discipline itself, which is progressively shifting toward ways of thinking and doing, oriented on designing solutions, intangible offerings addressing complex problems (Zurlo and Cautela, 2013).
The first appearance of design thinking according to the literature (second half of the twentieth century) consists on the historical debate around the science of design and natural sciences from Simon and Schön. Their theories are followed by the researches of other important design scholars which develop the concept of these designerly ways of knowing (e.g., Cross, 1982, 2007).
More recent studies define design thinking like a successful approach and practice for businesses which aim to innovate (Brown, 2008, 2009; Martin, 2009): a series of tools and methods that support companies in facing and solving complex problems.
The current and continuous transformation of the definition of this approach, identifies designers’ main role as delivering the appropriate solution by “organizing complexity [and] finding clarity in chaos” through a combined process of synthesis of aesthetic, cultural, and technology trends that involve consumer and business needs (Kolko, 2010). Hence, design thinking is nowadays considered as an attitude to deal with complex and uncommon subjects that have uncertain answers and solutions (Burnette, 2018).
Starting from the design thinking evolution, this article tries to articulate what Buchanan identifies as the pluralism of design thinking (Buchanan, 2015), in particular defining different specific patterns of DT emerging from the design and management and innovation literature, where pattern is intended as a current frame with specific theoretical boundaries, set of values, scope and contexts of application.
To address these questions a literature review process has been performed on a timeline of 23 years including both the design literature as the business and management one. The process has been conducted exploring the presence of design thinking within the main academic electronic database; different specific criteria of relevance and citations number were adopted in order to refine the sample of the review, combining an accurate process of reading of abstracts and articles.
The defined list of sources which have been analysed, clearly shows the emerging changes of scopes and fields of the application of DT in literature. This analysis supports the definition of the three specific theoretical patterns: the first one design thinking as creative problem solving (CPS) that is the most consolidated and is defined as the foundational model, in which the subject of DT consists of the innovation of products and services starting from user needs; the second pattern deals with the changes of process and procedures in the consolidated context of digital ecosystem and is named here as digital execution catalyst; thirdly design thinking as creative confidence enabler (CC) embraces the subject of human capital and the set of values in organizations, aiming at nurturing the organization culture and the employees mindset in working contexts.
Each of those outlined patterns are explored within the article showing the different explicit values, approaches and contexts of application. Moreover, each of them is critically and deeply investigated in order to show some implicit values that may be considered a key factor for future development of DT.

The article is divided into 4 main parts. Following, the methodology part presents and examines the process of literature review in detail, illustrating the overview and structure of results. As second part, the main theoretical findings are presented with a description of the explicit values related to each of the 3 patterns, moreover, presenting the implicit and more hidden values for each of them. A discussion part follows where the contribution to the literature is shown.

**Methodology**

The literature review process started with questions like “How much the literature on design thinking admits a unique theoretical model? What are the main sources that underline the different patterns of design thinking during its evolution in the period from 1995 to 2018? What are the key aspects that represent each pattern?”. The research was focused on understanding the main related contents inside the academic sources.

In order to find academic material that can provide appropriated answers to the previous questions, it was conducted a search using academic electronic databases and journals. For the academic electronic database, Scopus, Web of Science and Jstor were adopted. Moreover, informal methods such as Google Scholar were included in order to expand the number of resources to be analysed and have the possibility to get a greater overview on the subject.

The literature review process was made on sources coming from both the design and the management and innovation fields.

The analysis was conducted searching “design thinking” inside parameters as field, title or abstract. Moreover, the obtained list was refined taking the first 50 results for both relevance and citations up of 15. Later, the database was further refined considering the relevance of the results while reading all
abstracts and selecting just the more appropriate with the objectives of the research. This last operation resulted in a reduced list of sources, because some of them were then ignored. Indeed:

- on Scopus the research was made searching for “design thinking” inside the title AND abstract AND keywords, and refining the results taking just those up 15 citations and most relevant papers; the database provided 47 results coming from the previously described analysis;
- on Jstor the research was filtered searching “design thinking” inside title AND abstract and filtering for relevance; in the present case, the results were 29; relevance on Jstore is a combination of analysis of unique terms in the searching words with phrase searching matches;
- on Web of Science, it was searched for “design thinking” inside title AND topic, crossing results with the first 50 more cited (up of 15) plus 50 most relevant items; here, the total result was composed of 78 sources; relevance in Web of Science is intended as “sorts records in descending order based on a ranking system that considers how many of the search terms are found in each record. Records with the highest ranking appear at the top of the list”;
- on Google Scholar the logic used was to search “design thinking” inside title OR abstract and refining the results taking just the first 50 more relevant; according to the Google Scholar website, relevance ranking “takes into account the full text of each source as well as the source's author, the publication in which the source appeared and how often it has been cited in scholarly literature”.

From this process, a list of 146 sources to be analyzed for the review was obtained, without considering the repeated elements from the different researches.

Later, through the last screening process conducting an abstract review, the final sample resulted in a list of 77 sources, from 2000 to 2018. It includes books (12), book section (7), conference papers (6) and journal articles (51).

In the following table are summarized the number of sources, that during the review process conducted on abstracts, were associated with each of the three patterns.

<table>
<thead>
<tr>
<th>Creative problem solving</th>
<th>Digital execution Catalyst</th>
<th>Creative confidence</th>
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</thead>
<tbody>
<tr>
<td>38</td>
<td>41</td>
<td>33</td>
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</table>

Annex 1 provides an overview of the sources analysed for the development of this research, divided for each of the three patterns. The first results obtained for this research are around 2000 for CPS, while from 2005 from the other two patterns. All these results increase exponentially after 2005, where it is possible to notice a small reduction for the first two after 2016, while CC still continue to have the same presence in literature, as shown in figure 2.
In the next chapters each of the three design thinking models/patterns identified from the literature review are presented starting from their origin and scope than summarising the main values, approaches and contexts of implementation.

The literature review conducted on the final 76 sources presented a huge contribution for the explicit values discussion part, while sources containing references or contents to be inspired for the hidden values of each discussed patterns were present in a very limited amount.

Table 2: Percentage of final sources containing both explicit and implicit values references.

<table>
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<th>Creative problem solving</th>
<th>Digital execution catalyst</th>
<th>Creative confidence</th>
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<tbody>
<tr>
<td>Percentage from the 76 final sources, containing references for explicit values</td>
<td>55%</td>
<td>54%</td>
<td>45%</td>
</tr>
<tr>
<td>Percentage from the 76 final sources, containing references for implicit values</td>
<td>11%</td>
<td>9%</td>
<td>12%</td>
</tr>
</tbody>
</table>

**Theoretical findings**

*DT as creative problem solving – explicit values vs implicit hidden contributions*

Explicit values: In the different meanings associated with design thinking, the first most diffused theorization is associated with its value as creative problem solving. Creative problem solving (CPS) is an iterative process that starts from insights about end-users, passing through idea generation and testing, arriving to implementation.

Designers ask “what if?” questions to hypothesize future scenarios, producing a new way to solve problems, more than accepting the way things are done now. Thanks to this creative way of solving problems, designers can turn their hands to nearly anything (Kimbell, 2011).

Dorst (2011) evidences the differences between common humans’ and designers’ problem-solving processes. The first is based on the equation that

\[
\text{WHAT (thing) + HOW (working principles) leads to RESULTS;}
\]
while the latter, the design one, it is concentrated to achieve the value that the users want through

WHAT (thing) + HOW (working principles) leads to VALUE.

What usually happens in this case, it that for designers is known both the value to create and the ‘how’, that will allow reaching this value. Usually, they create the ‘what’ (an object, a service, a system), that is missing, providing a different way to solve the problem.

The solution in the design process is different because it assumes that designers empathize not only with the end-user, but even with any stakeholders that can return pain points to address the solution. Moreover, design focus on both convergent and divergent phases, during which, in particular in the ideation phase, develop several solutions to respond to the initial challenge. The CPS doesn’t stop to the first idea, going through different solutions; seeking for a wide idea variety; this is the reason why ideation is much more than just a eureka moment (Onarheim and Biskjaer, 2015).

This way of acting recognizes CPS as a process to provide novel solutions (products as services), that make important the adoption of DT also inside the entrepreneurial world. It is widely recognized that design and design thinking can help to shape a company’s vision and strategy, which is something that is consolidated in a lot of important contributions in literature, such as from Roger Martin, Tom Kelley or even Tom Peters. One of the aims of this paper is to underline the different aspects and approaches coming from design thinking that are recalled in the entrepreneurial world, and in particular to the lean entrepreneurship, considering its theoretical foundation and underlying constructs. Analysing the two domains, it is possible to recognize a series of characteristics that design thinking recalls the lean entrepreneurship context.

Implicit values: The lean entrepreneurship takes his nature from the lean principles, developed in the early seventies by Toyota in Japan, called lean manufacturing. The concept, initially created to optimize production processes (Womack, 2003), making it more efficient by reducing any sort of waste, has been become also important for other disciplines. Lean entrepreneurship lays upon the principles of the lean theory, that are applied to companies to reach the most efficient innovation that the user can demand. This entail is important to avoid the creation of a product or service that nobody needs. Here, it is possible to recognize the first contribution that design thinking, indirectly gave to lean. The nature of design thinking can help to build concepts, products and services that consider real-live-problems as an impulse for development (Von Kortzfleisch, Zerwas and Mokanis, 2013).

The ability to address and overcome wicked problems is a key element of the design approach that provides possible solutions to the uncertainty that characterize the real environment and the consequences that can arise from determinate solutions (Sarasvathy, 2004; Sarasvathy et al., 2008). Also, the importance of empathy and the ability to use it, it is a fondant element in design thinking that has been acquired from the lean entrepreneurship. This element allows addressing explicit or latent needs, that after a long practice in design thinking, has been acquired in the lean entrepreneurship practice. Even if the design process could start from some initial specification, clients and customers can not recognize what they want until they can see what they can get. This reinforces the iterative nature of the design process (Glen, Suciu and Baughn, 2014). The ability to collect and process inputs, it is one of the most consolidated aspects in design thinking, where is searching the present for available paths to desirable futures (Krippendorff, 2006).

Design thinking prototype solutions to observed problems, in order to then test the results and observe the results. Also, in this case, design thinking represented the fertile soil for a similar way of proceeding that is embedded in the lean processes. Solutions coming from the design field try to foster innovation,
through desirable, viable and feasible solutions (Brown, 2009), three criteria which were inherited in lean.

Lastly, design thinking and lean entrepreneurship both test hypothesis. In the same vein the inception of a new venture as in the design thinking the problem framing activity assume at their base some starting (business) assumptions on which business hypothesis refer. Assumptions, hypothesis formulation and testing can be considered another common ground where the primary version of Design Thinking – known as creative problem solving – and lean entrepreneurship join.

**DT as digital execution catalyst – explicit values vs implicit hidden contributions**

Explicit values: Some of the values which characterize the Design thinking approach since its origin, perfectly fit with the current market trends and behaviors such as the obsessing need of shortening the time to market also due to the rise of the so called digital era: nowadays almost all the offering panorama is populated by products and services which are software-driven. DT’s characteristics such as iterative workflow and flexible process framework which comprises continuous step of visualization and prototyping, can support businesses in delivering solution rapidly and customized on users’ expectations. Therefore, the second theoretical pattern presented in this article defines DT as a digital execution catalyst.

Starting from fundamental literature, designers don’t rely just on traditional rational analytic techniques, but they refer to other tools and methods; designers usually work visually, transforming information into tangible images (Cross, 1982, 2006; Lawson, 2006). Moreover, prototypes also have a key role in the design process: it is possible to better clarify the idea and its characteristics, having the possibility to perform critical considerations and to obtain feedbacks. Indeed, the entire design-thinking process is characterized by active learning and experimentation (Brown, 2008, 2009; Leidtka & Ogilvie, 2011).

Rapid creation of low-fidelity prototypes makes stronger the dialogue with potential users, allowing also to better clarify the nature of the problem to be solved (Mogeridge, 2007).

In this way is continuously possible to concentrate on actual problem for the user, preventing the possibility to create products that are not desirable and that nobody really needs or want. This is becoming more and more a crucial aspect for businesses that have to deal with customers much more demanding in terms of customization, speed, and involvement with the value proposition of today’s services and products.

These are DT’s evident benefits to be adopted in order to face and adapt to the velocity of the digital economy ecosystem and market: working groups, in facing complex problem, need methods and tools for generating alternative solutions and for testing them in an extremely short time frame. In this sense DT can be the activator, the catalyst and guides these fast testing process through the realization of digital prototypes.

Implicit values: Within this theoretical pattern “Sprint: How to Solve Big Problems and Test New Ideas in Just Five Days” written by Jake Knapp, based on his experience in facing innovation challenge in Google and Google ventures, can be considered the bridging book among design thinking and digital and data driven innovation. Reading between the lines, the adoption of DT in a digital context is not only about shortening the process of “going to the market” and reducing the failure possibilities but is about impacting the whole culture of innovation within procedures and routines for innovation; in order to remain competitive, companies redesign their existing development processes splitting it in short deadlines and aiming at iteratively prototype solutions; defined as the most important aspect to
be considered the precise moment in which the potential customer meet the offering (product/service).
Thus, organizational procedures to face complex challenge are renovated in order to constantly capture the customer needs, rapidly conceive innovative, highly customer-oriented solutions, and perform these developments with an increasingly short time-to-market.

DT as a digital execution catalyst could be effectively adopted by organizations in:

- managing risk by doing a tangible and visible test before starting a large project;
- generating fast solutions in light of an approaching deadline;
- facilitating innovation and providing inspiration to easier the process of adoption of a fresh and disruptive approach.

**DT as creative confidence enabler – explicit values vs implicit hidden contributions**

Explicit values: The third and most recent model of design thinking refers to the applications of design methods, tools, technique and processes to the way people work (Kolko, 2015). Those processes are more often conducted as collaborative activities, involving multiple kinds of stakeholders that can vary from employees of different departments of the same organization to potential final users of the new product/service to be developed.

Therefore, in this theoretical pattern, co-design approach act as main actor in the process of implementation of design thinking. The user is engaged in the creative process not just at the beginning. Users instead, become more participative for the whole process: the involved actors considered are not just the final customers, but also other stakeholders that take part along all the process. In this way, the co-design might be implemented to produce a practical resolution to complex problems at different levels within the innovation process.

In this sense, design thinking is impacting on how organizations develop their creative asset: enabling the employee to create, dare and nurture their mind-sets with creative confidence (Kelley T. and D., 2013). The current debate (both design and management areas) recognized that DT is not only relevant for innovating product and services but it influences organizational culture and behavior. The “object” to be designed is shifting to new organizational constructs such as organizational cultures, organizational and business models (Kelley T. and D., 2013; Buchanan, 2015).

Thus, the value of design thinking must be reviewed “as more than a set of tools and, instead, as a cultural component of organizations” (Elsbach, Stigliani 2018). This cited article published on the *Journal of Management* from Elsbach and Stigliani can be considered as the one which most recently emphasized how organizational culture is benefitting from the design thinking’s spillover in organization’s tactical issues, operations, vision, strategy and moreover human capital.

In the actual business context, the technical and technological progress plus the changes in the socio-cultural dynamics are obliging enterprises to adapt or even anticipate changes. This includes the readiness for modification when employees are not motivated with the existing organizational culture: thus there are recurring difficulties for organization in retaining talents.

Scholars and practitioners are exploring how design thinking is releasing deep effects on organizational culture, where organizational culture is defined as comprising the underlying norms, values, and assumptions that define the "right way" to behave in an organization (Schein, 2010).

Implicit value: What is emerging is that the effective use of design thinking tools in organizations had a profound effect on organizational culture and, on the other hand, organizational cultures influenced (both positively and negatively) the use of design thinking.
Thus, can be emphasized an intertwined relationship between organizational day-to-day practices (what people do) and culture. DT acts as a mean of link between the operative and the strategic levels of change, and this can enable organizations (public or private) to overcome some of the limits and inefficiencies of the established practices (Deserti e Rizzo, 2014).

In this theoretical pattern than, the implementation of design thinking is strongly intertwined with the update of the knowledge capital and how organization learns: the experiential soul of design tools, methods and practices are in line with the importance of real-life experience as a central topic in learning within organizations.

The process of adoption of design thinking at this level of complexity has different nature and obviously various factors of difficulty. As stated by David Dunne in his recent book “design thinking at work” DT has existed for decades, however many still perceive it as an unstructured creative process rather than as a careful, reflective discipline (Dunne, 2018). Even if an authentic design mindset is very hard to instill within non design organizations, DT can be creative confidence enabler through the patience and long-term commitment from designers, the organization and its leaders.

**Discussion**

The article pinpoints how design thinking evolved from a product-service innovation approach to an activity able to forge the innovation routines and the organizational culture.

The article tries to provide an integrated framework connecting different literature streams in order to recall some “bridging concepts” that connects DT to other organizational and entrepreneurial practice.

From one hand DT is penetrating digital transformation providing consolidated heuristics and tools that the development of digital artifacts and ecosystem nowadays fully adopts; on the other hand, the recognized impact of DT on organization culture and entrepreneurial process seem to open new paradigmatic forms of Design Thinking.

The different patterns highlighted open new research avenues in DT. First the application of DT to digital environment risk to change the basic intrinsic principles of DT. What does it mean “reframing” in digital environments? What is the limit of reframing and divergence in a context where artifacts are mainly influenced by human interaction rules and fixed scripts?

On the other hand, the penetration of DT in organization culture opens new avenues for studying the real impact on employees’ sense of belonging, their satisfaction and the relative rewarding model. Does DT really affect the sense of belonging of employees?

After the time of the diffusion of DT in extraneous field, maybe it’s the time to launch new research avenues that investigate the real impact and the contextual factors that are – or not – really changed by the adoption of DT.

**References**


Design and Organizational Change in the Public Sector - Deserti - 2014 - Design Management Journal - Wiley Online Library. (2014).


The Anomaly of Design Innovation in A Post-growth and Post-human World

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Abstract: Whether mainstream or avant garde and progressive, design for 'the future' (as it is visualised in contemporary culture, business and design) could be considered a less-confronting - or whimsical reinterpretation - of artefacts depicted in sci-fi utopias. Functionally and aesthetically, what is imagined we will be using, building and living in 25 years or more from today is, however, mostly very different from now, yet in most ways those images are still grounded in our current paradigms of living, consuming, construction and community, with insufficient attention to feasibility and practicality. There is also little consideration of other possibilities such as new social structures, sentient cities or non-technocentric models that rework futures in novel ways.

These normative and expected – albeit imagined - images of 'design in the future' very much fit the 'flat-pack futures' (Smith) and 'used futures' (Inayatullah) approaches – convenient and ready-to-go solutions to an unsure future. They are sufficiently corporate and recognisable images that are insufficiently confronting; they fail to foster any real shift in our sense of urgency and action.

Designers do not often confront the real and significant challenges of the 21st century when positing design scenarios for a sustainable earth. While it may be possible in principle to maintain economic growth without affecting physical impact and forcing population growth down, we have yet to work out how.

Innovation, technology and design remain the magic combination or ‘silver bullet’ that will fix our fascination and self-centredness. Our inability to see beyond our view of the world and agency/role in it has led to global overshoot and demand for energy isn’t matched by resources available. And our human fascination with growth remains, although the sustainable lifestyle options presented to us now may only be possible in a future that is constructed as a virtual reality.

Keywords: Design, Futures, Degrowth, Innovation, Post-growth
The Cognitive Process of Vision-driven Idea Development

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Abstract: O’Connor & Veryzer (2001) propose the concept of visioning as a promising idea generation approach for technology-based radical innovation. They define visioning as “the imagination that comes from how a problem is approached technically, and an ability to identify and characterize compelling benefits of that technology in terms of a future market.” They claim that one of the main players in an organization who practices visioning is what they call the ruminator, who spends time thinking about the future, and is able to connect disparate pieces of information, by seeking far afield from their present businesses. Reid & Brentani (2014) show that visioning depends on creative individual thinking consisting of divergent thinking and idea-generating behavior.

Focusing on the creative aspect of visioning, this research aims to understand how a vision is imagined and how it leads to product ideas in an innovation project, by applying insights on imagination discussed in the creative cognition research. According to Finke et al. (1992), imagination, although it is the generation of totally new idea or a thing, is predictable by knowing the mechanism, which is essentially structuring of existing knowledge one has. With this focus, the research defines visioning as imagining a future market as a vision, identifying ideas of benefits of a product in terms of the market for innovation in general, which is not limited to tech-based innovation.

The author drew findings from case studies addressing seventeen projects including nine led by design directors: (1) Vision-driven idea development consists of two stages of imagination, i.e., imagining visions followed by imagining products idea that can bring the vision to life. (2) The innovativeness of an idea developed can depend on an individual’s: (2a) knowledge of the vision as a source of mental synthesis in the process of product idea imagination and (2b) knowledge of insights from research on market and technology development or on their beliefs as a source of mental synthesis in the process of the vision imagination.

The findings suggest managers who intend to develop ideas that lead to innovation: (1) should use divergent thinking to explore a wide range of knowledge in the process of imagining visions and product ideas, (2) examine the knowledge of the vision used for imagining the product idea, (2a) knowledge of the vision as a source of mental synthesis in the process of product idea imagination and (2b) knowledge of insights from research on market and technology development or on their beliefs as a source of mental synthesis in the process of the vision imagination.

Keywords: Visioning, Creativity, Idea, Creative Cognition
A Framework for The Role of Behavioral Experience Design in The Perception and Adoption of New Services for Users

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Abstract: Design may have become closely linked to the fate of business success or failure. In recent years, the importance of services in a mobile environment has increased in business. The widespread use of smartphones has replaced many products that had their reality with online services and mobile applications. However, for services that do not have tangibility, building understanding and trust are issues to be solved. If each touch point, and the overall experience, is not properly designed, it is difficult for the service to provide fun to the user and to gain the trust. In the age of experience, design is at the heart of businesses.

In order to discuss this issue, previous studies using technology acceptance models have been conducted. Originally, in the technology acceptance model (TAM), the adoption of information systems was analyzed. In the case of highly novel products, variables based on the spread theory of innovation are also used.

After that, in recent years, emotional impacts have also been considered, and the impact of customer experience and brand experience has also been analyzed. In addition, research has also been conducted to examine the influence of design aesthetics and visual appeal as antecedent factors that affect the perceived usefulness and perceived ease of use. However, this study focuses on behavioral experiences. The reason is that even applications on mobile are often not completed by online user usage. The importance of designing services as actions and a series of flows in a real environment is pointed out, so designing on the screen is insufficient. Behavioral experience is one type of customer experience with the body and behavior. From the point of view of embodied cognition, the discussion on the relationship between the human body and perception is prosperous. Therefore, it seems necessary to consider a model in which behavioral experience influences the perceived usefulness and perceived ease of use.

The purpose of this paper is to reveal the role of behavioral experience design in the perception and adoption of new services for users. Therefore, this study analyzes the influence of behavioral experience on the expanded technology acceptance model using structural equation modelling. In addition, in order to clarify the role of behavioral experience design, construct and propose a theoretical framework based on analysis results. This study gives suggestions about the design of new mobile services that are focused on business, especially how users will be more perceivable.

Keywords: Customer Experience, Behavioral Experience Design, Technology Acceptance Model, New services
Introduction

The importance of Services
In recent years, the importance of services in a mobile environment has increased in business. The widespread use of smartphones has replaced many products that had their reality with online services and mobile applications. There are various issues in service design, but the core is the design of experience. Experience design, an approach to create emotional connection with customers through careful planning of tangible and intangible service elements (Pullman & Gross, 2004)

The field of Service Design
The topic of service design has not suddenly begun. It receives a flow from the area of design and marketing. From the design field, usability design is first idea for the designing service. Such as service blueprint (Shostack, 1984), User centered design (Norman, 1988) is the central argument, after that, User experience design and experience design become big topic. From another perspective, in the field of management and marketing, first idea is customer relationships. After that, in recent years, several ideas for the Customer experience management has argued, such as experience marketing (Schmitt, 1999), Service Dominant Logic (Vargo and Lusch, 2004). After these concepts a field of service design was formed.

Acceptance of Service
On the other hand, there is an argument that not only becoming a service is great, but it also involves new difficulties. Rexfelt & Hiort af Ornäs (2009) pointed out the issue of Product-service system (PSS) acceptance. Thus, PSS is an attractive solution. Although, the new way of doing things involves uncertainty and requires at least some skill development, so the demands are high and changes due to the transition to PSS can be a barrier to acceptance (Rexfelt & Hiort af Ornäs, 2009). They pointed out these issues in terms of the diffusion of innovation and the acceptance of technology. In addition, from the results of interviews with focus groups, it is stated that “impact on everyday life”, and “uncertainties” are two factors that influences acceptance. It is important to argue about the acceptance of new service. As these are pointed out from the interview, measurement and verification based on the scale is necessary. It is important to present a framework of experience design based on the results of verification of acceptance of new service.

Literature Review

Technology Acceptance Model
There are representative models that can be used to examine consumer acceptance. Technology Acceptance Model (TAM) is a model to analyze what kind of factors influence intention to adopt technology (Davis, 1989; Davis et al., 1989). In this model, "Perceived Usefulness" and "Perceived Ease of Use" influence the "Attitude" that they want to adopt, which leads to the "Intention to use" that they want to use. "Perceived Usefulness" is whether the technology or system is useful, and "Perceived Ease of Use" is whether the technology or system is easy to use.

Many extension models have been developed for this model. There are also studies incorporating Perceived Characteristics of Innovation (PCI) (Agarwal and Prasad, 1997). Moore & Benbasat (1991) scaled perceived innovation characteristics (PCI) based on Rogers’ diffusion theory of innovation.
These studies have been validated using the scale. In this scaling, Observability was divided into Result Demonstrability and Visibility because it was complicated as a measurement item. In addition, Image and Voluntariness were added as important components to decide the adoption of innovation. Hsu et al., (2009) treat TAM and PCI as independent variables. Considering that the Relative Advantage of PCI overlaps semantically with the Perceived Usefulness of TAM, and the Complexity of PCI overlaps with the Perceived Ease of Use of TAM, the model combines the items of TAM with the Compatibility, Trialability, and Observability of the remaining PCI.

Extension Model in terms of experience
Recently, there has been an increase in research that analyzes consumer adoption and revisits for technologies and services with more entertaining elements, such as e-shopping, SNS, and online games. For example, Hsu & Lu (2004) has developed an extended model of TAM with Social Influences and Flow experience to analyze the adoption of online games. Thus, the technology acceptance model has been expanded not only for the system introduction in the organization but also for the adoption of the service of the consumer. As a result, studies incorporating Customer or Brand Experience as an emotional aspect of consumers have also been conducted (Morgan - Thomas & Veloutsou, 2013). In these experiences, behavioral experiences are relatively relevant to consumer understanding. Recently, the relationship between body, action and human perception, understanding has been studied in several fields. For example, it is stated that the body affects emotions and decision-making mainly in the field of psychology (Lee & Schwarz, 2014). The background was the attention to the concept of Embodied Cognition that think as people make judgments using not only the mind but also the body (Clark, 1997). Behavior consistent with product features facilitates understanding of product features and functions (Brakus et al., 2014) Especially in the case of innovation, consumers need to understand new values and usage. In such situation, the effect of the understanding promotion by the body seems to be important. Therefore, this study first examines the effect of behavioral experience on TAM and PCI variables.

Methods
Research Design
Based on the previous review, we analyze the impact of behavioral experience on the adoption of innovative new products and services by consumers using an extended model of TAM. The main previous studies assume Davis (1989), Davis et al., (1989), which developed TAM, Moore & Benbasat (1991), which developed the PCI measure, Hsu et al., (2009), which combined TAM and PCI, and Hsu & Lu (2004), which analyzed highly entertaining services. As a measurement scale of the behavioral experience, the item of Makino (2017) which arranged the concept and developed the scale comprehensively caught the behavioral experience is used.

For the general consumer, the item was evaluated using 7-point Likert scale (1 = "Strongly disagree", 7 = "Strongly agree"). In this survey, I asked Macromill Co., Ltd., a research company, to conduct a Web questionnaire survey. The survey period was from November 6, 2017 to November 7, 2017. The research participants were 18 ~ 59 years-old general consumers (n = 132: Number of respondents who had purchased something in this product/service in the 520 sample). The web service "Mercari" of the on-line free market was used as a service as an evaluation object in this survey. This service is a new service which the user rapidly increases after the service start. The feature is that it is the largest free
market application in Japan, which is advertised as "Easy Free market App on Smartphone" and anyone can easily buy and sell from a smartphone. The feature is that it can be displayed by a simple operation of uploading the image of the product taken by the camera. Therefore, it was judged to be suitable as a service for analysing the effect of the behavioral experience in this study on the technology acceptance, and it was adopted. As an analytical method, after confirming the reliability of the concept used in this study, structural equation modelling was carried out to verify the goodness of fit. Statistical software SPSS, AMOS ver. 19 was used for the analysis.

**Hypothesis**

Based on previous studies on embodied cognition, this study hypothesizes the effect of behavioral experience on TAM and PCI variables. As stated in the hypothesis in the previous chapter, Brakus et al. (2014) pointed out that the behavior consistent with the product promotes understanding of the features and functions of the product, which may affect its Perceived Usefulness. And, the effect to Perceived Ease of Use is considered from the behavioral experience, because action and gesture are useful for understanding and grasp of the object (Klemmer & Takayama, 2006).

**H1:** Behavioral experience positively influences Perceived Usefulness.  
**H2:** Behavioral experience positively influences Perceived Ease of Use.  

Imagining lifestyle changes promotes understanding of ideals and norms. Therefore, when the evaluation to the lifestyle is high, it is considered that the Compatibility which is the degree of agreement for the values, past experience and needs rises. Of course, since they are positive about their lifestyle and sympathize with their style and method, their Image will be highly appreciated. In addition, what is imagined as a lifestyle is that the situation when an individual uses it and the change by it are imagined. Therefore, there is a possibility that Result Demonstrability and Trialability become higher. Products/services with actions may also be more visible and observable than without actions. It is possible that the behavioral experience affects the image, because Brakus et al. (2014) indicate relationship between the interaction and product evaluation and Krishna (2010) indicated that the evaluation to the interaction itself affects the good impression to the product and service.

**H3:** Behavioral experience positively influences Compatibility.  
**H4:** Behavioral experiences positively influence Image.  
**H5:** Behavioral experience positively influences Results Demonstrability.  
**H6:** Behavioral experience positively influences Trialability.  
**H7:** Behavioral experiences positively influence Visibility.

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![Figure 1: the hypothetical model of the survey](image-url)
Data Analysis and Results

Table 1 show the descriptive statistics and the reliability of each construct. Although, Cronbach’s alpha for “Trialability” and “Bodily Stimulus” were slightly lower, they are still used in this study because they are an important construct and exceed 0.6. Since the value of “voluntariness” was as low as 0.36, it was removed and analyzed in this study. All other constructions showed high values, and sufficient internal consistency was confirmed.

Table 1: Descriptive Statics & Reliability Analysis

<table>
<thead>
<tr>
<th>Construct</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Cronbach’s α</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived Usefulness</td>
<td>4.5732</td>
<td>1.27766</td>
<td>0.86</td>
</tr>
<tr>
<td>Perceived Ease of Use</td>
<td>5.0303</td>
<td>1.22765</td>
<td>0.82</td>
</tr>
<tr>
<td>Trialability</td>
<td>4.1288</td>
<td>1.24118</td>
<td>0.62</td>
</tr>
<tr>
<td>Compatibility</td>
<td>4.4672</td>
<td>1.25661</td>
<td>0.84</td>
</tr>
<tr>
<td>Image</td>
<td>4.0076</td>
<td>1.22489</td>
<td>0.69</td>
</tr>
<tr>
<td>Voluntariness</td>
<td>5.0341</td>
<td>1.21409</td>
<td>0.36</td>
</tr>
<tr>
<td>Visibility</td>
<td>4.6970</td>
<td>1.55651</td>
<td>0.82</td>
</tr>
<tr>
<td>Result Demonstrability</td>
<td>4.5025</td>
<td>1.12682</td>
<td>0.77</td>
</tr>
<tr>
<td>Bodily Stimulus</td>
<td>3.9596</td>
<td>1.17294</td>
<td>0.62</td>
</tr>
<tr>
<td>Lifestyle Proposition</td>
<td>4.3232</td>
<td>1.23967</td>
<td>0.77</td>
</tr>
<tr>
<td>Enjoyment of Interaction</td>
<td>4.1970</td>
<td>1.23968</td>
<td>0.79</td>
</tr>
<tr>
<td>Attitude</td>
<td>4.7235</td>
<td>1.44401</td>
<td>0.87</td>
</tr>
<tr>
<td>Intention to use</td>
<td>4.6288</td>
<td>1.44969</td>
<td>0.87</td>
</tr>
</tbody>
</table>

Next, this study examines the results of structural equation modelling and the indices obtained from the analysis (Figure 2). Though the index of $\chi^2$ becomes significant at 5%, this index is not emphasized, because the number of samples is not small. GFI = .938 > 0.9, CFI = .986 > 0.9, RMSEA < 0.8. AGFI = .874 < 0.9, but exceeds 0.8, indicating a sufficient value. Since many of the variables of PCI are conceptually similar, it is necessary to pay attention to the fact that covariance is assumed for the error. All hypotheses, H1-H7, regarding perceptual effects in TAM and PCI from behavioral experience were significant. Perceived Usefulness and Visibility, and Result Demonstrability were not significant for either Attitude or Intention to use. Therefore, the Visibility and Result Demonstrability were removed. Perceived Ease of Use, Compatibility, and Image have significant and strong effects on attitudes.

Figure 2: Result of structural equation modelling
Discussion

The effect of Behavioral Experience

Mainly, Perceived Ease of Use, Compatibility and Image influenced the Attitude, which led to the Intention to use. As a reason why the Perceived Usefulness which is one of the most frequently used variables in TAM did not become significant, it is considered that the user did not use the application for the purpose of using it but enjoyed shopping itself. It is understandable that Compatibility and Image have become high because the adoption proceeds when values are compatible and easy to use. In that case, it is also important to transmit as action and lifestyle. The online free market is a new form of consumption. However, it is not a daily necessity like a smartphone. Therefore, the Visibility and Trialability are enhanced by the behavioral experience, and even if the understanding advances, it may not be adopted because it is not necessary for oneself. It is possible that the Compatibility which expresses the sense of values and needs has the strong influence by such property. And, because of the nature of the smartphone application, a series of actions are completed in the smartphone, and it is difficult to be seen by others, and it is considered that Visibility and Result Demonstrability had no influence.

Behavioral Experience Design Framework

Schmitt (2003) proposed the process of strategically building experiences as a 5-step customer experience management framework. The five steps are 1. Analyze the Experiential World of Customer, 2. Building the Experiential Platform, 3. Designing the Brand Experience, 4. Structuring the Customer Interface, 5. Engaging in Continuous Innovation. This process is well organized and still suitable. Although, when comparing the design of the overall customer experience with that of the behavioral experience, the basic process is the same, but the emphasis is slightly different. Based on this previous study, this paper proposes the key points of designing behavioral experiences, referring to the concept of behavioral experiences and the validation results of this study.

What is important in 1st step is the analysis of the social / cultural meaning in which the consumer acts; the understanding of lifestyles and business trends; and gaining insight into what behaviors people feel comfortable with. What is important in 2nd step is depicting an ideal lifestyle in conjunction with appropriate behaviors; and positioning the experience provided by a product or service. What is important in 3rd step is designing products and services integrated in terms of function, experience, and aesthetics; designing logos, symbols, packages, stores, and websites in accordance with the experience positioning; and to communicate the personality of the experience. What is important in 4th step is building an interface that allows users to naturally learn how to use it with fun actions; Use metaphors and analogies to relate to customer knowledge; Associating an ideal lifestyle with a set of touchpoints. What is important in 5th step is engaging in small and large innovations to continuously create behavioral experiences (figure3).
Conclusion

Behavioral experiences focus more on new behaviors, lifestyles, interactions, and the body as a medium for them than customer and brand experiences. The results showed that these experiences had a positive impact on the Perceived of Ease of Use, Compatibility, Image, and adoption. Therefore, continuous research on people's behavior, expression that conveys lifestyle, and contrivance of interaction and communication are important.

1 Mercari, https://www.mercari.com/jp/ : Japanese online free market application
2 This analysis revises and extends a part of the author's doctoral thesis.

References

Agarwal, R., & Prasad, J. 1997. The role of innovation characteristics and perceived voluntariness in the acceptance of information technologies. Decision Sciences, 28(3), 557-582.


**Appendix** (The survey was conducted in Japanese. This item has been translated.)

<table>
<thead>
<tr>
<th>model</th>
<th>concept</th>
<th>items</th>
<th>source</th>
</tr>
</thead>
<tbody>
<tr>
<td>TAM</td>
<td>Perceived</td>
<td>Using this service enables me to accomplish tasks more quickly.</td>
<td>Davis(1989), Davis et al.</td>
</tr>
<tr>
<td></td>
<td>Usefulness</td>
<td>Using this service enhances my effectiveness on the job.</td>
<td>(1989)</td>
</tr>
<tr>
<td></td>
<td>Perceived</td>
<td>It would be easy for me to become skilful at using this service.</td>
<td>Davis(1989), Davis et al.</td>
</tr>
<tr>
<td></td>
<td>Ease of Use</td>
<td>Learning to operate this service would be easy for me.</td>
<td>(1989)</td>
</tr>
<tr>
<td>PCI</td>
<td>Compatibility</td>
<td>People in my organization who use this have more prestige than those who do not.</td>
<td>Moore &amp; Benbasat (1991), Plouffe et al.(2001)</td>
</tr>
<tr>
<td></td>
<td>Image</td>
<td>People in my organization who use this service have a high profile.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Result</td>
<td>Using this service is compatible with all aspects of my work.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Demonstrability</td>
<td>I think that using this service fits well with the way I like to work.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Visibility</td>
<td>Learning to operate this service would be easy for me.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Trialability</td>
<td>I would find this service easy to use.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Voluntariness</td>
<td>I would find this service easy to use.</td>
<td></td>
</tr>
<tr>
<td>Behavioral Experience</td>
<td>Bodily Stimulus</td>
<td>I feel a stimulus to my body.</td>
<td>Makino (2017)</td>
</tr>
<tr>
<td></td>
<td>Enjoyment of Interaction</td>
<td>I feel like I want to tell others experiences I enjoyed.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lifestyle Proposition</td>
<td>I feel a suggestion or message to my life from this product/service.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Intention to use</td>
<td>It is worth to use this service.</td>
<td></td>
</tr>
<tr>
<td>Extended TAM</td>
<td>Attitude</td>
<td>I feel good about using this service.</td>
<td>Hsu &amp; Lu (2004)</td>
</tr>
<tr>
<td></td>
<td>Intention to use</td>
<td>I like using this service.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>I will frequently use this service in the future.</td>
<td></td>
</tr>
</tbody>
</table>
Literature Review on Designers' Characteristics: Investigating on The Identity of The Designer/Non-designer

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Abstract: As a way of thinking, communicating, and collaborating, design thinking has been applied to many disciplines and the intersections between them, where design is becoming common knowledge to create directions, share their specific knowledge, and moderate the collisions between different disciplines. In this trend that design is playing multiple and intersectional roles in any field, the applications of designers’ attributes to other disciplines have expanded into more cognitive levels such as a way of thinking, mindset, and attitude. Nowadays, with the diffusion of design thinking, everyone can apply some of the designer’s attributes into their practices. The concept of "Non-Designers" emerges from this circumstance to differentiate those who apply designer’s attributes to their practices from traditional designers. However, what kind of attributes can be required for a "non-designer" to be identified as a designer?

This study explores the designer’s attributes from the literature review on this topic and narrows down the identity of designers by questioning who non-designers are. In addition, it examines the research methodologies that the past researches conducted in order to build a theoretical foundation for future researches.

Keywords: Design Thinking, Design Attitude, Designer's identity
The Design Management Principles Derived from The Co-occurrence Network Analysis of The Testimonies of Italian Furniture Entrepreneurs

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Abstract: Italian design entrepreneurs are not only mediator between engineer and designer but also evangelist of good taste by issuing magazine Mode, Qualita or supporting Domus, Ottagono in order for people (especially housewives) to be able to image their interior space on their own, taking into consideration elevating quality of life. The concept of good taste (buon gusto) is democratic because it is desirable that not interior designer but general people can image their interior space. Design management principle is anti-marketing because consumers cannot look ahead more than ten years and predict future lifestyle and thereby if the design entrepreneurs follow the result of marketing research, the new developed product becomes obsolete or banal.

Keywords: Design Driven Innovation, Co-occurrence network analysis, Italian design thinking

Introduction

This paper focuses on formulating the design management principles derived from the co-occurrence network analysis of the testimony of Italian furniture entrepreneurs. Insofar as design management, Cautela et al. (2012) has proposed design process management tool using graphical chart. Design driven innovation (DDI) theory advocated by R. Verganti (2009) is thought to be based on both the testimonies of Italian furniture entrepreneurs, which are recorded in the book: La fabbrica del design Conversazioni con i protagonisti del design italiano [The factory of design Conversations with the protagonists of Italian design] (Castelli, G., Antonelli, P., & Picchi, F., 2007) and research project on Italian illumination industry, which are compiled in the book: Innovare con il design: il caso del settore dell’illuminazione in Italia [Innovating with design: the case of the lighting industry in Italy] (Zurlo, F., Cagliano, R., Simonelli, G., & Verganti, G, 2002). Through DDI, terms such as technology epiphany, innovation of meaning, design discourse etc. has pervaded academic field. It is certain that as people’s life style changes, product’s emotional and symbolic value (i.e. meaning) in addition to functionality also changes or can be updated. C.Dell’Era (2011) carried out quantitative analysis of heterogeneity of products’ signs (indexes, symbols, icons) and languages (message) and designer’s portfolio based on DDI.

However, as long as reading the two books above, it is possible that formulating the design management principles in a different way from DDI.

What is Italian design thinking?

In Italy, there have been several intellectuals thinking deeply about design, among which, as far as I know, Giulio Carlo Argan, Gillo Dorfles, Enzo Frateili and Arturo Carlo Quintavalle are thought to be
excellent. Vittorio Gregotti’s major is architecture rather than design and despite being designer Andrea Branzi is included in such intellectuals. From those intellectuals’ arguments, it is the characteristics of Italian design thinking for designers to image new form (shape) as components constituting whole the interior space or the world and at the same time assuming symbolic meaning, thereby evoking emotional feelings. In other words, the characteristics of the form as a part of the whole world or interior space is “dematerialised” (A.Branzi,2008). In the Reformation age (ie.16th century), Roman Catholic Church was obliged to permit the independence of man’s ratio and intellect from God. However that ratio and intellect are not perfect because human beings are not God and therefore the reality grasped by imperfect human being is supposed to ambiguous, a non-substantial being full of holes, and irrational reality based on a plurality of viewpoint. Since a form (shape) is given to the non-substantial being or irrational reality by force, the form is “dematerialised” or assumes symbolic meaning such as Titania of Luceplan that anticipates Utopia and in case of Enzo Mari, Utopia means socialism.

Figure 1 shows Italian design thinking model in which designers give new form (shape) based on concepts. The quality of the new form given by designers is high, thereby that form in contrast to that in fashion is prevented from being obsolete, taking into consideration natural science, social science and humane studies simultaneously (Fratelli,E.,1969 ; Argan,G.C.,1982 ; Mari,E.,2001). It is desirable that new form images (drawings) created by designer are forwarded to modeler as sculptor who is able to make 3-dimensional solid wooden models and at sometimes has mastered the laws of perspective. S.Micelli (2011) points out that there exist sculptor-like modelers only in Italy and the
origin of artisanship is in studio (bottega) in Renaissance. Giovanni Sacchi and Pierlugi Ghianda were famous two modeler who created wooden models as works of art. According to Sacchi, wooden-prototype models, such as the sewing machine or telephone, were first made without color to avoid bringing voluminous sense (massiveness) into existence. Then, designers performed trial and error, “dressing up” the models with neutral colors (P. Polato, 1991). Ghianda points out that wooden-prototype models are considered works of art with an “aura,” in a W. Benjamin sense, because they reflect the modeler’s mood and features of the individual timber, such as grain color or the surface’s silkiness (A. Colonetti, 2016). To maintain the productive “Made in Italy” system, a provincial government should foster a tripartite relationship, allowing modelers as sculptors a way to collaborate through designer-modeler-entrepreneur operations.

While IDEO’s design thinking is solution (problem solving), in Italian design thinking designer as demiurge create fantastic new world by putting together and locating objects with new form because human beings is primarily surrounded by various forms and they perceive the world through the form. Since civilization is made of various form, either our modern industrial society succeed or not depends on the quality of the form. The origin of design is in Baroque era (M. Bellini, 2005) in which human beings were casted out from closed world governed by Catholic Church to endlessly opened world after the Galileo-Copernican revolution (A. Koyré, 1957) and thereby instead of God they cannot help but create Utopia or fantastic new world by their ingenuity, poetics and scenography (U. Eco, 1967). Before Galileo-Copernican revolution human beings only need to imitate figure of nature as it is because everlasting order of God is reflected in static nature (G. Argan, 1989). The principle of the Baroque, which is also the principle of design, comes from the crisis of the manierisme, which means imitating natural order that is perfect as Lamarck stated because it is thought that God has made nature. However after the Galileo-Copernican revolution a conventional view of the world is upset and human beings were casted out from closed world to endlessly opened, thereby they are destined to create dynamic second nature or artistic artifacts surrounded by them. From a lacanian psychoanalytic point of view (A. Juranville, 1984), sublimation means creating fantastic new world as a work of art based on new legal order including aesthetic principles after accepting existing legal order, which means “castration”. Sublimation, however, is repeated for ever because human beings are not God and therefore it is a man’s fate to design or create fantastic new world.

Branzi pointed out that Tomás Maldonado and his followers at Ulm School of Design advocated scientific design theory by a way of configuration and an analysis of technology and the forms evoking consumer’s emotion were suppressed (Branzi, 1999). In other words, form has to follow function because design is thought to be rational in German while in Italy form (είδος) as the outward appearance of an object envelops contents or materials (ὕλη) as Benedetto Croce wrote in Breviario di Estetica or form is completed as a result of creative expression as Luigi Parayson who wrote I Problemi dell’ Estetica.

**Research Methods and data**

From co-occurrence network analysis on the text data in the testimonies of Italian furniture entrepreneurs recorded in the book above: La fabbrica del design, the design management principles that Italian furniture entrepreneurs suppose universally has been derived. As the text mining tool, Kh Coder ver.3.0 has been used in implementing the co-occurrence network analysis. In order to depict co-occurrence network diagram that reflects character of the each Italian furniture entrepreneurs,
question (utterance) of interviewers, that of Giulio Castelli, Paola Antonelli and Francesca Picchi, is excluded in implementing text mining.

**Result**

Figure 2 shows co-occurrence network diagram of Rosario Messina who founded the company *Flou* in 1978. The size of the circles or network nodes stands for the “frequency” of the word that appears in the text of testimony. A big circle means high frequency and “community” means co-occurrence words’ subgroups as a result of dividing a whole text data based on modularity Q index.

![Figure 2: co-occurrence network diagram of Rosario Messina](image)

In general, the designer’s name appeared in co-occurrence network diagram design showed that it brought wealth to design entrepreneurs or left behind unforgettable memory of design projects. In the network diagram of Rosario Messina, the big circle size of letto (bed) means that the company *Flou* mainly engages in the bed. It is the word gusto (taste) that characterize design management by design entrepreneurs. Collaborating with designers, design entrepreneurs propose future interior space with good taste to people. Design entrepreneurs such as Maddalena DePadova learn to image future interior space through association with designers and Sergio Cammilli who reigned the company *Poltronova* was able to image ideal interior space for his own house from the beginning because before entering into the company he studied sculpture in Firenze. Design entrepreneurs are good taste missionary or
“evangelist” by issuing magazine *Mode, Qualita* or supporting *Domus, Ottagono* in order for people (especially housewives) to be able to image their interior space on their own, taking into consideration elevating quality of life. The concept of good taste (buon gusto) is “democratic” because it is desirable that not interior designer but general people can image their interior space. If interior designer design customers’ interior, it means imposition of his/her taste on them. Being cultivated or educated means to be able to image one’s own interior space with good taste and not only entrepreneur but also general people are expected to become a well-educated person. Carlo Molteni pointed out that in South Italy people bought set of furniture in bedroom or living space. R.Messina also made a sharp indication that in South Italy socioeconomic market segmentation did not function because market is segmented by “taste”, saying an episode that a poultry-keeper bought very expensive sofa “Erasmo” designed by Tobia Scarpa. In other words good taste is preserved by buying set of furniture with a certain style of beauty. G.Dorfles (1970) makes a list of bad taste (cattivo gusto), in which “the terracotta dwarfs of the gardens, the false classical statues cast in cement, the curious bought by tourists in Venice or San Marino, and down all the worst songs of music festival in San Remo, the pink films, the appendix novels, the comics photographic, consumer songs” are include. Contrary to bad taste, if new and not-momentary mode of beauty such as in Liberty (Art Nouveau) architecture, among which Maison du Peuple by Víctor Horta or Gaudi’s Casa Milá is good example (G.Dorfles,1970,pp.361-362), is established without superfluous ornamentations or decorations, good taste is preserved and thereby it is desirable that design entrepreneurs be cultivated by studying fine arts or sculpture. For example, Patrizia Moroso studied the arts, music and stage entertainment at Dams (Discipline delle arti, della musica e dello spettacolo) in Bologna and she think comprehensive art including photography and architecture evokes people’s emotion. Design entrepreneurs such as Paolo Boffi said that after the war there emerged Italian entrepreneurs who made new furniture with courage against bad taste furniture made in the Chippendale style or in the pseudo-barocco style in Piemonte. In general Italian design entrepreneurs are familiar with change of a style of chair or table. For example, Enrico Astori who reigned the company *Driade* has a high opinion of Philippe Starck because he inherits good tradition of French furniture and at the same time tries to elevate the quality of life through design projects. As an educated man who understands deeply fine arts, Astori testifies that design entrepreneurs are regarded as a kind of curator or gallery owner. Carlo Forcolini who reigned *Alias* went through Accademia di Belle Arti di Brera and Dino Gavina was familiar with all the art museum in Europe. There is a fusion of management theory and humanities in Italian entrepreneurs. Since they have the knowledge of the arts, they are able to transfer the value of work of art to the industrial goods as beautiful artifacts, which form the second nature or living environment. For example, Cammilli collaborated with not only designers but also artists such as Max Ernst, Mario Ceroli and Lucio Del Pezzo etc. Gavina also collaborated with surrealist such as Man Ray, Sebastian Matta etc. Moroso transformed Ron Arad’s sculpture into the chair *Big Easy*. Figure 3 shows co-occurrence network diagram of Renato Preti who is the large shareholder of B&B Italia and the head of private equity fund *Opera*. According to his testimony, high-end Italian furniture is located within the framework of luxury (lusso) brand such as Dior or Bulgari and while investigating future trends, high-end Italian furniture must be suitable for consumer needs. Giuliano Mosconi who reigned *Poltrona Frau* since 1999 and head of investment fund *Charme* also uses the word luxury within the framework of luxury marketing and points out that it is desirable state for consumers to select a chair or table that pleases them from a wide variety of furniture in order to increase sales. It is hear that design management principle comes into collision with marketing because the former is based on “good taste” while the latter on “luxury”. In other words, design entrepreneurs are evangelist
of good taste while marketing managers engage in luxury marketing. Design management principle is anti-marketing because consumers cannot look ahead more than ten years and predict future lifestyle and thereby if the design entrepreneurs follow the result of marketing research, the new developed product becomes obsolete or banal. According to the testimony of Patrizia Moroso, the society proceeds faster than the reality visible through marketing lens and therefore she likes visionary research based on sociology to predict future lifestyle. In addition to the consumers’ deficiency of predicting future lifestyle or making future vision, if a marketing manager gives common consumers a free hand to select a “single” furniture that please them, it is possible that their interior space becomes bad taste because except for the Milanese who has the knowledge of interior design, common consumers are not good at imaging well-harmonized interior space through a combination of pieces of furniture. Mario Bellini pointed out that the company IBM tried to sell sole office automation equipment such as Fax or Printing Machine while the Olivetti provides total office environment including OA equipment (M.M.Bellini,1986). Selling single goods without considering the whole interior space brings about bad taste.

Figure 3: Co-occurrence network diagram of Renato Preti
As mentioned above, the concept of good taste is to the democratic what luxury to the privileged. If one thinks one can live out his or her dramatized life in a non-ordinary life setting, such as dinner at an exclusive restaurant, a concert at an opera house, or one’s honeymoon with lodging at a high-class hotel, his or her lifestyle fits into the French style, where people use luxury in non-ordinary life scenes
as described above. In contrast to the French way of life, if one thinks s/he can live his/her dramatic life in an ordinary life scene, with the idea that everyday life should be sophisticated, his or her lifestyle must be Italian, where people use high-quality goods with taste in ordinary life settings. In the Italian way of life, people adeptly refine personal manners with high-quality goods with taste and communicate their elevated aesthetic sense (or good taste) to each other in daily life (F. Morace, 2003, 2008) because one’s aesthetic sense cannot be elevated by oneself or in an isolated manner. This suggests that there should be happiness or voluptuousness not in non-ordinary life scenes but in that of daily life. Therefore from the point of sociology, the concept of “good taste” comes into collision with that of luxury whose homeland and origin is France.

**Conclusion**

From the findings in the preceding section, design management does not refer to a firm’s control over design but to the way design controls the endeavors of a firm (whose scope, shown in Figure 4, should consist of “good taste,” “design,” and “democratic features”). In other words, a firm controlled by design carefully limits the scope of its activity, avoiding areas of “marketing management” or “luxury brand management.” In Figure 4, styling vs. design axis leads to a time axis, and, in styling, transitional beauty is sought, such as in “Remembrance of Things Past” by M. Proust. Luxury collides with the democratic, in which good taste is nurtured in daily life.

The design management field of study seeks to clarify what qualifies, or disqualifies, something as being in “good taste,” as design entrepreneurs are “good taste missionaries” (or “evangelists,” as noted above.)

![Figure 4: The field of design management](https://example.com/figure4.png)

**Future research**

This paper focus on formulating design management principles in an exploratory or inductive way based on the testimonies of Italian furniture entrepreneurs and remaining issues are to locate this research outcome in existing management academic literature. Since fashion does not follow principles of design but styling, it is possible to contrast furniture design management principles from
fashion design management principles (Saviolo, 1998) and it could also formulate car or yacht design management principles.

Since Baroque era the world is thought to be a theatre and within it people are not consumer or citizen but actor and actress. The objects surrounding human beings such as chair or table are regarded as parts of the stage decoration, thereby research of the history of scenography (scenografia) is needed to design fantastical new world. In other words, since the world is thought to be a theatre, it is desirable that design entrepreneurs is able to judge the design project or exhibition from the point of scenography (C. Rovatti, 2009).

Italian design thinking is founded on creating images based on key concepts of a design project; therefore, a “mood board” or “concept board,” is decisive tool to implement design thinking, especially in interior design. Until 15th century, human beings were accustomed to think by the help of alphabet (letter) and modern age has begun when they started to think by the help of mathematics. From 20th century their thinking is creating image mixed with colour, line, form, volume and sound based on future lifestyle vision (V. Flusser, 2000). The way of creating new image without considering the existing concepts is suggestive of the phenomenological reduction (E. Husserl, 1970). Mari (A. C. Quintavalle) noticed that infants’ thinking was to devise various images without using alphabet or mathematics and their thought is not regressive or uncivilized (magical) but creative in itself. Argan (R. Bossaglio, 1992) said that if designers create new images from nothing, the degree of design thinking is very strong and this is called “fantasy” and that if they reproduce images that they saw on one occasion in the past, the degree of design thinking is low and this is called “imagination”. The plants that does not exist in the world as depicted in Voynich Manuscript might be born from the phenomenological reduction, the manipulation of which gives birth to “fantasy”, and to create fantastic image the bracketing or suspension of naive consciousness (epoche) need to be researched.

References

Bellini, M. 2005. Tra styling e design in Made in Italy. designpress, pp. 78-81.
Castelli, G., Antonelli, P., Picchi, F. (eds.) 2007. La fabbrica del design Conversazioni con i protagonisti del design italiano. Skira.
Colonetti, A. 2016. Pierluigi Ghianda. La bottega come simposio. Bellavite
Koyré,A.1957. From the Closed World to the Infinite Universe. The Johns Hopkins Press.