MECHANICAL ENGINEERING / PHYSICS / PRESERVATION OF THE ARCHITECTURAL HERITAGE / STRUCTURAL, SEISMIC AND GEOTECHNICAL ENGINEERING / URBAN PLANNING, DESIGN AND POLICY / AEROSPACE ENGINEERING / ARCHITECTURE, BUILT ENVIRONMENT AND CONSTRUCTION ENGINEERING / ARCHITECTURAL, URBAN AND INTERIOR DESIGN / BIOENGINEERING /DATA ANALYTICS AND DECISION SCIENCES / DESIGN / ELECTRICAL ENGINEERING / ENERGY AND NUCLEAR SCIENCE AND TECHNOLOGY / ENVIRONMENTAL AND INFRASTRUCTURE ENGINEERING / INDUSTRIAL CHEMISTRY AND CHEMICAL ENGINEERING / INFORMATION TECHNOLOGY / MANAGEMENT ENGINEERING / MATERIALS ENGINEERING / MATHEMATICAL MODELS AND METHODS IN ENGINEERING

DOCTORAL PROGRAM IN DESIGN

Chair:

Prof. Paola Bertola

Field of study

The Politecnico di Milano established a PhD programme in the field of design already in 1990. Based on this tradition, the current PhD programme in Design was established in 2008, resulting from a substantial review of how design was researched at a doctoral level.

The PhD programme in Design aims to develop skills to carry out high quality research in terms of design as an established academic field. Its main objectives are: to reflect on the overall nature of design, with its aesthetic, performance and meaning values as well as its capability of being an agent of social change; to develop and share design knowledge, in terms of theories, methodologies and sets of tools as well as designed artefacts.

The PhD programme in Design deals with various **research strands**, each of them carried out by a given research team within the Department of Design. All the teams cluster around three Sections:

- Design and Cultures
- Products, Strategies and Services
- Design for Environments, Landscape and Mobility

The programme aims at educating researchers who will contribute original knowledge to the field of design by tackling the problems and identifying the potential of contemporary society.

Their contribution may be brought to bear in:

- creating designs, visions, and proposals (research through design);
- developing tools and methods for putting these into practice (research for design);
- developing critical analysis of design and its application domain (research on design).

The Programme develops project and analytical abilities, proposes different methodologies of research, promotes the attitude to collaborate, and offers working opportunities in universities and research centres, design enterprises and public corporate bodies.

Mission and goals

The programme develops design skills and analytical abilities, proposes various research methodologies and promotes a collaborative disposition.

The main academic field is Design. Other academic fields partially covered are: Philosophy; Language Theory; Sociology of Cultural Processes; History of Art; Science and Technology of Materials; Industrial Engineering.

The achievement of the PhD qualification in Design requires a study and research activity equivalent to at least three years of full time study. During this period, both educational and research activities are provided.

At the beginning of the programme, candidates become effective members of a **research team**, within which they develop an original research topic: this activity is the core of the learning process. Parallel to this, candidates are involved in *training* and *specialist* activities.

Moreover, the activities of the PhD in Design include participation in conferences (as listeners or speakers) and writing of research papers and/or journal articles.

The programme offers doctoral candidates the following **opportunities**:

- to develop an original theme of research, becoming an effective member of a research team;
- to attend courses and seminars on design research and on research in general, developing skills concerning the discipline of design and the profession of the researcher;
- to attend courses and seminars referred to a specific field of research, developing high-level specialist skills and acquiring knowledge and tools for the development of their own research;
- to develop the ability to clearly and effectively present the contents of their own work;
- to spend a period abroad as visiting researcher in a research centre to verify the assumptions, the methodologies and the results of their doctoral work.

Qualifications

The PhD program in Design intends to educate a flexible figure: a designer who knows how to carry out research and a researcher who uses design tools. At the same time, she is also an expert in knowledge management, in constructive interaction among different actors and in the sharing of ideas and proposals.

The combination of these skills is useful in a variety of work environments. Specifically: in institutions expressly dedicated to the development of design research, such as universities and research centres; in design agencies and in design-oriented companies; in public corporate bodies and in organizations for territorial development which, increasingly, are faced with complex design problems, which the Designer-Researcher can effectively address, analyse and contribute to resolve.

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TOWARD A YACHT DESIGN 4.0
HOW THE NEW MANUFACTURING MODELS AND DIGITAL TECHNOLOGIES [COULD] AFFECT YACHT DESIGN PRACTICES

Arianna Bionda - **Supervisor: Andrea Ratti**

In the field of design, Industry 4.0, Internet of Things and intelligent products are profoundly transforming not only the representation of a design project but also the formal references, the input data, the communication strategy, and the design process itself. In the contemporary panorama, a designer needs to face up design requirements strongly influenced by an advanced technological system, which is characterized by connected, computational, and open-sourced digital manufacturing. Manufacturing passes from being a producer of objects to be a producer of services. Industry mixes with the lives of people quickly and continuously drawing from them useful indications to redefine the production itself.

In this panorama, the doctoral research explores the topic of Industry 4.0 to understand its role in manufacturing transformation and introduce its challenges into the field of yacht design. The choice of focusing on this research topic does not derive from a recognized field of study – the Yachting 4.0 topic is almost absent in the literature review and in the industrial praxis – but rather from an intuition about the need to foresight the role of the new digital technologies and new manufacturing models in the transformation of the yacht design sector to understand and guide the

undergoing digital transformation. Nowadays, the nautical sector is facing several challenges linked to the world economic, environmental, and societal context. Furthermore, the global Yacht Industry, led by Italian production, is projected to grow by up to 11% by 2022, considering both yacht's length and number of vessels under production. Despite that, the sector is suffering from technological backwardness and is recovering from a downturn that began in 2010. The recent economic crisis has highlighted both a needing of significant changes in the production systems led by an afterthought of the entire yacht design process. Because of these, the Industry 4.0 scenario could have a disrupting impact on the current yacht design processes, still mainly described as a process of iterative engineering refinement and incremental optimization called "yacht design spiral".

The driving research hypothesis is the assumption that digital technologies of Industry 4.0 will change the manufacturing models of the yachting sector – as is currently doing in another industrial context – affecting, therefore, the yacht design process. If future scenarios and challenges cannot be predicted with an unquestionable level of uncertainty, they can be foresighted and understood to inform present acting. According to this consideration, the research aims at answering the

following questions:
- Did the new manufacturing models and digital technologies of Industry 4.0 affect yacht design practices?
- How could the Industry 4.0 digitally-enabled technologies be better implemented in a Yacht Industry 4.0 scenario?
- How could the Industry 4.0 digitally-enabled technologies modify the disciplinary approaches to the yacht design project? So what are the alternative yacht design processes and tools?

The research approach is placed across the two main categories of the design research Research through Design and Research for Design. While Research for Design mainly refers to the aim of the present study, the nature of this research is close to the actual design practice. Consequently, the research output has a twofold nature: a problem framing – the Yachting 4.0 Forecasting Framework – and a series of artifacts – the Yacht Design 4.0 Roadmaps – to drive the study reflection – computational strategies in Yacht Design –.

Due to the freshness of the Industry 4.0 topic and the lack of reference in literature and industrial cases, strategic thinking to explore alternative futures is prioritized. Therefore, the doctoral study is placed in the broader conversation on the relation between Discipline

of Anticipation (DoA) and Design. The theoretical investigation on the field of anticipation aims at defining the methodological contest of the study and selecting the appropriate research strategy and methods. The six -ing phases of Strategic Foresight in which the research strategy is divided – Framing, Scanning, Forecasting, Visioning, Planning, Acting – are put into practice with two different mindsets: the first phases are characterized by an expert mindset and the using of qualitative methods, namely: industrial survey, cluster analysis, unstructured field observation, and key informant interview. The following phases have a participatory mindset and involve stakeholders in scenario-building workshops.

At first, the study shows a general level of immaturity on the theme of Industry 4.0 in the whole yachting sector. The international industrial survey, the interviews with yacht designers and project managers in shipyards and the field-observation pointed out a global lack of awareness on the opportunities introduced by the fourth industrial revolution on a strategic design level. In order to build a forecasting framework, a Case Studies analysis on 4.0 enabling technologies applied in the yachting industry was carried out in order to understand relations between industry 4.0 design principles and digital technologies and to reveal opportunity and trends for the scenario building phase. The identification of the fourty cases was undertaken thanks to the consultation with stakeholders during the international boat-shows and yacht trades in 2017-2018. The case mapping mainly focused in understand the relations between

industry 4.0 design principles and 4.0 enabling technologies, comprehend the possible impact of the use of digital technology on the yacht design and manufacturing, and, more in general, investigate the potential to scale up the experiences in supporting the scenario building activity. The resulted Yachting 4.0 Forecasting Framework represents the guiding backdrop for yachting 4.0 foresight activities.

At last, the outcomes of the scenario building workshop are gathered in three roadmaps aiming at bridging the gap between the co-design visions and the present situation. The main research results – the Yachting 4.0 Forecasting Framework and the Yacht Design 4.0 Roadmaps – came from a systematic and comprehensive study of future alternatives with the purpose to answer the research questions. Sustained by all the qualitative data and knowledge collected by case studies and by the co-design visioning activity of the Scenario Building Workshop, the roadmaps represent an unavoidable subjective synthesis of the research results on impact on yacht design processes. The roadmaps highlight three different approaches to the yacht design process driven by digital and computational modelling tools as a disruption of the "yacht design spiral": Digital yacht design spiral, Digital yacht module optimization cycle, Generative yacht design tangle. These different approaches to the yacht design practices contain, furthermore, a reflection on data input, design processes, design tools, and communication media. Specifically, the research evidence highlights three central possible and future shifting in the yacht design practices: (i) the input data are moving

from analogic to digital, reframing the focus of the designer practice from the measured data to the inferred data; (ii) the use of parametric and generative design tools is shifting the "digital doing" from digital drafting to digital logic; (iii) the digital twin is modifying the approach to communication media toward a more collaborative media strategy.

The Yachting 4.0 Forecasting Framework, the Yacht Design 4.0 Roadmaps, and the three shifting in yacht design practices represent the main contribution of the study in the Yacht Design field. However, the study results are positioned on a conceptual level of the research in the field representing, as the fourth industrial revolution itself, visions of possible digital development. Because of this, they still need to be pragmatically tested and verified by applied research projects both in shipyards and in design studios.

CREATIVITY 4.0. A METHOD TO EXPLORE THE INFLUENCES OF THE DIGITAL TRANSITION ON HUMAN CREATIVITY WITHIN THE DESIGN PROCESS

Carmen Bruno - Supervisor: Marita Canina

The doctoral dissertation moves from the observation that the ongoing scenario of digital transition is deeply impacting the human being, from the inner, less visible, cognitive and emotional levels that concern individuals to the outer, more evident and articulated interactions with other people.

The ongoing digital transition has led to the complete restructuring of space and time creating a third reality, the onlife, a new experience of a hyperconnected world where physical and digital converge. Major digital transformations (e.g. artificial intelligence, machine learning, big data analytics, etc..) are so ubiquitous and invisible that are becoming our next nature, blurring the distinction between human, machine and nature. Human being is co-evolving with technologies and a new digitally enhanced generation is growing up totally immersed in a digital world, accepting digital enhancement as an opportunity and an integral part of their existence.

Developing creative abilities become therefore a mission and a requirement for achieving a digital maturity, which enable to adapt to an ever-changing digital landscape, to collaborate with machine and to wisely lead the technological development to boost innovation.

The emerging assumption is that the creative abilities of the digitally enhanced generation is strongly influenced by the human, social and technological evolution characterizing the digital transition.

Therefore, the research aims at structuring a scientific method to explore the main positive and negative influences that the current scenario of digital transition is bringing on multiple level of human creativity to inform and thus empower the creative design process for innovation.

The exploration draws on the knowledge produce in the emerging domain of study named "Digital Creativity", that is a wide and magmatic realm in rapid evolution and constant redefinition, where multiple disciplines already investigates the influences and relationship between creativity and digital technology from several and fragmented perspectives. A Human-centred approach has been adopted as a basic principle of the research.

An extensive part has been dedicated at framing the creativity boundaries by identifying, from the psychology and sociology domain, the human components and related factors of creativity that influence the creative potential within the creative process. Five main components have been identified - creativity relevant processes, knowledge and skills, motivation and attitudes, emotion, social environment - that can be enhanced by stimulating the factors of creativity included within each of them.

This theoretical analysis resulted in the definition of the Creativity 4.0 Model (Fig. 1) whose structure explains the complex and multidimensional nature of crea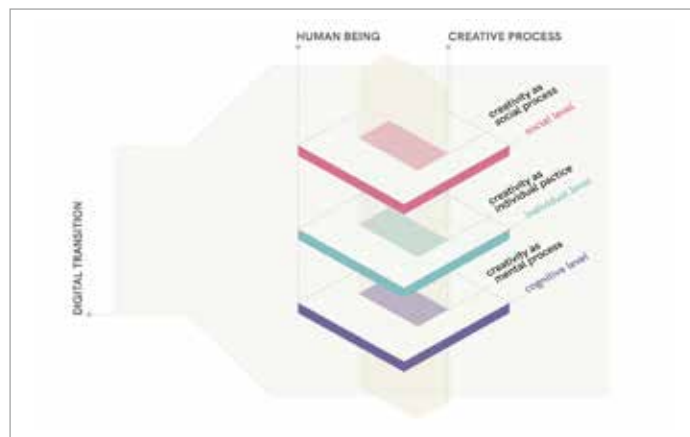tivity in the digital transition from a human centred approach. The model recognize three main level of the human being involved in a creative activity that could be impacted by the ongoing digital transition: a cognitive level that includes the intellectual and cognitive processes of acquisition of knowledge, the individual level that include the behavioural and affective dimension, and the social level referred to the communication and collaboration with other individuals. The main aim of the model is to guide the exploration in the Digital Creativity domain to identify some influences on the human creative abilities, and to analyse which among the collected creativity factors are the most crucial ones in the digital transition.

Three main qualitative exploration has been conducted through the model. The first aimed at observing some impacts of the digital transition on the three human levels and understanding how they positively or negatively influence the factors of creativity and the creative process. The second analysis aimed at exploring the opportunities offered by digital technologies for supporting the creative process. The third aimed at confirming and enriching the achieved results with experts within the digital creativity realm.

The resulted influences have been mapped on an analytical framework that deconstruct the design process in step, activities and factors of creativity to generate a Creativity 4.0 Framework whose aim is to provide a deep understanding of the changes that influence the creative expression within the design process. The framework, therefore, supports the definition of action to empower the creative design process by exploiting the opportunities provided by the digital transition.

The research path contributes to formalize a human-centred method (Fig. 2), where the Creativity 4.0 Model and Framework become the fundamental tools to make a wiser and consciously use of the digital opportunities addressed to human creative enhancement for innovation. The method support a continuous exploration of the influences on the creative abilities within the design process to design tools and methods that facilitate and support the emotional, motivational, cognitive and social factors of the human being that intervene in the creative design process as well as the process itself. The research grows at the intersection of different disciplines, design, psychology, sociology and computer science and has benefit from a continuous dialogue with a network of experts in these fields.

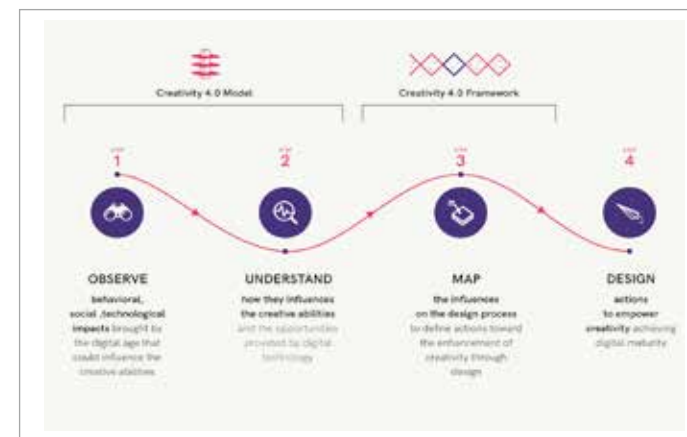**Fig. 1 - The Creativity 4.0 Model**

Fig. 2 - Visualization of the steps and tools of the Human-Centred Design method that support the exploration of the influences of the digital transition on human creativity within the design process.

DESIGN FOR SUSTAINABILITY IN FASHION
A CONSOLIDATED KNOWLEDGE-BASE AND KNOW-HOW FOR ENVIRONMENTALLY AND SOCIO-ETHICALLY SUSTAINABLE ACCESSORY DESIGN

Trinh Bui Mai - Supervisor: Alba Cappellieri

Over the past decades, fashion educators and designers have been focusing on answering the question "how the fashion industry can be more sustainable?"; however, the fact is fashion has become one of the most polluting industries in the world. It should be highlighted that there is currently a disparity in the concern and diffusion of Design for Sustainability in educating and designing Fashion between high-income and low-income countries.

The purpose of this study was to investigate and build up a proper set of knowledge-base and know-how to support and equip fashion designers in designing and orienting the process of introduction and diffusion of Sustainability in Fashion, with a focus on Accessory Design. In order to achieve this, three research stages were conducted. The first stage, preliminary research, aimed at exploring how "fast fashion" can be transformed into "slow fashion", and describing the dynamics and factors influencing the implementation and diffusion of Design for Sustainability in Fashion. This stage was based on a literature review and case studies research. The next stage, prototyping, and assessment phase, aimed at developing and systematizing the consolidated knowledge-base and know-how to support and enable designers to engage and implement Design for Sustainability in Fashion.

The research focuses on investigating proper approaches and tools in the Vietnamese context in design practices and education. The third stage, a reflection phase, aimed at presenting a retrospective analysis of the research, to define original contributions, generalize the research results, and identify potential paths for further researches.

Realizing the need for a better understanding of the environmental and social-ethical impacts in the fashion industry, a handbook was created based on the main results of the research. The handbook is designed to support and enable designers to engage and implement Design for Sustainability in Fashion. This can help fashion designers, especially young designers, in facing challenges and grasping opportunities, as well as being aware of their responsibilities.

After identifying the problem, it shows that sustainability should be integrated into teaching and fashion design. A set of consolidated knowledge-base and know-how was assessed through participatory research, and its effectiveness was examined through a series of pilot workshops and courses, as well as projects in collaboration with stakeholders. From these key considerations for the development of a new curriculum for fashion

education in higher education institutions in Vietnam emerged, which is essential for sustainable design education and practices there, where there is a lack of synchronization between the awareness of the problematic environmental and ethical issues in the fashion field and knowledge-base and know-how of implementing sustainable practices. From the experiences of sustainable practice in this Vietnamese context, the model can also be applied for different environments with specific features.

FROM ADRIANO OLIVETTI'S PROJECT: EDUARDO VITTORIA. RESEARCH, DRAWING AND DESIGN.
NEW METHODS OF REPRESENTATION TO ENHANCE THE MODERN ARCHITECTURE.

Sara Conte - Supervisor: Michela Rossi

The proposed research develops two contemporary themes: the experimentation of new project representation systems as tool to communicate the modern architecture and its documents and the cultural heritage enhancement left by Olivetti and his company.

The architectural heritage is the most evident but still the most fragile object of the design process and the cultural and social environment that led at its construction; the buildings narrate their present and the place where they are located, often revealing complex situations and contexts. Especially in the framework of modern and contemporary architecture, buildings are conditioned by the events of their properties, the technological development dynamics and economic and the urban developments of the territory in which they are located. Those are events that affect the building survival, transformation or dismantling and that often are not followed by enhancement or protection processes.

The drawing is the context of the building concept and its design process and together with the archival files tells its past. Preparatory sketches, study models, technical drawings, pictures of the construction site, correspondence between clients and designers, personal diaries testify the contents and meanings of the work itself. This documentation, which finds an initial form of enhancement in academic researches and publications, is protected and preserved in Italy, unlike in other countries, by small entities and institutions spread over the territory. The current archival system structure, the fragmentation of the documental heritage and the lack of standardized methods of management, which differ from archive to archive, entail some critical issues that hinder the integrated reading of the architectural work and its documentation.

The introduction of *IT*, digitalization, and communication media in museum and archival sector supports the development of new fruition methods of cultural heritage. Architectural museums are the institution that more than any others could benefit from the use of *ICT* to support their exhibition paths, providing alternative answers to both the difficulties of architecture musealization and communication. This type of museum has had to confront, since its origin, with the heterogeneous content of its exhibitions, the need to make it understand to different kind of users and the impossibility to exhibit the real manufact, with few exceptions. The use of digital technology allows to integrate the visit of places and buildings with various virtual contents in order to facilitate and empower the interaction between work and user, and to create new itinerary, all developed in virtual environments. Furthermore, the *ICT*, introducing new ways of data preservation and management, opens the archives more and more often to communication and educational functions. The digitalization of analogue drawings and photos, which potentially allows to put online the archive collections, and the metadata addition to digitalized documents simplify the fruition of the contents, and allow faster and effective researches by increasing the possibilities of finding and consulting files.

Fig. 1 - The biunivocal relation among the virtual model, the archival document connected to the geometry and the Olivetti's card catalogue.

In a scenario where *Information and Communication Technology* is more and more present both in cultural institutions and in architectural design process, the research experiments the use of *info-graphic BIM-oriented* application and models as archiving systems and tool for communication and enhancement of modern architecture. The main objective is the integrated digitization of the architecture and its documents based on executive drawings, making the three-dimensional parametric model a container and interface for heterogeneous data. Specifically, this thesis aims to design a solution for the musealization of the architectural process by enhancing the cultural heritage left by Adriano Olivetti and his company to the city of Ivrea, which represents a tangible example of industrial idea based on innovation and ethics and covered all the design field. The Olivetti's legacy is made of a material part, that is the buildings along viale Jervis, historical headquarter of the company, and of documental part preserved in Olivetti archive in Ivrea and in the personal designer archives. The industrial, residential and social buildings collection is one of its kind in Italy and all over the world and it is preserved and enhanced by the open-air museum *MAAM*, after a process started in 2008 since the 1st July 2018, Ivrea, the meaningful importance of these architectures and the idea which underpinned their creation was officially acknowledged at international level with the inscription on the list of *Unesco Word Heritage Sites* as "*Industrial City of the 20th Century*". The many different Italian and foreign designers involved in the project, the importance and the amount of buildings and the extension of the construction period required to identify with a regesto of all Olivetti works a representative timeframe and author in that period, who could respond to the premises of the thesis. The object of the experimentation is '*Centro studi ed esperienze*', designed by the architect and designer Eduardo Vittoria in the early '50s. The building strongly wanted by Adriano Olivetti has a high symbolic value for the company, the author himself and the history of Italian architecture. It was the first Vittoria's work for the company and was the symbol in the world of Olivetti's innovation and research: it was the place where all the future products were designed. With this building, Vittoria introduced the organic space design and the use of colours for the first time in Ivrea, and furthermore he provided the basis for the future development of module-object, which would generate and unify architecture and landscape, and anticipated an unitary vision of the architectural project on which the info-graphic software are based today.

The research shows how being a three-dimensional database, distinctive feature of the *BIM-oriented* software, and the possibility to link different kinds of documents and information to a modelled object allow to virtually combine all the documents of a building that are often located in various archives. This kind of visual database favours research, offering a comprehensive vision of design process, strengthening the system of documental collections and introducing new possible archiving methodologies.

It shows specifically how parametric models can be applied in the museum field as a tool for communicating the architectural object to various users with different knowledge and aims. This is possible thanks to the intuitive three-dimensional representation combined with multi-level contents within it, conveyed by new technologies and virtuality. Finally, the methodology of the research has shown, through the compilation of Olivetti's regesto and the catalogued data comparison, the relationship between the drawing, meant as evolution of the project, and its representation in the company innovation.

DELAYING OBSOLESCENCE OF DIGITAL PRODUCTS
INTERDISCIPLINARY RESEARCH ON EMOTIONALLY DURABLE DESIGN AND WELL-BEING IN THE Z GENERATION

Mario De Liguori - Supervisor: Francesco Zurlo

The present study wants to be part of literature about Life Cycle Design, and the design for long-lasting products, addressing the topic of sustainability from the perspective of Psychology.

The theoretical part is an interdisciplinary exploration on the beneficial effect of a systemic slowdown, which could be economically sustainable as well. The empirical part of the study investigates on whether planned obsolescence of products negatively affects people's emotions and whether having a longer relationship with things improves, on the contrary, the psychological well-being of users.

In order to answer to these questions, the research focuses on electronic goods and smartphones, as case study, undertaking an empirical investigation on a sample of about 1.300 young people, mostly belonging to the Z generation, as representative of new trends.

The methodology assumes tools and theories of Positive Psychology on which bases the design of an unpublished psychometric scale, specifically thought to measure the well being that comes from our relationship with objects.

The works ends by summing up only the main results of a broader amount of collected data - the interpretation of which deserves to be deepened during next years of study.

Impact of WEEE

WEEE stands for Waste of Electrical and Electronic Equipment, which by its nature undergoes an ever-faster technological obsolescence. Landfills are full of physically intact and functional products, especially electronics. Their obsolescence is pushed by a market logic of continuous incremental innovation, technology driven, which does not add substantial value to the emotional experience of users, prompting people to replace still efficient products before their time. It has been estimated that seven billion mobile phones have been sold worldwide in the last 10 years. Common users are not aware of the actual devastating effect of such rapid production and of the disposal cycle of these seemingly small and harmless objects.

A smartphone weighs a few grams, but the extraction of the precious materials it contains requires the excavation of at least 30 kg of rock. A single smartphone contains more than 60 valuable raw materials of which many are potentially poisonous.

Extending the life cycle of a smartphone, even for a few months, would have an enormously positive impact on the environment.

Emotionally Durable Design

In design literature, many studies have supported product life extension as a strategy for sustainability, mainly basing it on the physical and functional durability of products.

Fewer are the scientific studies today, like the ones of Professor J. Chapman, which systematically work on emotional design as a tool of environmental sustainability. According to Chapman's construct, in fact, the product durability depends more on the duration of emotions, than on physical or techno-functional capability of products to last.

His "Emotionally Durable Design" theory has also been applied to practice, to draw up the British government waste management policies, and it has become subject of attention by important companies such as Puma, Philips, and Sony. The present study would like to be a contribution to that theory by demonstrating a strong ratio between emotionally durable products and psychological well-being, which will lead promoting a "positive" user experience.

Methodology

The empirical research consists of a survey of 1338 young people, mainly between 14 and 26 years old. The psychometric scales, traditionally used to measure psychological well-being, has been investigated, to finally choose the Martin Seligman's PERMA model, from Positive Psychology, as main general interpretative filter for the creation of the survey.

PERMA model was adapted to generate an unpublished tool dubbed Perma Product Profiler (PPP), created for the specific research purpose.

The PPP provided 30 questions (items) divided into five modules, corresponding to the five variables that, in Seligman's theoretical framework, are the ingredients for well-being and "good life".

The survey also included other questions, in order to collect several information about duration, intensity and meaning of the bond to the objects.

In order to give the collected data the most reliable interpretation, they have been processed through the Statistics software Microsoft SPSS, thanks to the collaboration of skilled researchers from the Psychology faculty of Università di Milano Bicocca and the Azienda Sanitaria Universitaria di Trieste.

Results and Discussion

The main results have demonstrated the assumption. There is actually a strong ratio between duration of the affection to objects and well-being. This correlation, in the statistical analysis, was measured by the Pearson coefficient (R), and thus proved to be significant and causal. Standing to the PPP final score, the longer you keep your objects, the more well-being you get from those objects and vice versa.

Of the 14 object categories, those which induced the most well-being on average percentage value are objects related to sport, play and leisure. Video-photo cameras were second and then came other objects related to memory. The products that induce less well-being (lower PPP) are smartphones, followed only by consoles of video games.

The research results confirmed that the link established by users with digital technology products was weak and scarcely significant from an emotional point of view. Despite smartphones being the Z generation's preferred object in the survey, the link with this object results the least lasting and its emotional contribution is minimal. The bond is temporary and motivated only by techno-functional performances, to the detriment of emotional reasons. The technological-digital product neither seems to generate user-affection nor acquire meanings that are comparable in duration, intensity and meaning to those embodied by other "analogical" objects, mentioned by interviewees.

The users' affection to the physical, material, and aesthetic dimension of the electronic product seems to disappear or be confined to the initial phases, i.e. the purchase and first use.

At the blind test it brings the lowest score of PPP in terms of user well-being, and then the object with the lowest psychological satisfaction. Another strong signal emerged from the research is the emotional importance of the covers of smartphone for young people. These look like a sort of remedy that compensate for the emotional shortcomings of cold digital technology and humanises it. It customizes the object rendering it more meaningful(...) and allows the self expression of the user. It acquires a deeper function than its primary, technical one of protecting the mobile phone.

Conclusion

This research is a contribution to the studies on the meaning of objects and the Emotionally Durable design theory, showing unpublished results on the relationship between young generations and material things (objects), focusing on smartphone and electronic goods.

A strong correlation between product durability and users' psychological well-being was demonstrated. The study remarks the centrality of long-lasting product design among the circular economy's strategies. By demonstrating the positive effects of emotionally durable objects on users' psychology, it makes them more attractive for consumers, but also economical for companies aimed to improve user experience.

The thesis also provides a methodological contribution to design research by testing a new psychometric scale, specifically designed to measure the psychological well-being due to the duration of the bond with objects. Despite some technical limitations, this study has the overall value of a multidisciplinary approach, generating unexpected data and information worthy of further studies in the future, even interesting for other disciplines.

LEVERAGING THE POTENTIAL OF SERVICE DESIGN IN NON-DESIGN-INTENSIVE ORGANIZATIONS: A KNOWLEDGE TRANSFER VIEW

Filipe André de Moura Lima - Supervisor: Daniela Sangiorgi

Co-supervisor: Bård Tronvoll

Service design is increasingly understood as a valuable approach to service innovation, and several initiatives are in place to insource and explicitly develop service design within non-design-intensive organizations instead of just outsourcing design work from external design agencies. Those non-design-intensive organizations include public, private and non-profit organizations employing less than thirty percent of their staff as professional designers, and which are not traditionally associated with design. Following that growing phenomena, a group of researchers started to investigate the challenges and approaches adopted by those non-design-intensive organizations to develop service design as an internal capability. One of the contemporary research gaps that emerged in very recent years concerns the need to better understand how those organizations can develop and distribute service design knowledge internally so that it does not remain dependent on a limited and exclusive group of professional designers and can instead become spread across different staff members working in organizations. The understanding of the transference and amplification of design knowledge from designers to larger groups in organizations is relevant to grasp one way in which service design is growing and becoming part of a broader

organizational life by impacting the existing human resources working in organizations. This dissertation had addressed that gap by developing a conceptual model for investigating design knowledge transfer between service designers and other staff members (non-professional designers) in organizations.

As a first step to address design research gaps on the topic, this investigation integrated knowledge transfer (KT) literature from the broader field of knowledge management (KM) to develop an initial conceptual model that would complement current interpretations of the development of service design in organizations. That lens introduced missing theoretical concepts that

acknowledge the heterogeneity of knowledge sources and receivers, the nature of transferred knowledge, the diversity of knowledge strategies, tactics and operational mechanisms, and finally the underlying organizational contexts. Subsequently, this dissertation adopted a qualitative and interpretative research design, providing two in-depth, retrospective case studies, one of a public sector organization (a regional County Council in Sweden) and one of a private sector organization (a consultancy in Italy) that have been leveraging service design internally, addressing the emerging issue of design knowledge transfer.

Based on the cross-case findings, this research recognized first how the

Fig. 1 - Design Knowledge Transfer Model

underlying organizational contexts, and in particular the organizational structures, conditioned design knowledge transfer over time. Findings suggested that the division of job-tasks in the organizations and the departmentalization were two elements creating boundaries or proximity between service designers and staff members over time, and therefore controlling the opportunities for them to interact and to transfer knowledge directly to each other. Secondly, findings revealed that organizations relied essentially on the use of person-to-person networks as a means to transfer knowledge (personalization strategy) rather than on the use of documents and technology (codification strategy) and that they were greatly operating informally and at an individual level (individualization tactics) rather than formally at a group level (institutionalized tactics). Moreover, besides those overarching trends, results revealed a gradual increase in the number and diversity of the individual knowledge transfer mechanisms that built on each other and collectively expanded the possible ways to scale-up design knowledge. The operational mechanisms supporting the implementation of the dominant personalization strategy expanded beyond collaborative projects to also include training moments and emergent self-directed activities led

by the social groups spread across organizations. Thirdly, findings revealed that the knowledge flows between service designers and staff members were not unidirectional, as service designers and staff members' knowledge bases were both affected, and they were not bound to fixed roles as knowledge sources and receivers. To conclude, cross-case findings suggested not an exact replication of the professional serviced design knowledge of the service design teams through organizations but in a gradual formulation of a new type of design knowledge (here conceptualized as "organizational design knowledge") uniquely attached to the organizations, their human resources, and their distinctive properties. Based on those observations, this research proposed a reification of the original knowledge transfer model and formalized the Design Knowledge Transfer model (fig.1). The DKT model conceives design knowledge transfer as a contextual, dynamic, and bidirectional phenomenon that can lead to the transformation of professional design knowledge into organizational design knowledge.

This study offers three major contributions to the existing body of knowledge on service design research:

- It introduces a new perspective on how to understand the growth

of service design in organizations based on the transference of design knowledge, informed by the knowledge management (KM) field.

- It offers the Design Knowledge Transfer (DKT) model as a more temporal, situated, and flexible way to understand and interpret the transference and amplification of design knowledge in organizations.

- It introduces a conceptual differentiation between the professional design knowledge and the organizational design knowledge to place in evidence a transformation rather than a simple replication led by the transference and scaling-up of design knowledge within organizations.

To conclude this research advances the understanding of the development of service design in non-design-intensive organizations through the transference and amplification of design knowledge beyond the expert design teams, and the results and proposed DKT model provide interpretative lenses that can inform research, practitioner and even educational audiences dealing directly with this emerging and growing phenomena.
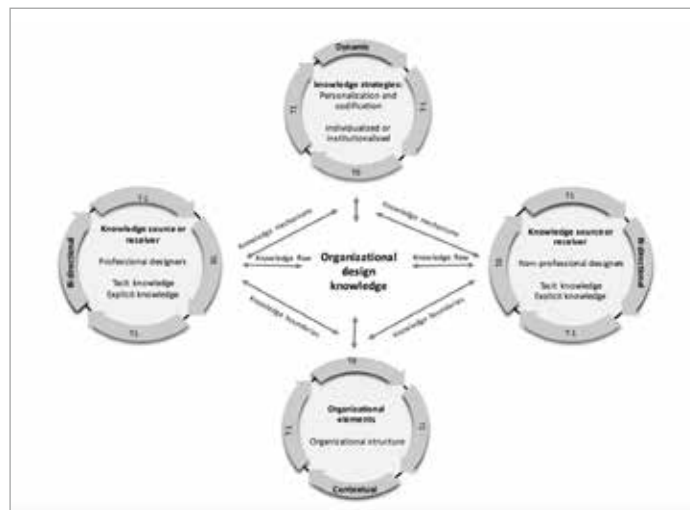
DESIGN FOR INTERCULTURAL EXPERIENCE:
A DESIGN FRAMEWORK WITHIN USER EXPERIENCE APPROACH

Shushu He - Supervisor: Margherita Pillan

Multiculturalism has become a widespread phenomenon in societies. People gain more and more opportunities to be exposed to different cultures. Designers inevitably have to deal with people's experiences in a multicultural environment. The cross-cultural design capability matters not only for business success but also for individuals' experience of the product/service, as well as for the communication of the design group. The challenges and opportunities coexist in a multicultural environment. This research starts with the challenge of helping User Experience designers comprehend values in cultural diversity and improve the cross-cultural experience through their design expertise. By studying cultural models in sociology and anthropology, as well as investigation tools in experience design, the current research adopted an ethnographic approach within UX tools. The fieldwork took place at a Chinese catering service in Milan, which was ideal for studying cross-cultural service experience. The restaurant business is traditional of the Chinese community and has been widely accepted by other cultural groups in Italy, which provides this research a multicultural field to study. There are some typical stereotypes embedded in such a context, and the restaurant owners lack awareness of presenting the cultural value in their business, thus calls for designers' contributions to service experience in

this multicultural environment. The fieldwork consisted of three phases: mapping the context, identifying the diversity, and representing the cultural value. The research employed different UX tools (i.e., Mental Model Diagrams, co-design, and diary study) and ethnographic approaches (i.e., digital ethnography, participatory observation) according to different situations of fieldwork phases.

This project developed the Framework of Designing for Intercultural Experience (see figure 1), which is a reference for cross-cultural designers to refine design questions, plan design ethnographic practices, and identify appropriate research tools in the field. The design framework consists of three parts: 1) the onion model of designing for cross-cultural experience, 2) the circle of design ethnographic practice, and 3) the matrix of designer's perspectives. The onion model of designing for cross-cultural experience is an adaptation of Hofstede's cultural onion model (1984) and the levels of cultural objects and design features proposed by Leong & Clark (2003), Norman (2005), and Lin (2007). Designers can refine the design questions of their design practices according to the aim of different layers. By the ethnographic practice viewpoint, the layers are identified as: 1) the situation – the multicultural context wherein the cross-cultural design takes place. Design projects

usually have limited time, and designers need to understand the context as much as they can within such a short time. In order to keep the richness of the materials collected from the field, the thin description is suggested for turning designers' critical attention to the various influences at play in the realization of richness. 2) the instances – the typical examples of the multicultural context. For example, this research takes Chinese catering service in Milan as the field under study, and four restaurants are selected as instances. The thick description is encouraged for further understanding of the cultural values hidden beneath the stereotypes with respect to a focused area. When merging the instances, the overlapped features can be the reconfirmation, and the distinct ones are the compensation. Designers' expertise draws on employing the appropriate research instruments for observation and analysis so to highlight the design opportunities with respect to values of cultural diversity. 3) the leader – the positive example fostered by design that stands for meaningful cultural characteristics. Designers first need to identify a target with some potentials, such as the preconditions of the cultural characteristics, the service people's will to collaborate, the feasibilities of conducting fieldwork, and so on. The service providers and the designers have different knowledge; thus, they

usually hold distinct perspectives of the service. They need to figure out how to share knowledge and communicate about cultural values equally. Since the communication is not only between designers and service providers but also between the service people and their customers, designers also need to consider how to enable the

Fig. 1 - Framework of Designing for Intercultural Experience

service providers to communicate the cultural values with their audience and customers. In this layer, the designers' significant role is both as a participant and as an observer, so that they all employ tools that help communicate the design insights with non-designers and record the change process.

The circle of design ethnographic practice is adapted from design ethnography. It is a circular process composed of three elements: observation, analysis, and improvement. This circle plays a role in guiding designers' practices in each layer of the first part of the design framework. The observation refers to the activities of data collection to understand what is happening and/ or what happened before. Usually, the oral accounts, physical resources (e.g., written documents and physical artifacts), and digital resources (e.g., user-generated data) are considered as significant channels for collecting data from the field (Hammersley & Atkinson, 1983; Wang, 2016; Wittel, 2000). The analysis is the step of extracting meanings from the raw materials collected from the field, always along with the observation in traditional ethnographic practice. Social researchers produce a thick description for explaining cultural phenomena or cultural groups according to their knowledge of society and culture (Geertz, 1973; G. E. Marcus, 1998). The focus of analysis in design ethnography differs from traditional

ethnography. Designers can benefit from the traditional ethnographic analysis approaches to grasp meanings and processes that are under the guidance of the ethnographic approach but with variations.

The matrix of designer's perspectives refers to a debatable topic in traditional ethnography, the emic and etic perspectives, and the distinct views of user experience research, which are the holistic and reductive views. The horizontal axis stands for designers' variable perspectives while carrying out the cultural inquiry that extends from the outsider's view to insider's view, and the vertical axis stands for designers' variable perspectives regarding UX as the individual experience or co-experience while doing cross-cultural design. This matrix provides a reference to cross-cultural designers to pick up the suitable tools from the "armory of UX tools."

The design framework can benefit designers when they are studying an unfamiliar context incorporating cross-cultural design, as well as help them to think outside their mental frames, which are formed by their cultural backgrounds. Through this conceptual framework, UX designers can identify the appropriate research tools for mapping the cultural context, refining design questions, and carry out fieldwork according to specific cross-cultural design practices.
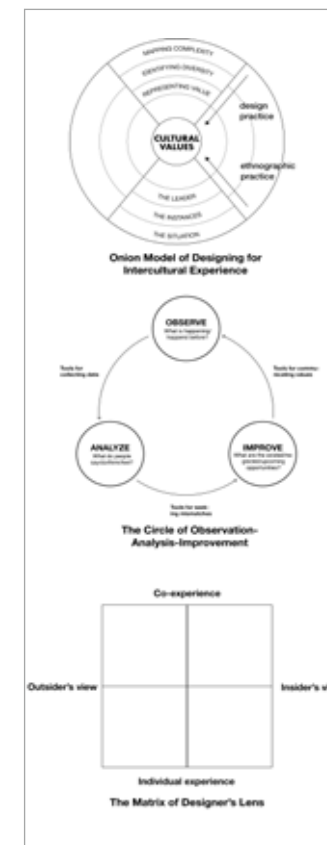
DWELLING IN THE LEFTOVERS
DESIGN STRATEGIES FOR POST-INDUSTRIAL SOCIETIES

Fiamma Colette Invernizzi - Supervisor: Anna Anzani

What comes to mind while looking at an old battered, burned book with damp stained pages? Is it solitude or past memories? Or is it about to meditate on all the things that we use and leave behind? Working on dismissed buildings is like dealing with old burnt books. It is about multiple stories, forgotten beauties, and human absence. It is about fighting over-production and over-consumption in a world in which it is totally normal to buy and throw away things even if they are still new. The same happens with buildings. In Italy, 8 square meters per second are built every day, every year, no exception for Christmas or New Year's Eve. To make it clear, during this short reading, already 400 square meters of soil has been covered by concrete. Uselessly. Society needs to use what it is already built because it is enough. Society needs to use what it is already built, by thinking of it in a new, more flexible, sustainable and ethical way. So, by mixing knowledge from Architecture, Interior Design, Exhibition Design, Art and human sciences – such Anthropology -, abandoned buildings can find a new way of being part of the contemporary urban fabric. These empty-uncertain spaces are places that have ceased to perform the function for which they have been realized and now have fallen in a state of suspension. Leftovers. As produced in a society that considers waste its religion, they represent an extraordinary resource, not just able to carry out new functions without producing further soil consumption, but also considered as care-takers of human memory and stories that otherwise would be lost. Like old books, by keeping their old covers as a memory of their past, abandoned buildings can be renewed from the inside, as contemporary nests, able to adapt to contemporary way of living, by becoming crosswords of interculturality, capable of producing new spaces for relationships and stable anchorages. Cross-disciplinary approach, short-time interventions, and low-cost interventions are the clue solution to make those abandoned architectural leftovers live again. Ethically, flexibly and sustainably.

"And yes, we do need hope. Of course, we do. But the one thing we need more than hope is action. Once we start to act, hope is everything. So instead of looking for hope, look for action. Then, and only then, hope will come."
It was January 2019 when the 16-year-old Greta Thunberg's speech at TEDx in Stockholm became viral. Since August 2018, the young activist has been struggling to defend an environment that is drifting. First with the Fridays For Future, then the TEDx, the World Economic Forum in Davos, the COP24 and the conference at the UN. Everything to raise a voice and say that something is mistaken, something is going in the wrong direction, towards a planet without a future and - to put it bluntly and

Fig. 1 - Bolognese Marine Colony, Riccione, Interior of left wing, Ph. Fiamma C. Invernizzi, 2015

uncompromisingly - towards ruin. I would like to start this report with the words of Greta Thunberg because if there is a social and theoretical background to which we all have to look, this is it.
Chaque civilisation a les ordures qu'elle mérite, wrote Georges Duhamel on his return from a trip to the United States between 1929 and 1930. Every civilization has the garbage it deserves. In the following ninety years - after the Second World War - to commodity fetishism (already theorized by Karl Marx) have followed the economic boom of the 1950s and 1960s, the development of the marketing of consumer goods of the years 70s-80s, the third industrial revolution, globalization and the normalization of a gesture linked to the indiscriminate acquisition of goods - often unnecessary - defined as contemporary consumerism (Lynch, Ceccarelli, 2008). The biggest effect of this chain of events? Waste generation.
On a global scale, a nationwide zoom is proposed, in order to show the drastic variation in urban density in the last fifty years and how the Italian territory is undergoing uncontrolled cementing, to the detriment of existing architectures, rich in history and memory. The application of alternative choices and innovative territorial policies is supported and demonstrated by specific national studies and with them the possibility

of approaching the existing through the ability to rethink construction and the territory in a way that is sustainable and ethical.
Grow, grow, grow. This is the imperative that the entire globe has undergone since the industrial revolution until it is consolidated to the present day. If initially the fascination derived from a technological upheaval in favour of an increase in common well-being, from 1950 to today the myth of growth has turned into a mercantile illusion of consumption without control. Growth is today the categorical imperative imposed by society, so much so that simple but not obvious questions like Growing to what point? At whose expense? With what effects, costs or implications? They do not claim the need to obtain an answer. Despite the immediate effects that we recognize in Western society - capable of satisfying any need as a result of a click or of a day spent within the contemporary cathedrals of consumerism - the need to recognize the danger of a system devoted to the illusion of infinite economic growth. In addition to a first mere mathematical limit, in fact, behind contemporary unconditional growth there are weaknesses and criticalities of an unfair and unsustainable system from a social, human and ecological point of view. The economic market that becomes myth, the technology that becomes religion.

A path towards mistrust, towards the decrease of happiness at the expense of the increase in GDP, a slippery road between high energy consumption and low human communication, a path headed by the presumption that, for every need, a machine can exist able to satisfy it, which for every practical (or psychological) problem can be foreseen, prevented and resolved by a technical, rational and absolutely suitable object (Baudrillard, 1968), in which the space for human thought is relegated to some hidden place and poorly manifested.
The well-known sociologist and philosopher Serge Latouche moves in complete countertrend, who, in his innumerable writings, once again proposes the theory of sustainable de-growth - or happy de-growth - which, insisting on the above all "convivial" side of intelligent austerity, would demonstrate how the turnaround will not bring a profound sadness but the demonstration of how to reverse the consumer race "is the happiest thing there is" (Rumiz, 2008).

DESIGNING FOR AMBIENT UX: DESIGN FRAMEWORK FOR MANAGING USER EXPERIENCE WITHIN CYBER-PHYSICAL SYSTEMS

Milica Pavlovic - Supervisor: Margherita Pillan

The area of inquiry is being shaped through the collaboration with TIM S.p.A., company supporting the PhD research path. The telecommunication company is looking into designing meaningful services supported by the new stream for a 5G network that will be guiding the company's service application fields within the current and following years. The network promises to have significant higher speed and reliability, thus enabling with ease employment of complex connected services that rely on diversity of systems of sensors and actuators implemented within the physical space. The research aims for responding to observed emerging needs of novel design systems, which are becoming ever more complex in terms of connected physical devices supported by artificial intelligence (AI) algorithms.

In regard to the development of meaningful application areas for connected spaces and IoT systems, the research refers to a vision of Ambient Intelligence (AmI) and Cyber-Physical Systems (CPSes). This vision and the application area find their connections within diverse fields that finally merge towards same practices. The fields are AI, Pervasive and Ubiquitous Computing, and Interactive Architecture. Within the research, I address this application field with an approach of designing for users' experiences (UX), as such an approach looks into sustainability and durability of design systems in terms of user engagement over time. Furthermore, as the application field represents a convergence, the design approach is observed through convergences as well, positioning itself on the merge between Service and Interaction Design, and Digital and Spatial Design.

Objective is posed for defining an Ambient UX strategy as a possible suitable approach for responding to the focus application field. The aim is to develop a framework for a design process that emphasizes user experience values, and a toolset that would support such processes within a multi-stakeholder working environment.

Research questions are shaped as the following:
- What might be the suitable design strategy for Ambient UX?
- How to map user experience and how to represent its values within CPSes?
- Are the currently practiced UX design tools enough for addressing projects of Ambient UX, or is an update needed?

For responding to posed questions, the tailored research methodology comprised three main research areas: (1) hypothesis of a design strategy for Ambient UX (based on literate review), (2) verification of the Ambient UX framework hypothesis (based on case studies), (3) investigation on design tools for the Ambient UX framework (based on gathering and analysis of tools currently employed in design practices).

Ambient UX is a conceptual framework that provides a strategy for structured design processes that target Cyber-Physical Systems. The framework consists of a definition of Design Domains (DDs) (what is to be designed) and User Values (UVs) (why it is designed) observed within Ambient UX and CPSes.

Design Domains are analysed through possible outcomes of complex systems of enhanced spaces, in terms of what can a designer manipulate with and shape. More precisely, what are the domains and elements a designer can manipulate with in order to create enablers and constraints for activities, thus influencing the user's experience. The observations provide possible grouping of design outcomes as physical products and space, information flows and triggering of social relations. In this context, Design Domains are interpreted through three architectures within CPSes: Spatial, Informational and Relational. Besides the architectures, the element of Time is also considered, presented as a variable between the architectures which impact on activities and experience has the same significance.

Defined DDs are in direct relation with the user's experience, and therefore, the User Values, perceived as such in regard to the interaction with a designed system. Experience is, thus, influenced on diverse levels, scaling from personal towards social perceptions and acceptability. The levels here are discussed as: Usability, Meanings & Motivations, and Social Consensus. This is to say that recognized architectures and time as a variable influence comfort and wellbeing, creation of meanings and motivations over time, and socio-ethical issues imposed by the interactive system.

An initial case study of a dynamic lighting system for a workspace was conducted for verifying the overall Ambient UX framework, by confirming the Design Domains and User Values during the designing process. Furthermore, three case studies of design projects took part that were taken as research sample for analysing further in-depth implications on design practice (*Humanitas*, *MEMoSa*, and *Connected Lighting for a Caring City*). Namely, in these projects, user experience was shaped within diverse environments (hospital, automotive, city) for enabling observations based on a broad range of Ambient UX applications. Three projects reflect on one of the three architectures (i.e. DDs) that appear as the dominant one in each of them. UX values that emerged during the research phases in case studies showed the importance of identified levels of UVs, and thus confirmed their importance for the Ambient UX framework. During the design practices developed through three case studies, UX design tools had to be modified according to the needs of the CPS and adapted towards the complexity encountered within UX. After verifying the Ambient UX framework hypothesis, tools samples were collected with majority deriving from practices in industry and design consultancies. The search focused on tools that support design processes targeting value alignment. Such tools are: Customer Journey Maps, Experience Maps, Mental Model Diagrams, Service Blueprints, Spatial Maps, Ecosystem Models, Stakeholder Maps, Storyboards, Touchpoint Matrix, Business Model Canvases, Value Proposition Canvases, and Empathy Maps.

The UX tools currently employed in practices appeared as not sufficient for covering all the aspects of the Ambient UX framework; for this reason, the research proposes an update of tools and a development of a novel toolkit in correspondence to the framework. The main six conceptual issues were identified as mismatches between the framework and the gathered tools, and as such are proposed as tools' upgrades. The recommendations on including novel conceptual issues within a novel toolkit imply having: (1) All three architectures considered simultaneously, (2) Analysis of alternative user paths, (3) Zooming in and out within the aspects of the design system, (4) Inquiry on social acceptability and desirability in regard to the design concept, (5) Overview of different time spans of user engagement, (6) Analysis and planning according to employed intelligence levels within the design system.

The research contributes in translating the very fuzzy moments of moving from user research to design hints within a design process, by proposing a conceptual framework for a design strategy and upgrade of design tools that help implementing the framework within a process in a tangible manner. Research contribution provides the industry practitioners with a solid comprehension of designing for a holistic UX in CPSes through the proposed conceptual framework. Practitioners here range from companies offering diversity of digitized services, as well as hardware product development, towards architects and governing organizations and institutions. Establishing a strategical design framework based on user values can support building sustainable systems with a conscious societal impact on long terms. Future steps of the research look into a proposal for development of a software platform that would support embodiment of the Ambient UX framework and its further dissemination within design practices.

DISPLAYING OPEN CULTURAL COLLECTIONS.
DESIGN GUIDELINES FOR CULTURAL CONTENT AGGREGATORS.

Giovanni Profeta - Supervisor: Paolo Ciuccarelli

Co-supervisor: Michele Mauri

Galleries, libraries, archives and museums (GLAMs) have been digitising and providing access to their collections for years. This digital transformation is due to several reasons regarding, in particular, the physical limit of the exhibit spaces, the need to efficiently manage the growing collections by cultural institutions and the request for remote access by users. In this context, several computer-based information systems have been developed in order to allow users to search and access the catalogue of cultural collections.

Recently, cultural institutions are releasing part of the digitised cultural objects under open licenses – in specific Creative Commons (CC) and Public Domain (PD) - to increase the usage and the awareness of their cultural collections. The availability of open cultural collections, together with richer metadata, is fostering the design and implementation of web applications which provide digital access to resources belonging to collections that are physically disconnected. These cultural content aggregators gather open multimedia content (such as images, videos and sounds) coming from several sources and index them through a searchable database. Most of cultural content aggregators are based on the contribution given by cultural institutions. However, end-users can contribute to expand and enhance

the content. While digital archives consider curation as an approach aimed to select and organise the content, cultural content aggregators gather digitised collections through aggregation - a process which requires the contribution of multiple individuals and which organises and shows content according to descriptive, structural and administrative metadata.
Cultural content aggregators are particularly conceived for students, scholars and writers (in particular, journalists and bloggers) who need digitised artworks for educational, research, artistic or dissemination purposes.
From the literature review, the end-user analysis and the examination of existing case studies gathering European digitised collections, it

emerges that most of the cultural content aggregators have several limits in terms of content and usability. Among the most relevant issues that may reduce the access to digitised collections, there are the lack and unclear content, misleading classification and limited access tools. The thesis investigates classification systems and interface solutions that may foster the access and use of digital surrogates of cultural objects within cultural content aggregators. It was born from the observation of the will by cultural institutions to open part of their collections for educational reasons and the need by writers, photographers and other professionals to access digital surrogates.
The thesis concentrates on aggregators which collect digital

Fig. 1 - Proposal for an access model which integrates searching, browsing and explorer tools.

images and related metadata. The contribute is at the intersection between interface design and Cultural Analytics. In particular, the thesis tries to integrate the design research on the access to digitised collections with the emerging interaction modalities which take place thanks to the release of open digital surrogates.
The research questions are the following:
• Which interface characteristics can foster the access and use of open digitised collections?
• Can we apply design features used by digital archives to cultural content aggregators interfaces?
In order to answer the first question, I analysed four aspects which characterise conventional web-based information systems: classification, access, navigation and usage of the content. Classification refers to the modalities administrators and end-users adopt to organise content, access concerns how end-users reach content, navigation shows the modalities to move among content and usage refers to the way end-users interact with content (creation, editing and organisation). I examined the four aspects through stakeholders' interviews, together with the analysis of existing cultural content aggregators. Furthermore, through the development of the Map the GLAM project, I investigated a case study of how an open collection takes shape and spread within a content

aggregator. In specific, I focused on Wikimedia Commons – the multimedia repository of Wikipedia which provides open data about the use of its content – and the open collection by ETH-Library of Zürich – which is one of the worldwide leading cultural institutions in terms of files uploaded to Wikimedia Commons. In order to answer the second question, I analysed the existing literature about the interaction modalities with cultural digital archives. With the information gathered, together with the results coming from the Map the GLAM project, I tried to validate the usefulness of a set of features related to the access, navigation and use of digitised collections. Thus, I designed and prototyped GLAM Culture Hub – a cultural content aggregator that has been tested by several end-users who daily use this kind of web platforms. Then, I defined a set of guidelines for the design of cultural content aggregators. They try to synthesise in five chapters the knowledge acquired through scientific and empirical research. The design guidelines tackle five main aspects: classification, access, navigation and use of digital surrogates, and the encouragement to end-users to contribute content. The design guidelines are based on OpenGLAM principles - a set of five guidelines developed by the Open Knowledge Foundation in collaboration with the European

Community, which provides cultural institutions with strategies aimed to open their collections. I transposed the five principles concerning the cultural institutions into design guidelines: OpenGLAM principles give GLAMs the content requirements and the OpenGLAM Design Guidelines provide designers with interface requirements.
In conclusion, the growing number of collections released under open licenses is leading towards a reconceptualization of cultural content aggregators. The research has shown that facilitating the access and the use of digital surrogates does not require only technological advancement, but also a shift in the way the cultural content aggregator is intended. End-users no longer need a mere searchable database but a more active search and dissemination tool.
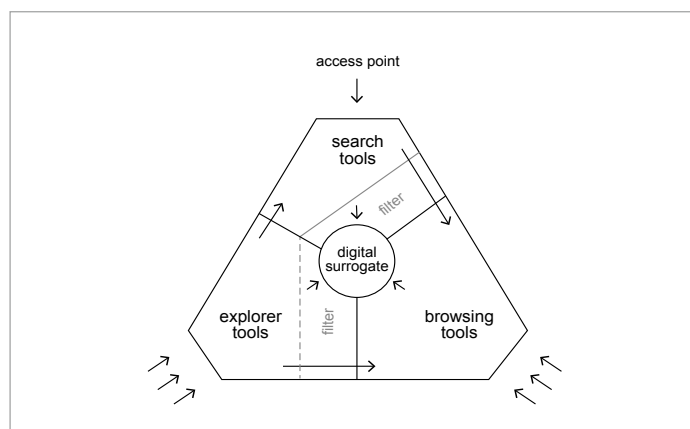
HUMAN RESOURCE DESIGN
STEERING HUMAN-CENTRED INNOVATION WITHIN PRIVATE ORGANISATIONS

Martina Rossi - Supervisor: Anna Meroni

The research aims at investigating collaborative practices that make use of design tools and methods within organisations. In particular, the study focuses on private organisations and contributes to the comprehension of how service design could be applied to **'contextual factors'** of project teams in order to enhance collaboration.
In the last decades, much attention has been focused on investigating the effectiveness of service design and design thinking in increasing innovation in the solutions produced by the design process internally and externally, with regard to the organisations, namely the **'content'**.
Less exploration instead has been addressed towards understanding how the design process both influences and is influenced by the way the people involved interact, behave and grow. All these aspects regard what has been identified as the 'context' and represent the focus of the research.

In doing so, the study faces the demand of **Human Resource Management** functions to adapt to major changes in the organisational structures.
This demand is increasing due to the major changes that the labour market is undergoing and that are affecting the employee-organisation relationship. Those changes are driven by global forces like: demographic transformations that are increasing the level of diversity in the workforce; the diffusion of digital technologies

in all aspects of work; the evolving expectations of the younger generation on the experience of work and the general acceleration of the rate of change which requires organisations to adopt 'agile' configurations to better suit the velocity of the internal and external market.
The so-called 'agile' organisations are made of fluid structures where teams are dynamically assembled according to the specificity of each project.
This kind of configuration inevitably implies an increased level of flexibility and adaptability of employees, who find themselves collaborating with a large number of people within the organisational context.
As a consequence of these changes, interactions among workers and between workers and organisations are transforming, spawning a series of inquiries that concern the ways in which those interactions should occur and develop in the most advantageous manner, both for the company and the employees.
Private organisations therefore express a greater demand for consultancies for solutions and interventions aimed at innovating the way employees work. This request is often considered as a 'design thinking' issue and tackled without a structured practice specifically dedicated to redesigning collaboration and internal behavioural dynamics.

This study proposes a framework that

defines a dedicated course of action, based on design features, that can be adopted by private organisations aiming to make the first step towards an **internal transformation**. The framework represents guidance especially for undertaking projects related with organisational change, which mainly appeal to Human Resource Management departments. Moreover, the research contributes to the configuration of a set of new skills required for the professional designer who is called to tackle and guide a process of transformation within a company.

There are two main bodies of background knowledge that have been explored to guide the entire research. The first one regards the definition of **Human Resource Design in comparison with Service Design for Human Resources**. The second one covers the **main interpretations given to the Design Thinking** practices in the literature with regards to the relevant connotations in applying those practices within the Human Resource Management field.

The research methodology adopted is mixed and composed by three different parts: **a 'preliminary study', an 'in-depth analysis' and a 'participatory action research'**.
The 'preliminary study' includes a first exploration of those that defined as 'collaborative design practices' within

private organisations through a set of interviews and observational studies. The 'in-depth analysis' enriches this exploration with a specific focus on the aspect of collaboration. Within this paragraph are included both insights gathered from the field through interviews and literature deepenings. In particular, the study builds upon the group development model of Tuckman, comparing it to the most relevant group models; it then explores the concept of teaming as a learning experience and the correlations with innovation processes such as design thinking; it introduces the topic of behavioural design as a discipline that can support organisational change and finally it provides some experiments and applications of Service Design for Human Resources.
The 'participatory action research' is composed by three different experiments of Human Resource Design where the features that would compose the final framework are developed and tested.

The experiments, called 'projects', are followed by a paragraph that summarizes the lessons learnt and includes the discussion of the thesis which leads to the development of the final version of the framework.

The **final framework** is the result of the iterations of the experiments and subsequent reflections upon them. It is presented following the stages of the design process (proposed in an extended version) divided through 'content' and 'context' level. Each stage of the process is described with dedicated tools to be used and indications about specific behaviours that the facilitator needs to perform according to the group status. The 'context' indications also include information about the configuration of the group and specific stakeholders to involve at each stage. The second paragraph of this chapter provides a proposal of skillset for the professional that could lead a Human Resource Design project and act according to the

framework. The skillset of the so called 'human resource designer' includes some skills which are typical of the service designer, enriched with other competences coming from change management and psychology areas of knowledge.

The thesis ends with a chapter of **conclusions** which includes the limitations of the research and the implications of the findings in the field of education and practice.
The implications in education foresee a new dedicated training path for the human resource designer both as a specialization of a trained designer or an executive short course for practitioners who want to approach projects about transformation.
The implications in practice regards possible alliances to be established between human resource designers and professionals in the human science field within particularly complex situations or environments.
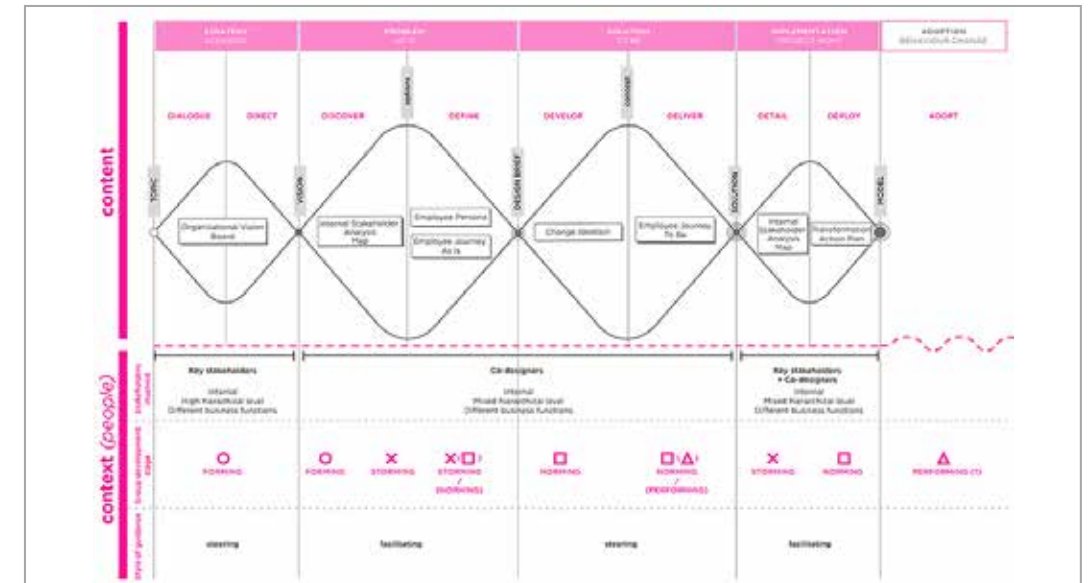

Fig. 1 - Proposal for a Human Resource Design framework

DESIGN THINKING AS A DRIVER OF VIETNAMESE INTERIOR DESIGN EDUCATION

Pham Tu Ngoc – Supervisor: Davide Fassi

Interior design has changed significantly over the past 20 to 30 years and has established itself as a recognized profession due to the evolution of design methods and the emergence of the new design disciplines. The contemporary practice of interior design is becoming more and more concerned with human interaction instead of simply beauty, form and shape, in which the creation of spaces and environments take on a new meaning and often become activities or services with an increasingly socially responsible stance. It is strongly believed that the key to solving these issues lies in the educational transformation which requires the curriculum to be built that focuses on developing of analytic skills, problem-solving skills, and design skills, not on teaching available knowledge. However, in Vietnam, as a profession trying to evolve into a discipline, interior design has severely lagged behind in its ability to engage in its philosophical evolution. Originating from the inadequacy of teaching and learning frameworks in interior design education in Vietnam, this study suggested a pedagogical approach based on the concept of Design Thinking for Design Studios to overcome the disentanglement in interior design education. All the research methods were already implemented to answer the two primary research questions:

RQ1. How is Design Thinking be applied in interior design education globally?

RQ2. How can Design Thinking be applied to the Vietnamese interior design education?

The research methods adopted to answer to the first research goal were a literature review and case study research. In particular, building upon the review of literature (on theoretical framework and the evolvement of both interior design and Design Thinking, the evolution of design approaches and methods, the list of diverse interior design courses, the list of universities and graduate schools employing Design Thinking approach), a dialogue relationship between interior design and Design Thinking was examined in order to clarify the qualities of Design Thinking that make its value for the current needs and evolution of interior design in both practice and academia.

A case studies research, investigating the innovation teaching journeys done in three Design studios: 1) Temporary Urban Solutions, 2) the Interior Design Final Studio, and 3) the Contest Design Studio (within the context of Politecnico di Milano). This study aims to introduce the conceptual framework, outlined by a number of emergence factors, so to describe how Design Thinking approach takes place in the Design Studio courses. Based on the outcomes of both desk-research and in-field research through observation activities, four factors that enable the application of Design Thinking in interior design studio classes are identified: 1) factors of formation; 2) factors of environment; 3) factors of social interaction; and 4) factors of evaluation. After a cross-comparison analysis among three Design Studio courses, the author decided to propose an "Interior Design Thinking" model, which was identified by two versions based on the concept of scenario design, named as forecasting and back-casting approach.

In order to examine the appropriateness of the suggested approach for integration, two pilot studies were carried out at National University of Civil Engineering (NUCE) Vietnam, within the Department of Interior design, Faculty of Architecture and Planning. The first pilot study was conducted through the module "Design Studio 3", with a focus on cultural and educational interior design. The second pilot study was held one year later, which emphasized designing residential spaces to meet the future needs of the users (Design Studio 1). The models, methods, and tools were tested and verified in term of learning effectiveness (design methods and tools are practically usable in the settings for which they have been designed and developed) as well as teaching effectiveness (the use of the design methods and tools brings to desired outcomes).

The results of the two pilot studies were evaluated using both quantitative and qualitative data analysis techniques. The findings demonstrated a positive attitude towards the application of the "Interior Design Thinking" model, which achieved the teaching purpose of human-oriented design innovation and guidance, so that students could improve their sensitivity towards problem identification, deepen their discussion of users' needs, and come up with a variety of ideas and innovative thoughts. The study also recorded the significance of the potential applicability of human-driven approaches such as co-design and service design that led to the ability to design interior spaces towards "multiple functions" rather than focusing only on the surface beauty. Additionally, a further advantage of the new teaching model was to create emotional engagement by involving diverse stakeholders, which increased social interactions and mutual social benefits. On the other hand, some limitations of the model were also indicated, and a number of suggestions were taken into account. The study concluded by developing a handbook to provide the necessary theoretical knowledge and practical approaches, methods and tools to support design educators in introducing and teaching interior design focusing on creativity and social innovation.

PERSONAL INTERACTION DESIGN: INTRODUCING IN THE DESIGN PROCESS THE DISCUSSION ON THE CONSEQUENCES OF THE USE OF PERSONAL INFORMATION

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Personal Interaction Design: Introducing in the Design Process the Discussion on the Consequences of the Use of Personal Information
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In a context where the development of data-based technologies and systems opens new domains for the design of interactive and responsive solutions, the management of personal information has become a significant issue. It's a critical concern for both the user's management, and the designed system's one. The research aims to investigate on the use personal information as signifiers that contribute to the creation of the meaning. The research identifies several contemporary issues relate to consequences of the use of personal information clarifying the need of ethical criticism in the design of solutions that imply the use of personal data and information. The creation of innovative connected services must consider, during the design process, the reliability and safety of the final solutions. New services and innovative solutions bring changes that can be perceived as utopian to somebody, and as completely dystopian to somebody else. In the creation of such innovative services, designers face with the multiplicity of different perspectives about wellbeing, sustainability, and

social justice; they should orient design choices embracing both the contradictions implied by the changes they can produce, and deal with the complex issues that goes beyond utility. Active and passive, aware and unaware tracking and use of data impacts on different layers of the individual identity and everyday life. First, the use of personal information impacts on the awareness and perception of the self. This impact layer belongs to the very personal sphere of interaction with the self. The return of information from system to users in the form of visualization, feedbacks and insights, impacts on individual self-perception and self-reflection. The second impact layer concerns the dimension of actions and behaviours. The proactivity of the services, their suggestions, alerts, and tailored experiences based on profiling, impact on the action the user performs in specific occasions and in daily life activities. The third one relates to the interpersonal relationships and roles within them. Social interaction based on data, the comparison with data from other people and tailored experiences offered by services, impact on the relationships and the roles users have with their network both personal and professional. The fourth impact layer refers to the social agency in the political, cultural and public domains. Participation and contribution to the society, through sharing and providing data for research, for data-driven policies, in collective values and

even contributing to social labelling mechanism user's information has an impact on how the society shapes itself. The investigation on the impacts leads to the creation of tools to support the design process introducing critical thinking so to help designers in creating responsible and robust solutions. The design of human-computer interaction needs a comprehensive understanding of the cognitive processes considering the relationships between all the elements that participate in the process. Critical thinking has to be introduced in the design process, among designers and involved companies and stakeholders so to: 1) improve the services thanks to the possibilities personal information offers, and 2) to avoid negative consequences through the anticipation of possible issues related to the designed solution. Is, then, essential for designers, to understand how technological solutions can imply the use of personal data to provide meaningful new services or improve the already existing ones. The Impact Anticipation Method, outcome of this research, has the purpose of support designers who deal with innovative products and services in creating robust and reliable solutions. It can improve the design process by foreseeing what the potential user will perceive about the solution with respect of several issues. It can also help in understanding if and how the solution will be socially and ethically accepted, and this can also influence its success

on the market and the long-term adoption. The method consists in the application of different tools specifically created in the form of toolkits addressing different design phases and different depth of the analysis of the use of personal information addressing two main objectives: raising awareness in designers about data and actors involved (understanding of data flows), and the identification of possible consequences related to the solution (exploration of impacts). Among the possible applications of the method in the design processes for interactive innovative products, we can reflect on the use of critical themes and issues as assessment and discussion elements to: i) frame the state of art in term of current solutions in the preliminary context analysis and foster reasoning in the preliminary user analysis; ii) identify possible impacts of a solution concept so to make more aware design choices during the creative phase; iii) assess proofs of concept and the related scenarios of use to verify the solution and support the definition of user tests. The use of these discussion elements in different design processes can help to identify user's rights, generate design guidelines, assess concepts' features, and identify possible improvements. The application of the method performed in design activities, helped not only the designers to develop awareness on the consequences of their actions and outcomes, but also to assess and improve the method itself and its

findings. It helped designers in creating robust, consistent and resilient solutions supporting the design through the introduction of critical thinking in the whole process, from preliminary phases to the assessment of the solution. The designers involved in the application of the method demonstrate a raising of personal awareness on the topic by changing and improving the outputs of the design processes through more thoughtful design choices with respect to: i) the use of personal data in terms of collection, storage and elaboration; ii) the derived information and knowledge; iii) the possibilities that this knowledge opens in adding values to the services; iv) and the possible impacts that the use of personal information could have on individual and society. Furthermore, while exploring case studies, designers have the sensibility to understand and identify valuable user's right and design principles that go beyond the topic of privacy, using a critical thinking approach that embraces the complexity of the various impacts looking toward design choices as possible solutions.

As the research pointed out, the design of solutions that implies the use of personal information is a critical concern. The need of critical thinking for the design of such solutions emerged not only from the literature and the critical themes came out during the application of the Impact Anticipation Method, it has been made clear by the difficulty faced by the designers and

the students in figuring out and so be aware of both how and when personal information is implied in their designed solutions, and the potential impacts that the use of such information and the derived knowledge could have. The Critical Themes clarify the need of thoughtful design choices that take into account the user's rights regarding privacy and security, but also regarding less evident impacts such as: i) the perturbations in self-perception and self-awareness due to self-mirroring into data and feedback received by the services; ii) the automation of the extraction of the knowledge about the individuals that changes the people's cognitive load, actions and behaviours; iii) the alteration of people's quality of life, freedom and access to services thanks to increasing availability of services that imply personal data as a matter from which extract knowledge; iv) the alteration of the individuals' participation in the society and the community and the changes in their interpersonal relationships and roles.

THE DESIGN METHODOLOGY FOR CONNECTED OBJECTS IN HIGH-LEVEL DESIGN EDUCATION: RESEARCH ON DESIGN METHODOLOGY-CENTRED CONTENTS AND STRATEGIES FOR CHINESE ART UNIVERSITY SYSTEM

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The connected objects, also named smart products or smart device, are permeating into people's lives and changing their behaviours and habits, and are becoming the necessity to human's life. By the development of information technology and the Internet of Things, they updated from regular, traditional and non-electrical products by implanting electronic chips and system, connecting to the Internet or other devices, and users have to operate them through the physical the digital interface. Thanks to the convenience and popularity of connected object, they are bringing new growth of the economy and changing the consuming habit of society, the relevant market is expanding. Internet of Everything and everything became smart are seems to be the new trend for part of human civilisation. Thereby, the design of these technology-related product becomes the mainstream for the manufacturing and creative industry. On the other hand, the emerging connected objects impact design education. Many design disciplines are involving to the connected objects, e.g. industrial design, interaction design, user experience design, service design. Indeed, design education is facing evolution by technological influence.

However, the actual situation of connected objects is not as favourable as the economic indexes demonstrate. Most of them were failed, the failure comes from the low concept acceptability on crowdfunding platforms, also from the user experience quality for the products that already released into the market. These failures lead to design waste. Although there are various reasons for the success of a product, design as the force for innovation was given greater responsibility at this time. Design methodology as the approach to generate the solution from concept to product, it is playing an essential role for the connected objects. Meanwhile, a design methodology is always the main content for design education, and it is also applied in the profession and industry. Therefore, a specific design approach for the design of connected objects is required for both the design education and industry, to enhance the quality of the connected objects, especially for the user experience quality. Thereby, this research attempted to produce specific design methodology for the connected object, included design process and methods.

Meanwhile, because the author of this research is a lecturer of the industrial design department in a Chinese university, another vital part of this research is design education. China as a country with manufacturing power, it is gradually paying attention to the power of innovation. Both the number and types of connected objects in China have a significant share in the world. It is one of the countries with the largest markets of connected objects all over the world. Studying the design and design education related to connected objects has reference significance to other countries. Chinese universities are attempting to educate the design of connected objects. They are updating their curriculums; most industrial design majors try to combine interaction design and user experience design.

Nevertheless, most of these institutions apply the Western knowledge of industrial design, interaction design and user experience design directly to teaching digital technology-related products without concerning the domestic context and circumstance. The design education in most of these universities is facing a challenge from traditional design to combine with interaction design, user experience design or service design which are connected objects relevant disciplines. Thus, this part of research is to define the specific educational situation of interaction design and the state of the art of design methodology's teaching in the university for connected objects' design, and to find the gaps of the high-level design education between Western countries and China, then to explore the possible solutions for educational reform of connected objects' design.

Besides the investigation and research of the design education in the international and Chinese context, the author adopted his Chinese university as a case and experimental environment. This university is a typical and traditional art-backgrounded university, and it is struggling in a dilemma from traditional industrial design to design connected objects in the industrial design department. This part of research intended to conduct an intensive study of the educational system and deduce a set of guidelines to meet the challenge from traditional industrial design to interaction design, thus to promote the education of connected object design in university. The results of this research can offer inspirations for theoretical contributions and potential practice value about the design for connected objects, the contributions can not only for China but also for all the universities.

Consequently, three main sections are discussing paralleled- design education, design education and connected objects. The main issue of connected objects part is the quality factor of a connected object. The purpose of the design methodology section is the novel or updated design methodology for the connected object, and these two main results combine to generate the design methodology for the connected object with high quality. The research of the education part narrows down the industrial design education from global to the Chinese context, and focused on the type of Chinese art backgrounded university, then select the China Academy of Art. The study of the design education in CAA reveals the opportunities for improvement. This research focused on the intersection of these three sections. The purpose is to study out the design methodology of connected objects in design education, to enhance the quality of the product and its experience. This design approach should concern the situation of the education, to exert its advantages with the contemporary knowledge of design methodology in the international context. Meanwhile, the research intends to figure out how to make the higher-level design education fit for connected objects' design and employed a Chinese art-backgrounded university as a case to proceed with specific research activities.