Craft, Technology and Design

Tarkko Oksala, Tufan Orel,
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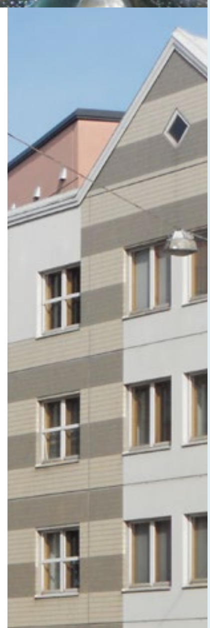

HAMK
HÄMEEN AMMATTIKORKEAKOULU
HÄME UNIVERSITY OF APPLIED SCIENCES

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Content

Project description

What is CTD? Shortly it stands for Craft, Technology and Design. The project started from negotiations between Tarkko Oksala (Finland) and Tufan Orel (France) after their co-operation in Design theory. The intent was to build a bridge between theories of Design and Craft and in this sense, it is good to notice Technology as well. First challenge was to find active participants and host for the project. We have been happy in finding HAMK for this duty. Quite soon HAMK opened home pages used actively. First Call for papers were send during the summer of 2019. The home pages were used in communication relatively long, because Covid19 pandemic forced us to proceed in distant mode and somewhat slower than expected. Good is worth to wait and now the e-publication is ready.

The Finnish Society for Practice Based Inquiry (PraBa, www.praba.fi) is a multidisciplinary research association. One of the most central tasks of the association is to collect all the researchers interested in practice based inquiry together to study fundamental questions of the practice based inquiry. Some examples of such fundamental questions: methodology, philosophy of expertise, and knowledge and skills. The main activity is the Annual Congress of Methodology which was held first time in 2002. The Methodology Congress is a multidisciplinary congress; some of the congresses have been international. The association has published several books on fundamental questions of practice based inquiry.

Acknowledgements

We like to thank Häme University of Applied Sciences, as the main sponsor, and the editorial board for encouraging co-operation and generating inspiring atmosphere for all of us to plan and manage the project. We like to thank all the reviewers for their contribution to the content of the book. Most importantly, however, we want to thank all the authors, each of whom made an important and valuable contribution to the book. The authors represent different fields of science, of arts, and of skills which make the book rich in content. Names of the authors can be found in text, reviewers are acted anonymously and Editorial Board is listed below. We hope the book will inspire readers to further develop the themes of the book.

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Tarkko Oksala & Tufan Orel

Craft, Technology and Design

Introduction

The testimony of the persistence of craft heritage in some cultures, in design practices and in recent craft sensibility of consumers, can help us better understand today's design reality. Meanwhile, it also sheds light on the choice of this special theme – craft, technology, design – for this book project. What is more, this theme hopes to bring together and be beneficial for all the participating scholars, researchers, designers and artisans, allowing them to exchange/coordinate their points of view and their expertise, and hence find new solutions for the major design challenges of today.

Design knowledge has its origins in Craft and the works of Craftsmen. We can refer back to the Poiesis of Aristotle and the builders of the cathedrals in the Middle Ages. In the sixteenth century, the idea of *Disegno* was well propagated in Italy by Zuccari and in Portugal by Francis Hollanda. In England, Thomas More defends in his *Utopia* the idea of Craft, in the *The New Atlantis*, Francis Bacon was already talking about material and immaterial Designs of everyday objects (such as light, sound, perfume and food designs).

During the *first* Industrial Revolution of the eighteenth century, when trade was passed to the manufacturers, it was the energy problem (electromagnetic, kinetic, automatic power control) which dominated the main debates in the scientific milieu, and at that time design also made itself an autonomous activity, as was witnessed in the manufacturing projects of Wedgwood. Now the new workman - the designer - is paid twice as much as the craftsman, and is mainly involved in drawing design objects according to market demands: differentiation of sex, social classes, and age groups. In the nineteenth century, the heyday of the rise of Capitalism, the new factories and their normalisation and uniformalisation of human gestures and tastes created a counter movement: the Arts and Crafts Movement of William Morris and Mathew Arnold. In that century of revolutions, the craft problem will not be an easy case to deal with for some other intellectuals like, for example, Oscar Wilde, who will defend the cause of Craft in the UK and will be a publicist of design when he visits The United States.

So, before Craft completely evaporates in what becomes an outright 'design affair', it will pass by this transitory period that we may call the

Technological Stage of Design, where household devices became totally mechanised. The Technological stage of Design is mainly involved in 'work-saving objects'. But we may also recall the importance given to Form, especially in the movements of the beginning of 20th century, such as Art Deco, De Stijl, Vorticism, Futurism and Bauhaus. Hence, in that era of Machine Kingdom and Technology, those 'relief-providing -objects', and social prestige objects (like the patina objects of the eighteenth century) which characterise craft work, was again pushed back into the annals of history. The role of women in Craft is also notable. On this topic, we can remark a certain ideological change from the old social role of the "Angels of the Home" to the new role of women in Craft as creators and "entrepreneurs".

If the production of everyday objects was in the beginning completely dependent on the hand, it passed afterward to the power of the machine and finally in our era, this productivity - and what we call today innovation – is totally dependent on the human brain. Our era can be labeled as the Knowledge, the Information or the Digital Age, and what is ultimately the most important characteristic of this age is that not only everything which can be producible is tested beforehand by design, but also Design is now also a meta-activity: the 'Conceptability' of the products can now precede design proper: the conception of the products. In the new era of designology (the study of design as unified science), design seems to have shut all its doors completely for, what we may call, a 'craft sensibility'. But is it really so?

Craft still seems to be hanging around like a 'spectre' inside and over design activities. A close reflection on the design activities of today may show that a craft argument is still a valuable business argument for traditional and emerging economies, as in some African, Asian and Latin American countries. From a socio-economic point of view, it is also possible to see the importance of craft parallel to the design business. Some contemporary Nordic Design still seems to be in close relation to the craft tradition. But that is not all. Although today's knowledge-based design tries to perfect the methods of formalisation and knowledge acquisition, we can nevertheless still track some traces of old craft knowledge, like the tacit and implicit knowledge of design activities. Additionally, nowadays craft seems to be a new trend and a new lifestyle. The more technological design (connections between household devices, for example) takes commands, the more there is a new tendency in consumers' attitudes: the urgent need to be surrounded by traditional and artisanal everyday objects.

The papers presented in this book offer a fresh outlook on the relationships of craft, technology and design. On one side, the authors depict a long history of craft knowledge and practices which is still perpetuated in an overt or implicit manner in the contemporary design professions of today. On the other side, much attention is brought to the evolution of the *modes of cognition* of the Designers in relation to their use of digital tools in certain stages of the design process. The topic of technology, besides its role as an 'intermediary object' between the artisan and his/her final product, is considered to be the objective world of artifacts, i.e., craft work, artwork, design products, architecture and urban planning. Finally, the book proposes further investigations into the world of artifacts. More precisely, the book is divided into three major thematic sections and a synoptic epilogue. How can we detect the persistence of craft knowledge, not only through historical evidence, but also in design professions and in the arts of today? What are the craft applications of the Digital Age? Furthermore, what are the epistemological characteristics of designers' knowledge and the ontological views on the objects of design?

Craft knowledge, design and arts

In the First Section of the book, much evidence is put forward by the authors on the persistence of Craft knowledge, which enables us to recognise some of its special and permanent characteristics. By taking into consideration the standard theory of knowing-how, as opposed to the theory of knowing-that (application of concepts, rules, that are inherent to a special domain), the artisan's knowledge is rendered intelligible not only in its recognised role in the design process (tacit or implicit knowledge) but also as a skill knowledge *per se* which still plays an important role in the creative productions of today. Furthermore, the topic of Artisan's knowledge, which is explored in this section, takes into account its historical, epistemic, as well as its artistic dimensions.

In the first article, Tarkko **Oksala** and **Tufan Orel** discuss how the interest in craft has survived in historical discourse as well as in practice since Antiquity and how we can still witness its persistence in today's design productions. In order to make contact with craft practice, we use Finnish design as a case, which means directing a hand to our host organisation.

The main idea behind the theoretical part of the paper is to show how technology and design as well as the Fine-Arts evolved from a commun ancestor which is Craft. And today we can still certify its persistence in these domains with three different formes: i.e. the "hidden", the "ambient," and the "manifest" Craft. After introductory and historical remarks, the authors give examples concerning the CTD discussion of today. This renders it possible to connect the theory to concrete action in various regions.

After the historical approach of Craft Knowledge by Oksala and Orel, Eero **Kallio** brings into discussion the craftsman's or maker's knowledge by situating it in today's lively debates about the complex relationship between knowing-that and knowing-how. But this is his starting point. His main aim is to take us from craft knowledge to designers' knowledge or skill by accentuating the dual nature of productive activities. In his review of the 'knowing-that/knowing-how' theories, he highlights that there is not a consensus on the nature of knowing-how: what is the ideal dosage of "that" and "how" which permits us to speak clearly about the Maker's skill? For his case, he mentions the importance of intentionality; it is while acting intentionally that we create something and experience our skillfulness. Speaking more generally, the final aim of productive activities is artifacts. And these artifacts can be framed as physical structures if they are positioned in relation to natural laws and as functional objects if considered as objects for human needs. This double nature of the artifacts opens the gates to design science. From this perspective, Kallio considers that designer's skills are measured by how structure and functionality are combined. And finally, the know-how of the maker, which has a tacit or implicit nature, needs to be visible or objectified knowledge during the process of design. In the third section, this preliminary analysis of designers' knowledge will be re-examined by Mutanen, Oksala and Friman, from a larger epistemological perspective.

In her article, Hiltrud **Schinzel** raises the idea of love in the centre, using the myths of antiquity to consider the everlasting conflict between creation and conservation in art and design. Technology goes forward and today we face the challenge of the conservation of synthetic materials and even digital works. Schinzel points out that restoration should happen in an open-minded manner because artworks live under potential interpretations. People most often consider design objects under a visual communication frame, but Schinzel created the important notion that tactility is also at least as important to reception.

The use of plastic raises special problems in restoration but also on the waste side. In art and design, these problems are accompanied at the level of cultural erosion and conserving ideas with respect of the spirit of time. In conservation, we have the problem concerning "at what moment of the life cycle of the target do we have to focus?". According to the author, ICT can help us in this when we make museum installations. After timing, we have the problem of regional cultures, styles and even the hand movements in the original or the restoration work. Many objects in arts & craft are naturally products of our haptic senses. Design objects and artworks are still hand-made artifacts, but besides this key principle, first industrialisation and then ICT have changed the markets. The restoration of important products is still handwork. In this process, we can love the products of our culture and bring them back from the nearly wasted.

Craft applications in the digital age

The second section of the book concentrates on today's craft applications. These applications cover a large spectrum of activities such as graphic or typological works; glass works (or artworks), restoration and conservation of historical monuments; self-crafting or do-it-yourself objects with the help of 3D prints. These domains of applications show, not only the vitality of craft today, but also it brings forward new issues: what is the role of women as members of the 'New Culture of Makers'? And more generally, what are the transformations of craft activities of today, and notably by the use of digital tools by the Makers.

Antony **Radford** opens the discussion in this Second Section of the book by asking "Can an object be considered 'crafted' if it derives wholly or partly from artificial intelligence and numerically controlled machines?" With this remark, he proposes to analyse how craft activity is perceived today by calling into question the close relation of the 'makers, tools and the objects' and especially, the evolution of tools from the hand to the digital. Here, the makers' knowledge is not studied independent of the tools - which intervene in the process of production- and the materials. On this, he discusses the differences between the direct connection between crafts person and its material, for example, the "woodworker working directly on wood" and the case of producing the same object by "intermediate" stage introduced by the computer screen.

The special starting point of Radford is to combine the ethical ideal of Responsive Cohesion into the CTD context. Responsive Cohesion has its parallel in Aesthetics and this leads to interesting new cohesion suitable for Craft. This solution leads in a natural way to a human-centred approach. This is exemplified with small craft-related objects, which the author uses as evocation or inspiration tools in his own studio. Today design still goes with human tools, in a digital manner or in combination as using a 'digital hand'. In the case of quality control, the co-operation of hand and eye becomes important as exemplified in detail. This leads to the dream about computer art under the real genre of today. Then the demand of critique grows. It is also possible to criticise the whole idea of digital craft especially in architecture. What is the demarcation between computer art and just computerised face? Before we draw a conclusion, Radford leads us to think of the global dimension of digitalisation. Do the charming regional aspects of craft, like the Scandinavian one, disappear?

Ewa **Grabska**, Iwona **Grabska-Gradzińska**, and Teresa **Frodyma** draw our attention to the visual skills of the artisans in the domain of typography and visual design. This special skill which was once entirely dependent on artisans' creativity and its primitive tool (chisel), has changed in its visual content by the evolution of the tools (computers). The authors add the viewpoint of graphic design to our thematics. This is a common area for all design work and connects the problematic to symbolic thinking in general [which will also be discussed later in Mutanen, Oksala and Friman's paper]. The authors also show connections between craft and technology. Visual design in graphic information has its basic role, but the connections to audition and multi-modality are evident as well as cognition.

Writers see perception as skill and in active light. In the study, a short history from craft typography to an ICT one is illuminated from the times of China and Rome up to desktop publication. As craft is often related to art, so is typography. This relation can be seen in history and also in the art movements of the 20th century. Mixing Typography into all other arts is a remarkable phenomenon. In our built study, figurative and symbolic expressions form one key category and this paper brings them together like it connects craft, technology and design.

As for the importance of craft application in the conservation of historic settlements, restoration and reuse of traditional buildings, Özlem **Karakul**, by referring to the intangible cultural heritage of the UNESCO 2003 Convention, proposes a critical approach concerning the transmission and application of craft knowledge. For the efficient transmission of craft knowledge, there is a need to be attentive, not only to education and training, but also to active use of 'the new technology'. The correct combination of craft and technology can permit what she calls, a "Holistic Conservation of Traditional Craftsmanship".

This paper brings our discussion to a more governmental level and provides important practical definitions around the CTD used in UNESCO. Skills of craftsmanship are urgently needed in Architecture as the Mother of Arts, especially in conservation (today). Among the most important definitions of craft and between the lines, she sees factors "to make by hand and tools within". The basic objective cognitive aspects include the documentation of craft heritage, but there is another complementary dimension to discuss the viability of the intangible. Both aspects lead to education problems and revitalisation. The author concentrates on architecture and, on a more concrete level, on building and construction and provides the most important categories in concise figure form. She also connects the dimension of change throughout the discussion. The basic planning, design and building of technology is architecture, which has its many connections to other types of technology including the digital one. This opens up new ways to organise museums or street information. A deeper understanding facilitates the need for education of practices and values also discussed in a diagrammatic manner in the article.

In the first section, Kallio's paper discussed the need for knowing-how - craftsman's knowledge - to be objectified in order to become design knowledge, whereas Ariel **Aravot**, a student of an arts and crafts studio of glass situated in Denmark, takes a different stand: he tries to objectify his own craft work as 'Craftsman'. To this end, what he does and the meaning that he gives to his work is illustrated by the term *interlacing*. His paper is structured as a student diary of his ongoing activities. In the first part, he exposes his work, which consists of using the patterns of interlacing for glass production. Then he uses the term 'interlacing' as a metaphor or a model to explain his relationship to his work: a feeling of exchange taking place between the objective qualities of materiality and himself. His relationship with other work companions and Glass Masters also becomes "inter(laced)". Finally, he chooses the site of exposition of his work Campus Bornholm in Rønne because it is a place and a social institution that realises interlacing and interweaving between people, skills and life worlds. On the whole, we can say that Aravot's paper helps us to understand how craft activity can be seen beyond its empirical reality, given that the Craft Model (interweaving) can also be a useful epistemic tool for the social sciences. From that perspective, it may take its place next to other models, such as "social bond" or "interaction between individuals".

Previously, Oksala and Orel have introduced the idea of *Craft Culture*, which consists of the simultaneous study of the process of craft productions, objects produced and their users in everyday life. In a similar manner, Marinella **Ferrara** and Shujun **Ban** focus on Craft Culture by taking into consideration recent consumers' and designers' interest in crafting related to Do-It-Yourself (DIY) and the New Makers Culture as it is developed in the Fablabs. The originality of their study is that we cannot talk about Craft Culture without the active participation of women. This is what the authors call the "Women's Maker Culture" and it represent a form of opposition to previous deterministic trends and allows a voice to be given to a larger part of society. This topic will be under analysis historically (diachronicly) and synchronously, by taking into actual globalisation into consideration. Their very absorbing historical analysis of women's role in industrial production takes us back to the First Industrial Revolution of the 18th century and ends in the early decades of the 20th, including the arts and crafts movement. As for their synchronous analysis, after having concentrated on the active role of women in production in European Countries, they enlarge their survey to China and Brazil. Finally, coming back to the women makers in FabLabs, their final appraisal is that despite women in tech being a rapidly growing phenomenon, these women still remain a minority.

Designers' knowledge and the philosophy of artifacts

The historical evolution of craft towards design has also brought new issues about the nature of design knowledge and about the status of artifacts produced by design. In the first section, we have already mentioned the main characteristic of the artisan's knowledge as 'know-how', *(savoir-faire)* and the authors underlined its explicit or implicit transmission. Whereas the papers in this section focus on designers' knowledge, by bringing forth the importance of their *styles of cognition*, especially in different stages of the design process. To better understand the basic change from craft knowledge to design knowledge, we need go beyond the difference between 'knowing-how' and 'knowing-that', and hence re-interrogate the concept of knowledge in a more broad manner. This interrogation was already done by Hintikka by bringing up the distinction *Knowing and the Known*. The distinction that he proposed is rich in content and it also corresponds to a long history of German and French epistemological traditions, as in the distinction of *kennen / wissen* and *connaissance/savoir*. The main debates on knowing (cognition, thinking, reasoning, etc.) in design activities can be rendered better by the title of "Epistemological issues of Design" as it is put forward by design science(s) or by designology. The first two papers in this last section examine two different styles of cognition: the first one being *visual reasoning* and the second being *co-conceptualisation* or co-designing in the processes of designing. The third paper proposes an ontological approach to design cognition and the world of artifacts, through a critical analysis of some classical philosophies of technology.

In their article titled "On Visual Reasoning", Arto **Mutanen**, Tarkko **Oksala** & Mervi **Friman** consider that designers' knowledge involves theories of perception as much as theories of conception. Although this connection of percept and concept can be seen as paradoxical at first sight, the methodological investigation that they propose firmly shows the strong inter-penetration of Visuality and Reasoning. This investigation is done by incursion into many different research areas such as pictorial language; picture thinking; visual style; meaning in visual language; design science and finally architectural languages and reasoning.

In the article, the connection to analytical philosophy is given with the examples from Logical Empiricism and Otto Neurath. His original ideas on visual language contained strong syntactic, semantic and pragmatic character. The system in question provides pictorial instructions for body movements or even hand movements. This has connection to practical conduct and guiding of design in the case of craft, industry or ICT. The study of Visual Reasoning became central in the syntactic pattern study in the 1960s. The paper uses ideas of Jaakko Hintikka like “Possible World Semantics” and the “Semantic Theory of Information” from the same era and goes forward. The study of visual languages happens under design sciences or sciences of the artificial (Simon). The writes also refers here to the theory of artifact developed by Risto Hilpinen and to the philosophy of Technology by Ilkka Niiniluoto. In it, artifacts or tools and fabrication of them with our skills are understood under the notion of man-made manipulation.

Architecture is used as a testbed of the general ideas of the paper. It is multi-sensory and has connections to body and hand. A special dimension in that is prototyping in either a classic or digital manner. Style as a key concept in architecture refers to hand work and the human touch entailed in it. The thinking tool needed in that is described in detailed categories in the text.

The style of cognition which is examined by Carina **Söderlund** & Pete **Evans** is the participatory or collaborative design (codesign). This "designing together", which is developed through the help of the immersive virtual reality devices, also permits the co-presence, i.e., to become aware of the presence of the other team members, while collaborating. This technique can be used to exhibit ideas or products. Furthermore, the users can participate in such digital devices or displays in order to view and interact in public spaces ("museum exhibitions").

The authors take as starting point the temporal continuity in design and study the connections of design and virtual reality (VR) to a detailed degree. The result is quite up-to-date and future-oriented, although the short history of digital simulation is considered. The discussion combines environmental studies in the psycho-social realm. Then the idea of a multisensory approach connects visual space with tactile experience. This idea is enlarged up to introspection in general and as a self-reflective study method.

In their paper, Söderlund and Evans promote human-centred design. In the social dimension, this means the respect of human rights and human dignity. They note, however, that the definitions of co-design are still under development. These ideas should have a central role in design education supported with virtual documentation and museal context. The concretisation of co-design ideas is made in the paper by discussing real, actual or virtual artifacts and their making. VR offers a good study environment for prototyping in principle in a multi-sensory manner. The authors show methods for future studies to analyse the co-operation of the brain with inner and outer dimensions of human experience.

After the two previous papers on the epistemology of design, Andrey **Pavlenko** invites us to an ontology of design thinking and the artifacts. His ontological approach, which is developed by criticising some of the classical philosophers of technology of the early and mid-20th century, is primarily concentrated on engineering design. For the origins of design cognition, he takes us back to Descartes, who made existence and existing objects depending on human thinking. By following this philosophical tradition, it is noted that Ropohl, also considered human consciousness (or thinking) as the source of technical inventions. The opposite of this trend took place in metaphysical reflections on the world of artifacts: the interrogation on the "essence of technology" (Heidegger) left outside the scope of professional knowledge and skills of the designer. In a similar manner, Florensky (a Russian mathematician, physicist and theologian) considered that all culture (including artifacts) can be interpreted as an activity of organization of space: therefore, technology changes reality in order to rebuild space. Finally, commenting on the thoughts of Dessauer brings into the discussion the limited aspect of technical design and technical artifacts: since the technical objects do not exist in the realm of the real, but only in the realm of the possible.

The critical stand of Pavlenko consists of integrating the opposite premises of these philosophers, on the design cognition and the world of artifacts, into a coherent whole by the help of a new concept: "Ontological Propis". This concept, which also helps the author to leap from the classical Philosophy of Technology to the recent discipline of ontology of design and artifacts, wishes to accentuate the basic requirement of *consistency.* Formal expressions (formalised thinking) based on consistency are needed, because thinking and projects are “human-proportioned”: it cannot be arbitrarily chosen by a designer. At the same time, human construction or material realisations cannot be arbitrary; they rely heavily on the world of consistent and only consistent objects and events. The reader who is not familiar with logical formalisations may find his *Ontological Propis* (partially inspired by Von Wright, a Finnish logician) a bit too technical. But in spite of this difficulty, the main intellectual message that Pavlenko wishes to deliver to the discipline of engineering design is very clear: the admitted discrepancy between epistemology of design and the metaphysics of artifacts can be overcome by choosing an ontological viewpoint (in the actual sense of the term). Because after all, the engineer has to control his mental activities with a meta-level of reflection and test the place (or the space) of the artifacts that he has produced with a permanent preoccupation of consistency.

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The book at hand has discussed the persistence of craft and its notions through history having as one focus the turn to the Digital Age. By contrast, the papers have also to take their standpoint to the perpetual *Technological Change* and its *Imperative”* or to the *Myth of Progress* in the words of G.-H. von Wright (4th Aalto-Symposium, 1988 p. 66-). The scientification of design has its roots in Aristotelian tradition. We are working in the case of craft with art as well and may note in the terms of Alvar Aalto “The Passion to Quality”. The unification of “the Art of Reasoning and the pursuit of Passion” is one key theme in the essay of Greg **Andodian**, acting as a synoptic vision at the end of our book. He proposes his personal philosophical view on some of the topics already treated in the previous sections, such as knowledge, reasoning, tools, virtual reality and digital space.

The paper re-reconsiders the thematics of knowledge and reasoning in general from a historical perspective by using the Platonic metaphor of liberating knowledge from the "cave's life". It considers that, through history, the "art of reasoning" had to free itself from four successive caves. The first type of liberation is related to reflective and critical thinking, the second to imaginative and projective spirituality. As for the third type, Andronian refers to innovative and creative vision. And finally, the last one corresponds to artificial intelligence and systems thinking. Here, he considers that man is the creator of his virtual reality and the inventor in his cyberspace.

Human invention is the source of technological change and progress so far as it is under potential human control. This problem is related to the existence and essence of man. Andodian considers this problem in the dimensions of idealism, moralism and realism as connected to the "idea of human rights" [which is also brought up in the paper of Söderlung and Evans]. Art, Architecture and City planning connect the discussion on a more concrete level of design. Themes like mind over body and man over nature lead us to the recent problems, including pollution, suffering and the desires of the health environment.

Art has its roots in mythology and its future in utopia, but in order to fight for the better, we have to note the option of dystopy as well.

Pirjo Seddiki & Mirja Niemelä

From Crafts to Smart and Sustainable Design

The history of design education at Häme University of Applied Sciences (HAMK) is an illustrative example of the development from a crafts school to a design university. Founded in 1885 in Hämeenlinna by Fredrika Wetterhoff, the School of Crafts, later renamed Fredrika Wetterhoff Artisanal Teacher Training College, became Wetterhoff Institute of Crafts and Design during the 1990s. In the early days, the main education goals stressed the development of the cottage industry and, especially, giving women a possibility to earn their own living. The values in the beginning of the school included equality of education, internationality, technical progress and high quality of products.

The first students in the weaving classes were young girls who had been released from prison while the first staff members had an international background. New weaving technology and tools were developed and the resulting products won awards in world exhibitions. The graduated students taught not only in Finland but also in other countries (Laitila, 2015, 68–85.)

Today, HAMK provides design education in the Degree Programme in Smart and Sustainable Design (Bachelor of Culture and Arts, BCA) as part of the School of Entrepreneurship and Business. This education is available both in Finnish and in English for international students. (Älykäs ja kestävä muotoilu). The students can choose major studies in fashion, footwear or glass and ceramics. The education includes work-oriented design and expertise supporting the development of products and services in the design industries through conceptualization, product development, production and manufacturing expertise. HAMK is the only provider of undergraduate level education profiles in the footwear, glass and ceramics design sector in Finland. Focus is placed on project expertise and most of the study modules are implemented in cooperation with business and organizations in the field.

The students of Smart and Sustainable Design can also participate in multidisciplinary projects in HAMK Smart Research Units and Design Factory. The research units operate in international innovation ecosystems. Design research focuses on projects for the development of working life and education in a diversity of fields such as in the health care, environmental or social sectors. Smart and sustainable design can support the wellbeing and health sectors by following the principles of design for all.

The early School of Crafts had practice-based education in different materials such as textiles, clothing, knitwear, fur, footwear, glass, ceramics and industrial products. The education focused on art studies and utilized well-equipped workshops. In the first semester of studies there was also a preliminary course for all students in the spirit of Bauhaus *Vorlehre*. As a part of the school's curriculum national heritage was studied by the means of ethnographic field trips during which folk craft items and techniques for making them were collected. The values of local culture, homely materials and entrepreneurial citizenship were subjects of wider cultural political ideas (Kraatari, 2013).

These same values can be recognized in the Sustainable Development Goals (United Nations 2016). HAMK has developed a sustainable development program in 2020 (HAMK 2020). The program lists several objectives and measures to strengthen the sustainability of the university's activities in education, research and everyday activities. However, sustainability has been included in design education already for a long time. By following the Smart and Sustainable Design education the students are encouraged to take a critical approach to their design work.

The key competencies the designer achieves in the degree programme include material knowledge, production and service competencies, entrepreneurial attitude as well as life cycle thinking.

According to a report on the Finnish design sector (professional designers) (Ornamo, 2019) 89% of the survey respondents found climate change and circular economy either important or fairly important. Knowledge on outsourcing and materials, the environmental impacts of processes and socially conscious business models are core content of design education (Bertola, 2018, 10–11). Environmental and global issues concerning cultural, social and ecological sustainability form the goals for design education at HAMK.

Ezio Manzini's (2013) well-known concept of new models for sustainable production and economic systems; small, local, open and connected (SLOC) is suitable for the development of the design field although the concept was originally developed for the purposes of social innovations. A study by Sitra, the Finnish Innovation Fund from 2016 in four countries (Spain, Germany, Finland and USA) discussed the changing relationship between people and goods and indicated that enterprises with a purpose would be the winners in the future (Korkman & Greene, 2017).

Many alumni from HAMK design programmes have started their own business. To start with, these companies have had a small-scale design driven craft-based production in local workshops and studios. To keep the production local is becoming harder and eventually impossible with the volume of production increasing. Such companies are trying to find new business models to support sustainability globally. Instead of increasing production of new products these brands are looking for alternative ways of doing business. They concentrate on the longevity of products or recycling both materials and products or on new smart technologies in production.

The important core of design education at HAMK means working in studios or hands-on learning environments. There are several arguments defending the "studio culture" in design and architecture education. The studio is a complex learning environment. It includes collaborative workshops, peer-to-peer learning, blends of asynchronous and synchronous teaching, flipped classroom exercises, experiential learning or live projects with real clients. It is a place for experimenting, even playfully, for creating, analyzing and exchanging ideas. At its best the studio culture provides a safe and inclusive environment in which students can take risks and increase their confidence. (RIBA, 2020, 4.) In the studios working with different professional materials is essential.

"New Materialism" or the material turn has been launched as a concept in social, cultural and artistic research in the past decade (Barad, 2003; Bennett, 2010; Dolphijn & van der Tuin, 2012; Smelik, 2018). It incorporates interaction with the material world and human beings while showing care for both. From the smart design perspective, it even means understanding that materials can have agency as intellectual matter in technological or biological spheres.

Designers must have an understanding of the whole life cycle of products as well as the production chain with different stakeholders. Without deep knowledge of the materials it is impossible to understand the stages of the life cycles of products. The customer or user forms the core of design processes. User information is discovered through co-design processes.

The curriculum does not encourage drawing designs for some objects to be produced ´´somewhere out there´´. Visualizations, such as drawings, serve for communicating abstract concepts in design teams or among stakeholders in projects or to make ideas visible for the designers themself.

It is intriguing to recognize the same features in the early Wetterhoff School of Crafts education and today´s sustainable and smart concepts in the design field. Local production, the knowhow of making, understanding of materials and aesthetics of local cultures, small scale production in small companies as well as social awareness were all present in the late 19th century. This ongoing trend continues today and will shape the future, as well.

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I
CRAFT KNOWLEDGE, DESIGN AND ARTS

The interior of Hattula Church contains medieval illustrations of the stories given in the Bible manifested in the form of naïve and lovely hand-paintings. (Photo: Tarkko Oksala)

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Tarkko Oksala & Tufan Orel

On the Persistence of Craft

Despite its Ramifications as Technology, Fine Arts and Design

Past times: are we reactionists, then, anchored in the dead past? Indeed I should hope not; nor can I altogether tell you how much of the past is really dead. I see about me now evidence of ideas recurring which have long been superseded.

– William Morris, The Arts and Crafts of To-day, 1889

Introduction

This paper proposes to highlight some of the most crucial historical moments in the continuity and the persistence of craft culture. After its ramification as technology and fine arts in the 18th century and as design in the mid-twentieth century, craft loses its importance, not only in the modes of production, but also in the relations that we have with objects of everyday life. Yet some robust signs indicate that craft is still vivid today in production as well as in our daily lives. It has managed to continue to exist by other paths, as will be explained in this paper.

This paper has a theoretical frame which is followed by a case study: it is especially consecrated to Finnish culture and experience. — The theoretical approach itself is divided into two parts. In the first part we will pinpoint some important dates of craft culture since its origin in Ancient Greece until the 18th century. Afterwards we try to show how Technology, fine arts and design have obtained their autonomy by gradually distancing themselves from the craft. The second part is on the three major figures by which we can detect the persistence of craft culture today: hidden craft, ambient craft and manifest craft.

The aim of the case study is to test the theoretical frame presented earlier in which know-how in craft is divided into hidden, ambient and manifest forms. As a case we consider here the development of craft culture since 1900 in Finnish architecture and design in general. Detailed historical remarks are made in the first half of 20th century. The second half is discussed concerning general trends mainly having some relevance up to the global problems of today.

Art Nouveau came into Finland in the end of 19th century. The Finnish Pavilion in the Paris World Fair 1900 was the most famous sign of that. Many important works after that represented National Romanticism but continental inspirations became on agenda very soon. Arts and Crafts movement fitted very well with both competing style directions. The position of craft in design changed dramatically when modernism and the new wave of industrialization took command. Finland got very good start in functionalism and Finnish Design become a trademark besides Scandinavian style. Postmodern trends challenged markets since the sixties also in Finland both in practice and in design study or discourse.

Hidden or tacit craft knowledge had its roots in the long design tradition of Finland and even education was practice oriented until the fifties. Many successful organizations around industrial design were established. In this phase craft had its ambient position. In the sixties systematic design fitted with industrial action and changed the situation dramatically. The division between arts and crafts and industrial design was sharpened in design politics. Today design knowledge is opened and expressed in programs and manifest form, having some important historical predecessors.

I

According to a standard definition, “Craft (what *ars* means in ancient Latin and what *tekhne* means in Greek) is the power to produce a preconceived result by means of consciously controlled and directed action” (Collingwood, 1938, 15). We particularly take note of the idea of power in this definition. Considering craft as power certainly illustrates one of its most important features. But it is possible to enlarge this definition with the term craft culture. This consists of conceiving craft not only as *a process* of production — where power comes into play — but also as the *result* of this process: the *oeuvres* or the craftworks. What is more, we can also include the users of these craftworks when we talk generally about craft culture.

Instead of just giving a formal definition of craft and craft culture we should look into the different significations that were given to craft and the various debates that it has aroused since its origin in Ancient Greece until the 18th century. Moreover, we propose to show in this first part of our paper how craft and the craft culture have disappeared in the 18th century by gradually leaving its place to technology, fine arts and design. The persistence of craft in our time will be discussed in the second part of the paper.

Herodotus (5th century BCE) is one of the first to mention the importance of craft from a historical perspective. By mixing some elements of mythology with historiography, he considers that craft is a domain of technical competences (*tekhnai*) which is as important as the domain of honors (*timas)* obtained by heroic acts. More specifically he states: “Hesiod and Homer I suppose were four hundred years before my time and not more, and these are they who made a theogony for the Hellenes and gave the titles to the gods and distributed to them honors and arts." (*Historía, B*ook 2: Euterpe § 53)

Later on, the Sophists accentuated the cognitive aspect of craft (*tekhne*), but they extended its domain of application from the physical world to the social world. According to Protagoras, in the human world, *tekhne* was necessary for vital needs. But its apprenticeship was not required to all, "that is why the arts were distributed in a such a way that one man, an expert in the art of medicine, is sufficient for many laymen", but the "cities cannot be formed if only a few have shared a (social) *tekhne*". (Plato, Protagoras, 322, c; for a more general view on the relation of Plato with the sophists see Guthrie, 1971, 265 and sq.)

In the 4th (BCE) century Plato does not show a special interest towards craft knowledge (*tekhne*), privileging instead the rational knowledge: *episteme*. But according to the Finnish philosopher and logician Hintikka, Plato sometimes considers *episteme* and *tekhne* as synonyms. (Hintikka, 1974, 31–40) For Plato craft means the action of fabrication (*plattô*) (Brisson, 1994, 51). However, he will consider this activity as a subaltern occupation because in his profession, the artisan is not aware that the models he uses to fabricate objects are in reality models *(idea*) of the transcendental world. As for artistic creations such as the statues of Phidias, they are just imitations (*mimesis*) of nature and they do not represent the real idea of beauty. Plato applies the criterion of beauty to the ethical sphere (conducts and persons) where he relates *kalon (*good*)* to *kallos (*beauty*).* Furthermore, he distinguishes *poíesis* from the action of making*, plattô,* by saying : "only that portion of the art (craft) which is separated off from the rest, and is concerned with music and meter, is termed poetry *(poíesis)" (Symposium- 205c).* Yet this does not fundamentally change his position on the matter. The word *poíesis* in its literal sense means giving birth or creation and Plato also makes an ontological claim through this word: "Everything which passes from non-being to being is *poíesis."* But this formula is also not associated with any aesthetic considerations. We have to wait for the artistes of the Romantic period for aesthetic values to be assigned to creation (*poíesis).*

This speculative idea of beauty applied to the ethical sphere, kept its importance during many centuries (Tatarkiewicz, 1972), including the Hellenistic-Roman period (McMahon, 2009). It gets dethroned, however, by the emergence of the *sensual* considerations of beauty, notably applied to physical objects. Such considerations will be promoted by the English empiricists and will play a major role for the birth of the *beaux-arts* or the fine arts in the 18th century.

Aristotle gives more importance than Plato to craft activities. In his theory of the "Three ways of living (bios)", he considers craft activity (*poíesis*) as important as *bios theorètikos,* and *bios praktikos*, (*Nic. Eth*. 1095b). The main purpose of *poíesis* is the production of material objects and the result of this production is a *poiema* (what is *made)***.** But in his book called *The Poetics*, poiesis will have a new signification: it will be related to artistic production (*Peri poietikès)* and will mainly deal with drama: more precisely, the representation of human action (*mimèsis praxeôs*), or "what is done**"** on stage**.** This doing, or making (*poïeîn),* on stage is rendered either by the word *dran (*which is a Dorian word and from which—most probably—comes the word drama), or by the word *prattein*—used by the Athenians (*The Poetics,* 48 a30**).** Also, like his mentor Plato, Aristotle did not confer any aesthetic criteria, in the modern sense, to 'poetic activities'. According to him, the criteria of beauty, such as order and symmetry, do not belong to art but to mathematics (*Metaphysics*, 1078b*)*. Nevertheless, he uses incidentally the word *beauty* in *The Poetics* when he considers that the range or the extent of a plot (*muthos*) should not be too long or too short. This idea of magnitude (*megetos*) which Aristotle seems to attribute to beauty is still not related to our modern understanding of aesthetics, but to his legendary idea of the "golden mean": an idea that he *also* used for the scope of a city: a city must not be too big or too small. In his *Metaphysics,* Aristotle promises to reveal more about what he considers to be beauty, however, his promise is never realized.

Beside its importance for Art Theory, the *Poetics* of Aristotle also has an important role in elucidating the complex idea of craft. On the one hand, craft is a knowledge (*tekhne*) but on the other hand, craft is the power to produce material or artistic objects: it is a *poietike*. According to Aristotle, to consider that craft exclusively uses *tekhne* can be misleading, because craft productions can sometimes be based on habit (*Poetics*, 47 a 20) or on inspiration. It is only in specific cases that craft can use a sophisticated expert knowledge which is *tekhne*. As for the idea of power, craft is related to active power *poietike* (see also *Metaph*, 12 1019a 15) and not to potential power. In one sense, it is possible to consider the emergence of design in the modern times as relative to the importance given to the potential power. In other words, before the embodiment of a product (active power) there exists both conceptual phases (planning, designing) and representational phases (schematizations, blueprints, etc). It is these pre-embodiment phases that we can place in the category of potential power. We can also note that for Aristotle, the potential power to build a house is in the mind of the architect, but Aristotle of course ignores today's design processes. All the complexity of the contemporary virtual stages of design (conceptualization, planning, schematizations etc.) could not have been considered by him. [See also some interesting remarks of Hintikka (1974, 41–43) on "The Paradigm of Craft" related to Aristotle and Plato.]

This complex idea of craft encountered in *The Poetics* of Aristotle can be illustrated with the help of the following figure:

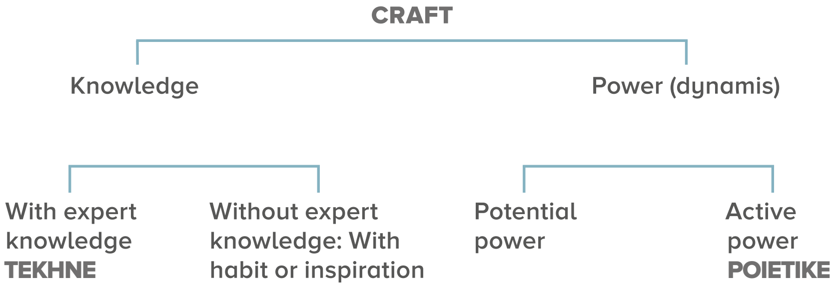

Figure 1.

Some modern philosophers like John Dewey have remarked that Aristotle's affinity with craft is not limited to his *Poetics*. Dewey considers that we can also find some reflections on craftsmen in the very foundation of Aristotle's metaphysic of "four causes":

- What to produce? (formal cause),
- For whom and for what purpose? (final cause),
- How will the production be done? (efficient cause),
- What should the product be made of? (material cause).

Dewey (1958, 92) makes this point of view particularly explicit when he says: "The Aristotelian conception of four-fold 'causation' is openly borrowed from the Arts".

Moreover, concerning the *formal* cause, Aristotle does not attribute any affinity between the formal cause and aesthetic preoccupations. It is only much later that the formal cause is related to aesthetic values by the peripatetic philosopher, Al-Farabi (10th century). For example, when speaking of a glass he specifies that, although the shape of a glass is printed in its material substrate, the fact that the glass is transparent is "to bring out the beauty of its content" (*Kitab Ihsa' al-'ulûm).*

Another crucial moment in the evolution of the idea of craft is the separation of professions into the categories of *liberal arts* and *mechanical arts*. Within this classification, Craft finds itself in the category of mechanical arts (*Artes mechanicae*). In the 2nd century CE, the philosopher and physician Galen was one of the first to propose this distinction. In his own words, "The professions are divided into two categories. The first comprises those in the domain of intelligence, called the honorable or the liberal arts; the second, those demanding manual labor, called the illiberal or mechanical arts". (Galen, 1930, 529)

Subsequently, the old Greek formula of craft (Craft = tekhne + poietike) will start to become gradually replaced by the common Latin word *ars*.

In the 6th century, Boethius considers liberal arts as constitutive of four disciplines (*quadrivium):* music, arithmetic, geometry and astronomy. In the 9th century, three other disciplines (*trivium)* are added: grammar, logic, and rhetoric. It is interesting to remark that music at the time was still considered as a theoretical discipline, as a liberal art, and not related to creation or composition. This tendency will mainly be reversed after Monteverdi. As for the mechanical arts, during the same century Johannes Scotus Eriugena divides it into different practices: tailoring, weaving, agriculture, architecture, masonry, military arts, trade, cooking and metallurgy.

The *artes mechanicae* of the Middle Ages is still exercised with an artisanal spirit, although some craftsmen, such as Villard de Honnecourt, will go beyond this tradition by developing sophisticated techniques of drawings for architectural designs (plans, elevations and detailed descriptions), such as figures in his famous *Sketchbook*. However, for the modern drawing techniques of architects and engineers to emerge, we must wait for Gaspard Monge to invent descriptive geometry in the late 18th century (see Finch, 1960, 86–89 and Orel, 1993, 121–150).

After its transformation into mechanical arts, another crucial epoch for craft tradition is the Renaissance period.

From the point of view of modes of production, the major transformation of that period is the passage from the closed system of guilds to a more or less open system of corporations. This concerns for example, groups of sculptors and painters who came together in workshops around a well-known master, like the Verrocchio's workshop in which Leonardo participated. Now the main aim of Artists (or proto-artists) like Leonardo is to liberate themselves from the status of workers of the mechanical arts. The best term to be used for this new status of these artists-craftsmen is *virtuoso* or as Vasari (1550) mentions: mannerly virtuose craftsman, *costumato e virtuoso artefice.*

Another important moment in the Italian Renaissance is the writings of Zuccari, especially the *Idea de'picttori, sculptori ed architetti, published in 1607.* The Idea of Beauty inherited from Plato, whereby beauty is considered to be in the Intellect or in the mind, and applied to human action and characters, now becomes the subject of re-interrogation. The question thus becomes: can this image of Beauty, which is in the mind (harmony, symmetry, proportion, etc.) and also holds a spiritual value, be projected to the physical world as a picture or an architecture? It is with such questioning that Zuccari develops the notions of *Disegno interno* and *Disegno esterno,* whereby artistic creations are considered to be the externalization of the (spiritual) inside design. Hence, Zuccari opens a new perspective in which the spiritual idea of Beauty can be transferred to the experienced world of objects.

Nevertheless, the idea of *Disegno interno* was not completely ignored by Renaissance architects, although in contrast with Zuccari, they did not attribute any spiritual values to it. For example, Alberti (1485) in his famous book *De re aedificatoria,* considers that "We shall call Design a firm and graceful pre-ordering of the lines and angles, conceived in the mind and contrived by an ingenious Artist" (Alberti, 1775, p. 2). Yet the main contribution of Alberti to Design thinking and architecture is found somewhere else. By reactivating the basic concept of the Roman architect *Vitruvius,* such as *Voluptas, commoditas and necessitas* (aesthetic look, usage and efficiency concerning a building) he orients the main aesthetic and design goals of fifteenth century architects (along with those who followed), and he also proposes some basic criteria for urbanists. It is worthwhile to mention that in his revolutionary work, Alberti does not refer to Vitruvius by name. This may reveal how in the Ancient world the engineers were considered as Craftsmen: they left behind them their *oeuvres*, and not their names.

By the 17th century craft is definitively identified as art. For example, Descartes (considered as the father of modern technology), in his project to become "like masters and possessors of nature", ("*nous rendre comme maîtres et possesseurs de la nature*", Discours de la méthode, part 6, 128), still refers to the word *art* as a method or process used to transform nature. Using the word *art* for mechanical arts will still be common in the 18th century, especially in the French tradition. For example, Diderot deals especially with the Mechanical Arts in his article of the *Encylopédie* entitled "Art". (Diderot, 2015, 82–101)

The 18th century can be considered as the most important turning point in the destiny of Craft, as during that century, Craft will gradually leave its place in favor of *technology* and *fine arts*.

It is during the 18th century that the knowledge or the *savoir-faire* of artisans becomes organized as objectified technical knowledge. On this subject, it is important to remember that for the *Encyclopédistes*, society now possesses an unalterable memory of *technical knowledge* and that, as d'Alembert (1759) states, it is a "system of knowledge that can be reduced to rules: positive, invariable and independent of caprice or opinion".

In 1777 Johan Beckmann coins the word *technology*. By this he means "the science of techniques", or more precisely: "Technology is the science which teaches the treatment of natural products or the knowledge of the trades". (Ropohl, 1984) The legacy of this terminology in the 20th century will be a permanent source of discord in the academic milieu. Beckmann's term does not seem to have any great effect on the Anglo-Saxon culture, since the English word technology refers mainly to machines or devices and not to "the science of techniques". On the contrary, contemporary French scholars will prefer Beckmann's definition of technology. Regardless of current academic disputes, what is the key for our topic is that in the 18th century, the long tradition of Craft is finally buried, in favor of technology. But the destiny of the *artes mechanicae* will still be in suspense. *The mechanists* still have to struggle before they become themselves accepted as *engineers*.

Another important event in the 18th century is that the speculative idea of Beauty, inherited from Plato and Aristotle, will undergo a profound transformation. With the influence of British empiricists such as Salisbury, Addison, Hutcheson and Hume, the idea of beauty now corresponds to *sensuality* or to sensual perception, as we experience in our relations with the objects of the physical world. The French politician and philosopher Victor Cousin proposes an eloquent summary and synthesis of the British sensualists and their aesthetic theories in the 19th century (see Cousin, *1858).*

In 1750 Baumgarten coins the word *Aesthetics*. Originally the idea of *Aesthetics* is closely related to epistemology, in the effort to promote a new mode of knowing or a new type of knowledge, called aesthetic knowledge. However, under the influence of Kant, it will be considered as a taste and/or a commonly shared feeling in front of objects of art (*sensus communis*), and appreciated with a *disinterested* attitude (Kant, 1790 § 2 and § 20). Yet, and most importantly, in 1764 Winckelmann establishes the first idea of the system of *Fine Arts*. (See Kristeller, 1952; and Rancière, 2011.) From that moment onwards it becomes impossible to talk about art independently of aesthetic values. But the system of fine-arts established by Winckelmann is not exactly what we today call fine-arts. Some artistic disciplines like music and ballet will be added much later on.

In the 18th century the role of Diderot is primordial for the constitution of the "System of Technical Knowledge" as well as for the *Beaux-Arts*. As an *Encyclopédiste* he contributes to the storage and the cataloging of craftsmen's knowledge (savoir-faire), and is mainly responsible for commissioning special drawings or boards which clearly indicate the artisans' skills and gestures in real work situations. Diderot will also be the first art critic in France (see Seznec, 2007).

During the *first* industrial revolution in the eighteenth century, as trades passes to the manufactures, a certain awareness of design also appears. In Wedgwood, an English manufacture of porcelain and faïence established in 1759, the new workman — the designer — is now paid twice as much as the ordinary craftsman, and his job consists mainly of drawing designed objects according to market demands: differentiation of sex, social classes and age groups (Orel, 2016a). But design, in order to constitute itself as an autonomous discipline, still has to wait until the 20th century for its full development.

Beyond the emergence of the term "technology" and the early simmering of design culture in the manufactures, there exists another important moment during the 18th century: the appearance of what can be called the inventors-craftsmen, or the proto-engineers. Among these engineers, we can mention the names of Thomas Newcomen (atmospheric engine) and James Watt (steam engine). But the birth of the new engineering profession becomes the subject of different debates and interpretations. For the common understanding, these engineers were simply mechanists in the tradition of *Artes mechanicae*. But for some others, like Vico, they were more than that. Giambattista Vico (1710) in his essay, "On the most ancient wisdom of the Italian", seeks the origin of the term engineer, in a concept that belongs to a mental process. For him the term *ingenium* denotes the ability or the power to "connect diverse and separate elements". And he considers that this mental operation is not only related to *efficiency* (adjustment, functioning) but also to aesthetic values, since the engineer seeks to obtain a "beauty of proportion".

We can even argue that, despite the gradual disappearance of craftsmen, the very first scientists of the 18th century were more or less in the craft tradition. For example, Faraday, who received little formal education and had a limited mathematical background, managed however to invent electromagnetic rotary devices. We had to wait much later for his inventions to be based on a definite scientific principle, which is established by Maxwell ("A Dynamical Theory of the Electromagnetic Field" published in 1865).

Recently, Paul Forman has remarked that the classical distinction between science and technology has become less important today. According to him, the historical discourse on science was important during the era of *modernity* (Enlightenment, the industrial revolution, and the formation of nation states) whereas in the *post-modern* age (he situates it around 1980) the discourse on science loses its predominance to technology. Or as he puts it more bluntly: "*postmodernity is when science is subsumed under technology"* (Forman, 2007). From this perspective we can argue that today's technology (in the information or the digital age) has not only absorbed the craft tradition, not only the mechanists, the inventors-craftsmen and the engineers, but has also absorbed three centuries of scientific tradition.

In the 19th century when craft seems to be sent to the remnants of history — since it is absorbed on one side by *technology,* and on the other side by *fine arts* — craft makes an unexpected reappearance during the rapid industrialization of Britain. But craft will not be all alone in its reappearance — it is *partnered* with fine arts.

In the heydays of rising capitalism, the new factories and their normalization and uniformization of human gestures and tastes, create a counter movement: The “Arts and Craft Movement” of William Morris and Mathew Arnold. In that century of revolutions, the craft problem resurfaces.

At the same time, the “distant drums” of design start to approach Europe. Oscar Wilde plays an important role concerning the reception of this new trend into England in the 19th century. Although he has defended the cause of craft in the UK, as a sympathizer of socialism and as a friend of W. Morris (Wilde, 1969, 1079–1104; Wilde, 1913, 109 sq.) he will be the publicist of design after his visit to the United States. (Wilde, 1913, 157 sq.) The arrival of American design into France will be much later, mainly promoted by Raymond Loewy during the 50s. This American industrial designer of French origin who was well publicized by the cover of Time Magazine (Oct. 31, 1949 issue), will have an immense success with the French translation of his famous book, Never Leave Well Enough Alone (*La laideur se vend mal*).

But before design declares its full autonomy, it remains in a state of compromise; pulled between the general issues of technology and fine arts on one side, craft and fine arts, on the other side.

At the time when household devices are becoming totally mechanized, (Giedion 1948**),** design activity gets involved in “Work-saving objects”, where ergonomic criteria were mostly dominant. In the mid 20th century, design tries to find itself a place between fine arts and technology, and for some time it will call itself, especially in France, *Esthétique Industrielle*.

When design gives a special importance to *Form* in the beginning of 20th century, movements such as Art Deco, De Stijl, Vorticism, Futurism and Bauhaus emerge. In these movements design had to comprise with the *fine arts* as much as with c*raft* by considering itself as *applied arts*.

More recently, was the attempt of design to liberate itself from “technology”. At the end of the 20th century, the project of design’s full autonomy is encouraged by the writings of Herbert Simon, the Nobel Prize winner in Economics. In his book *The Sciences of the Artificial* (chap. 5), he proposes a larger conception of design: “Everyone designs who devises courses of action aimed at changing existing situations into preferred ones”. In relation with this project, he considers that “designers” are not only engineers and architects, but also managers and social planners. Today, to this larger understanding of design, we can add also the workers in Informatics (software design) and in A.I. (robotic design). In close relation with this broad understanding of design, we can also mention a recent domain of research called *designology* (Gasparski & Orel, 2014), which proposes to unify different forms of design knowledge and design practices, into a coherent design *discipline*.

To summarize, whereas craft had been at the common core of technology, fine arts and design, by the end of the 20th century, each of these three domains of activity had become an autonomous discipline. But in the meantime, what has happened to craft? Did it really retreat from the historical scene? In these early decades of the 21st century some significant signs show that it may not be case.

To demonstrate the actuality of craft, we will first give a few snapshots of signs that point to the continuing persistence of craft, followed by the proposal of an analytical approach that will enable us to elucidate the complex and contemporary persistence of craft.

The Actuality of Craft: Some Snapshots

Taking examples respectively from the domains of Design, Fine-Arts, the craft production of the layman, and consumer sensibility towards craftworks, this section will illustrate few aspects of today's persistence of craft.

Craft & Design Process: Some signs suggest that the idea of craft as knowledge or as skills persists inside the design profession. Recent scholars have more or less accepted that the so-called *tacit* knowledge in design activities could have some relation with craft. (Sennett, 2008, 72–74) Under the influence of the philosopher Michael Polanyi, (Polanyi, 1962) instead of designer's knowledge being considered as completely objectified, it was commonly accepted that in design activities and processes, a *tacit* (or an implicit) knowledge exists. To give a general idea of what tacit knowledge is, we can start by stating that it is a certain number of shared values of the discipline concerning the making processes. These values are considered to be unconscious or pre-conscious and they are not formulated in a propositional or written form, but nevertheless present themselves as an "invisible chart" to which designers refer intuitively or quasi-instinctively whilst exercising their profession. Studies on *tacit* knowledge in design originally began in the late 20th century and continue to be important today. But relating tacit knowledge so rapidly with craft risks to only be a lip-service to craft, and therefore needs further analysis.

Craft & Fine Arts: Modern fine arts refer to certain qualities of craft culture, such as work or dexterity. Since the development of conceptual art (since Marcel Duchamp) and what is today called "contemporary art" (McCarty, Jeff Koons, etc.), the artist increasingly plays the role of a "manager" at the head of a new financial system (art business) where the ideas of oeuvre, work and *démarche* become obsolete. Even the distinction of painting, sculpture and engraving do not exist anymore: the contemporary artist is just a *plastician*. In reaction to these recent transformations of fine arts, some art critics, such as Aude de Kerros draw our attention to dissident artists whom they frame as partisans of the "True Art" : those who still know how to use their *hands*, how to *grip* the materials in their artistic creations (Kerros, 2016).

Craft & the Layman's Productions: In the late 20th century some economists and social scientists observed the development of a new type of craft activity, which is independent of industry and the service sectors. To these craft activities, exercised by the laymen – i.e. by the people who did not necessary had a formal craft education – different labeling was proposed: "proconsumerism" (Toffler), "self-service economy" (Gershuny), "invisible economy" (De Kerorguen), "autonomiques"(Aznar) and "domestic economic activity" (Gorz). The common term by which this new trend of craft is better known today is the "Do It Yourself" (D.I.Y.) activities or productions. The most recent developments of D.I.Y. show that these craft activities can be helped by modern technological devices like "3 D Prints" and the generalization of "Fablabs". According to some prospective views, the results of these auto-crafting activities are susceptible to change the nature of today's products, due to the affective and personal elements involved in such productions.

Craft & the Consumer: As a last example we may refer to a recent *craft sensibility* which can be detected in the attitudes of *consumers* towards objects of daily life. This sensibility already existed as a cultural specification in some counties like Japan *(The Folk Crafts Movement).* But today an emerging craft sensibility can be observed in many Western countries, posited as a counter movement to the frenetic globalization of the world economy. Regardless of which craft production (ethno-design, proxemic-design etc.) triggers this new craft sensibility, it shows that actual consumers wish to be surrounded by artisanal objects. We suggest that this is something else than to live in a technological or digital *environment* (connections between household devices, for example*),* as it is more like living in a natural *milieu,* where the relations between consumers and artisanal objects represent a harmonization or a natural composition, such as between a bee and a flower. This new sensibility for crafted objects is seen as a means to better master one's individual space and time. This is manifested in practices such as, the preference for locally crafted objects instead of standardized global products, and having freedom in one's own rhythm and use of daily objects, instead of "fast" consummation.

II

In the first part of this article (theory) we have observed the stability and continuity of craft tradition until the 18th century. But from the 18th century onwards, we noticed its ramifications as technology, fine arts, and later on, as design. Yet, we recognized some current "signs" of craft which could persuade us of both the vitality and the persistence of craft tradition today. But should we be contented only with these "signs"? If we scratch the surface, the persistence of craft seems to be a much more complex affair than what it *appears* to be.

In order to go beyond these simplistic observations of craft-signs, we propose a more analytical approach for the rest of our study. This consists of referring to ***three distinct figures*** by which we can detect the complex persistence of craft tradition in our own actuality. These figures are: 1) *hidden* craft 2) *ambient* craft, and finally 3) *manifest* craft.

The Hidden Craft

We can identify the hidden craft by its three major characteristics.

Firstly, we need to study the *cognitive* aspect of hidden craft.

According to the partisans of *tacit* theory in design studies, there exists a kind of knowledge which is not based on objectification, i.e. application of commonly accepted concepts, rules and laws during the processes of making or production. In a sense their approach to tacit theory is framed by *negativity*. When they take away all the objective or manifest aspects of design knowledge they come to the conclusion that there must be tacit knowledge. But what is tacit knowledge? Isn't it another way to say that there is "X knowledge"? But what is the content of this X knowledge? Looking at this issue from our perspective, i.e. with *positivity*, we can consider this X Knowledge, this tacit knowledge, as a "residue" of a distant past, a *tekhne*. In other words, it is a knowledge inherited from the artisans of the past, despite the fact that design had become autonomous from craft many years before.

What we consider as a residual aspect of craft knowledge, may also correspond to – as some phenomenological thinkers, like Searle, presuppose the back-ground competence: According to Searle "Some of one's capacities enable one to formulate and apply rules, principles, beliefs, etc., in one's conscious performances. But these are still in need of Background capacities for their application" (Searle, 1992, 190). To us, this seems like a significant avowal: the background competence is power. It strongly reminds us of Aristotle's concept concerning craft: craft is an "active power" (*poietike*), it is the power used for the *execution of an oeuvre*.

Yet, the phenomenological thinkers do not *explicitly* admit the presence of craft tradition in tacit knowledge or in background competence. Furthermore, they think that tacit knowledge and background competences work perfectly well in all its components. Their operations are ready to provide practical solutions to the objectives of design. Our understanding of the "residual" is that craft competences are not transmitted as a whole: they are not intact in their transmission. They are in fragments or in shreds, and sometimes their absences can be filled in by the elements (rules, principles, finalities) of the profession *under* which this silent craft operates.

Concerning the nature of these fragments we may refer to an ancient distinction made by the craftsmen: *finis operis* and *finis operantis*. "*Finis operis"* consists of following and applying the right craft rules in order to create or fabricate an object. I.e. if I follow such and such rule I will have a final work which is realized as a consequence of my operative acts. Whereas, *finis operantis* is the finality of the craftsman himself: it consists of creating or fabricating an *oeuvre* with positive values: a unique, perfect, resistant, usable, etc., oeuvre is to be made. So, from the perspective of craft transmission it is possible to say that some of the fragments in this residue may be washed away, whereas some others remain when they operate underneath design activities. For example, if the operational rules or principles are absent (or feint) in this residue, the ideal of a perfect oeuvre may still, nevertheless, be active. If it is the case, then the finality of the perfect oeuvre can be considered not inherent to design professions, but as a residual fragment of craft tradition. In this sense, the rhetoric of "quality", "durability", etc. of a product that we often find in today's design discourse can also be attributed to this residual aspect of craft's finality. [For the origins of *finis operis* and *finis operantis* see St Thomas Aquinas, Commentaries on the Book of Sentences of Pierre Lombard, IV Sent, dist. 16, q. 3, art. 1 and Jacques Maritain, 1965, 124].

A second characteristic of hidden craft is its *secrecy*. This archetype of craft tradition is related to the secrecy of the profession: a *savoir faire,* a know-how, not to be revealed to competitors. The partisans of tacit knowledge have hardly considered the concept of *tacit* from this perspective, despite the fact that the literal meaning of the word *tacitus* (from which comes the word tacit) is "that which must be kept silent".

In 1931 the famous German historian Oswald Spengler made the following prediction: European countries, "instead of jealously guarding for themselves the technical knowledge which constituted their best asset (...) offered it with complacency to the whole world (by exporting) secrets, processes, methods". He goes on to say that it is this transfer of know-how that would be responsible for" the annihilation of the European economy" (*The Decline of the West* (1918)). Although Spengler was referring to the necessity of the secrecy of the technical knowledge of his time (process, method), in this reflection he shows that he was still thinking within the mentality of the craft tradition: he was trying to rehabilitate the secrecy-instinct of the artisan "in-bedded" in technological knowledge.

On this point, Spengler was certainly not wrong, because the very idea of secrecy is inherent in the word craftsmen. In the Middle Ages, the common name for craftsmen was "Mystery-Men", (a word driven from *ministerium).* Even in the 16th century, Francis Bacon used the same word when he talked about craftsmen in his *The New Atlantis* (See Orel, 2016b).

A third aspect of hidden craft is its capacity to be *spontaneously* inventive.

This aspect of craft knowledge or skills invites us to think about craft not always as a routine or as a fixed cognitive activity. It can also be at the source of inventions. During the 14th century when the Latin word *Ars* (craft) gradually left its place for *Art,* especially in a regional language of France, *(Langue d'oï*l*)* the craftsmen gave it a secret meaning. When the word A.R.T. is read backwards), it represents the motto of the craftsmen: **T**rouve (invent). **R**ealize. **A**dapt. *Trover or Trouver* means to find, to compose, to invent or to discover, and it is the *langue d'oïl* translation of the Latin word *tropare*. The word *Trouvères* was also used for the troubadours of the North regions of France: those who invent a song or compose a poem.

But let us continue with the recent history of technology for our examples of creative craft. We have already mentioned the case of Faraday and his craft-based invention of electromagnetic devices. We could also talk about Edison in a similar way. As for today's creative craft taking place under technology, we can mention Roland Moreno (inventor of the computer chip used on smart cards) and the Noble prize winner in physics, Pierre-Gilles de Gennes, who not only considered himself as a "craftsman" but also founded the "Workshops for technical creation", open to the general public.

However, when we talk about this subject, we must clarify that we are not referring to "rational reflections on inventions", but to spontaneous inventions. This opposition can easily be understood, for example, by the oppositions of terms such as creativity/creation; inventivity/invention innovatics/innovation. For the "rational reflection on invention" we can go back as far as the writings of Ramon Lull (*Ars Magna*, 1305) and Leibniz (*De arte combinatori*, 1691). These kinds of reflections had their source in the tradition of *Artes liberales* (and later in mathematics) and not in the tradition of *Artes mechanicae*. For a long time, research on spontaneous inventions of craftsmen was limited to case studies. But today some research fields tempt to discover the general principles behind these spontaneous inventive acts. On this, the most recent studies on "Serendipity" can be considered as a promising avenue for research to better understand the presence of craft tradition in inventions, and in the domains of technology and science (See Orel, 1985). Finally, it's worthwhile to remember that all these inventions take place underneath the rubrics of technology or science, and are not presented in an overt fashion, such as an "inventors fair". Therefore we have considered them as one of the main characteristics of hidden or silent craft.

The Ambient Craft

By "ambient craft" we mean the presence of craft traditions which are apparent but are taken for granted, because craft does not manifest itself as an *autonomous* act, but on the contrary, appears mostly in connection (composition or co-mixture) with other competences or techniques. These kinds of craft events neither send a strong craft-message, nor do they make special claims *as* craft knowledge or craft tradition. In the same manner, although observers of these events may get a certain craft signal, they do not delve deeper to read the craft messages behind such signals. This is because craft *itself* does not show itself as a distinct entity, but on the contrary appears in a composition or in co-mixture with technology, design or fine arts.

To illustrate the composite aspect of ambient craft we can again refer to the aforementioned example of "Arts appliqués" (applied arts). Here, craft was combined with fine arts and to a certain measure with some elements of technology (particularly ergonomics under the notable influence of Bauhaus). But the public eye did not consider this as a pure craft activity and the main contribution of this composition was mostly in its role of generating a proto-discipline of design. It's also worthwhile to mention that when the word "design" was definitively introduced in France in the late 70s to gradually replace the Arts Appliquées, the public and even the media had some difficulties in assimilating the term. There was also a problem concerning the correct English pronunciation of the word "design". As a remedy to this, a monthly French design review called itself, with a certain humor, "Di·zayn".

Another aspect of ambient craft is its com-mixture with technology. A striking example is the alliance of auto-crafting (D.I.Y.) with technological devices like "3D prints" and the generalization of "Fablabs". In these recent craft practices where craft and smart devices are tightly linked, there is no special "craft message" to be given to society. Most of the time, the public eye sees this as "another application" of intelligent devices. As for scholars of the social sciences, many of them believe it was just a recent mode of "appropriation" of new technologies. Nevertheless, some opinion leaders referred to elements of either craft tradition or new technologies in this new kind of co-mixture. Yet, it is worthwhile to remember that the initial impulse or encouragement for the com-mixture of D.I.Y and 3D prints came from the spokesmen of new technologies, such as Ray Kurzweil, and not necessarily from the partisans of the layman's craft or D.I.Y.

Furthermore, a more recent example of the co-mixture of craft and technology is the new field of research in software engineering, called "software craftsmanship". This research area is mainly inspired by the works of Richard Sennett's (*The Craftsman*) and Freeman J. Dyson's, ("Science as a Craft Industry"). In their Manifesto they refer to some traditional artisanal values such as the finality of the perfect work (well craft software) and the solidarity of the guilds members (community of professionals), etc. Yet once again craft is not considered as an autonomous discipline. Concerning their "Manifesto", we posit that it would be more correct to characterize it as a computer workers manifesto blended with some craft ingredients, and certainly not as a radical craftsmen manifesto.

The fact that craft is not sufficiently visible in these cases is due to its sporadic appearance in the domain of technology. Although for some period of time the idea of craft can be enthusiastic, eventually craft becomes something "normal": craft gets naturalized. But this does not necessarily mean that craft is always absolutely integrated to technology, but rather at any time craft can declare its autonomy in different forms, in unexpected, or even in radical ways.

Finally, we can mention a sort of "reciprocal mimetism" of craft and design, especially in the domain of fashion design. As a marketing strategy, "fashion design" produces "limited series" like an artisan would, and sometimes it the artisans who try to give an industrial dimension to their own creations to reach international markets. This was especially encouraged by UNESCO, and sometimes by government backed organizations like the *Craft village* in New Delphi. These initiatives are also important for educational strategies: the final aim is to gradually transform artisans into designers.

Through these examples we can better understand how the apparent or the ambient persistence of craft tradition does not bother the public much, because in these cases craft is not claiming its autonomy: it is not showing itself as a radical or as a dissident act.

The Manifest Craft

The two preceding figures of craft: hidden craft and ambient craft, show that there is a persistent continuity and vitality of craft tradition, even if ignored by academic research (especially hidden craft) and not recognized as such by the public (ambient craft), because of its composite or mixed nature. But there is another aspect attaining to the persistence of craft tradition which is neither related to how it should be "proved" by the researcher, nor related to how it is received and "approved" by the public, but rather to how it is "experienced" by individuals in their everyday life. By this we want to emphasis the appearance of *craft sensibility,* as can be observed in relations between products and their users and in the arrival of new life-styles. It is difficult to be indifferent to manifest craft, which depends on personal convictions and not on research or opinions. In this figure craft manifests itself as a *spontaneous revolt* – as dissidence or as disobedience – and often refuses to compromise with the frenzied development of consumerism.

Before going further we must give some precisions on the definitions of “manifest craft”. Manifest craft can have at least three distinct meanings.

1) It can be considered as the manifestation of craft “in the very *figure* of the everyday objects”, as Tarkko Oksala suggested. In this sense we can detect craft by the appearance of the object. In a more phenomenological sense craft appears, it shows itself and reveals itself through some everyday objects.

2) Beside the ontological aspect of manifest craft, we can also refer to the attitudes of the persons who are sensible to craft production. In this second sense, “manifest craft” can be considered as an “arousing” of a new craft sensibility of the consumer.

3) Finally, we can talk about manifest craft in the sense of “craft manifests or manifestos”, like the manifestos of the Arts and Crafts movement.

Concerning the *actuality* of manifest craft, we will refer mainly to the first and second meanings. As for the craft manifests or manifestos, we will tackle this subject from a historical perspective and not in the contemporary context of craft.

Without a doubt, the best historical example of manifest craft is the “Arts and Crafts movement”. But we must look closer to some salient characteristics of that movement in order to determine in which way it differs from actual manifest craft (especially from craft sensibility).

Craft radically appeared during The Arts and Crafts movement of the 19th century. Although in this movement craft was in alliance with the fine arts, craft represented the matrix force in this relation. The fine arts “part” of this movement was not, for example, as important as the Pre-Raphaelite Brotherhood movement. The craft message addressed by William Morris was essentially to the “male” working class. At the same time other craft organizations, such as the “Guild of Handicraft” were even opposed to women’s participation. As for middle-class women, they were considered as *Home Angels*. These women, “fragile” by status and subjected to their husbands, were allowed to partake in “domestic” craft production, but not to be included in a craft organization. The idea of Home-angels was popularized by a poem of Coventry Patmore, which was later fiercely opposed by Virginia Woolf in order to defend the civil rights of women. Furthermore, May Morris, the daughter of William Morris, created the “Woman’s Guild of Arts” in 1907 with the aim of rectifying the exclusion of women from craft organizations. (See on this subject Anika Dačić, 2016.) In other words, the 19th century’s craft revolt was addressed to workers and factories, as a critic of both the modes of production and of the ugly mass produced daily objects, (already a *debut* of design consciousness). Today's craft revolt, in manifest craft, is arising not from factories but from homes. It is a critic about the standardization of products in global markets' and their associated styles of living.

A second salient feature of today's manifest craft is that it is not a general *worldview* as was the case for the Arts and Crafts movement. The Arts & Crafts was strongly linked to the socialist movement of the 19th century. This was also the major ideology of that time. But to explain what we mean by "ideology" in this specific case, we can refer to a distinction that was made by Mannheim (1936*)* between "total ideologies" and "particular Ideologies". A "total ideology" implies a global world-view in which majority of social actors is involved, whereas "particular ideologies" are limited to specific domains and are related mainly to the attitudes of individuals. So, we can consider today's manifest craft as a *particular ideolog*y, related to our relations with everyday objects and not necessarily as a total worldview, as was the case for the Arts and Crafts movement.

The importance of manifest craft (in the sense of craft manifesting in the figures of objects) can be detected by the recent multiplication of craft boutiques, craft fairs, and the international diffusion of some magazines (ex. *The Simple Things).* But maybe the most important feature of manifest craft can be found in the arousal of a craft sensibility in the consumer. But how does this craft sensibility manifest itself today? Can it be considered as a spontaneous revolt: i.e. as a manifestation taking place in the street or the public places? Not necessarily. This manifest craft sensibility is mostly *mediated* and it appears in "representations", for example in social media, and not in an *immediate* manner like a social movement which manifests itself in public places. It may be paradoxical to say that manifest craft is in "representations" and does not manifest in the streets. However, it becomes less paradoxical when we take into account the importance of Internet platforms which can "immediately" diffuse any *particular ideology,* including craft sensibility.

Now the question which arises is whether we can attribute any political color to this "particular ideology" of today's craft sensibility, and if it is possible, what are the main criteria that we should take into account?

It is possible to attribute two different political contents to this spontaneous revolt, depending on the nature of the relations that consumers have with the products. We can use the term *dissident* acts if the relation is connected to a *critical* attitude towards the products, and if the final aim, in doing so, is to correct the negative aspects of the existing products. This critical attitude may also lead to the improved future development of products. However, relations with products can also be considered as *reactionary* acts, which consist of rejecting (partially or *in toto)* the existing system of products *as such,* as well as the life-styles which are imposed by the same system.

Craft Sensibility of "Dissident" Consumers

It is certainly very tempting to relate the dissident acts of the consumers to one of the most important political movements of our time, environmental or green consciousness. Yet we must be attentive to some distinguishing features of craft sensibility as a critical attitude to products. Furthermore, these features may not correspond exactly to green dissident acts.

The environmental catastrophe to which we are confronted was well explained in 2009, by a group of scientists lead by the Stockholm Resilience Center. Their research assessed that the bio-capacity of our planet is pushed beyond its limits, by putting in danger the major natural systems that represent the earth's ability to sustain life (greenhouse-gas concentration in the atmosphere, biodiversity, marine ecosystems, etc.). Faced with this planetal danger some green dissidences are focused on *food* (organically grown agriculture with no GMO, biodegradable packages, locally grown food, etc.), on *transportation* (green cars) and on *the habitat* (sustainable cities and new conceptions of urbanism).

Alex Steffen, an opinion leader on the future green houses and cities, has proposed some ideas concerning our future relations with everyday objects. His formula is striking, as according to him these future objects will be at the same time "Green and Bright". They are "Bright" in the sense that they will be smart or intelligent objects. "Green" in the sense that they will be inspired by crafted "tools" of traditional societies. Although *tools* are not exactly the same things as the *devices* or the everyday objects that we use in our homes, here we record nevertheless, an overt reference to craft. But does the *anticipation* of the author represent a craft sensibility or a green consciousness? It is not an easy question to answer immediately. If we take into consideration that the craft perspective can correct negative aspects of existing products and help them improve environmentally, we may say that a craft sensibility exists in this attitude. But in this case, today's existing objects are not questioned *in toto* – *especially* their in-built intelligence is to be preserved. So maybe the best way to characterize this critical view vis-à-vis the existing products is as a "dissident" attitude, and not a "reactionary" one. Yet the question remains: Must we conclude that, after all, craft sensibility is just a part of green consciousness? If it is not the case, then how can we be sure that there exists a certain craft sensibility distinct from the green consciousness?

In order to answer this question, let us take a look at how today's consumers may criticize everyday objects proposed by industry.

Critique of the Form: Use authentic and original objects instead of products produced by standard models or reproduced by these same models with some combinatorial elements (the method of *variance*).

Critique of the Material: Use products which should endure over a long period of time, instead of "programmed obsolescence" products.

Critic of the Usage: Use products which are adequate to one's own rhymes and gestures, instead of so called "user friendly products" with extensive user manuals.

Critic of the Functioning: Use products which can function manually or by the natural elements, instead of products with high fossil energy consumption.

It is possible to distribute these critics in terms of green consciousness and craft sensibility. The critic of the *material* and the critic of the *functioning* may be put under the account of green consciousness. But we cannot say the same thing, for example, for the critic of the form. How can we be sure that standardized daily objects (or their variances) harm green consciousness? The desire for an authentic and unique object, can it not be considered rather as a manifest of craft sensibility? Briefly, although the *figure* of manifest craft sensibility can sometimes be confused with green consciousness, we cannot completely ignore its specificity, as we tried to show in a *cavalier manner* in the above example.

Craft Sensibility of "Reactionary" Consumers

Another way to interpret this emergent craft sensibility is as a "reactionary" act.

History gives us a good example of reactionary attitudes towards everyday objects. During The *Ancient Régime,* the aristocracy resisted the generalization of "comfort" and "luxury" objects. The diffusion of these objects became possible due to the mass production of the manufactures, promoted by the bourgeoisie. The aristocracy resisted this transformation of daily objects by defending the "ceremonial" aspects of objects inherited from medieval times. Henceforth, in their relations with objects, everything had to be by *duty,* and nothing for *pleasure* or for *utility*. The main argument of the aristocracy against luxury objects were in the moral values which were represented by "patina" furniture. This reaction was well formulated by Father Croiset, a famous defender of the morale of the nobility: "The bourgeois who has just made fortune can never distinguish himself from the man of quality except by a more brilliant luxury" (see Orel, 2016a, 139–160).

Today, this kind of reactionary craft sensibility can be assimilated to the attitudes of consumers who reject the high-tech or the digital-tech way of living, especially when they turn to vintage, to “happy home interiors”, to handmade objects, or to exotic importations. We should not, of course, be naive enough to immediately attribute this to craft sensibility. In such attitudes, the consumers may get caught in the web of marketing strategies of big companies. Some years ago, there was an interior design collection launched by a well-known American designer who sold them under names such as “Log Cabin”, “New England”, “Jamaica”, etc. These collections claimed to restore the bourgeois comfort of the past. These kinds of marketing strategies put the consumers in a double bind: on the one hand, consumers are solicited to be spontaneous, creative and the master of their tastes, or, to be free to “make their own mistakes of taste”. On the other hand, industry imposes models and standards of taste or style, so that they can personalize their own lifestyle. However, the recent craft sensibility of “reactionary” consumers seems to no longer be disillusioned by the *promoted* life-styles and the products which come with them, since their life-styles become non compatible with the *products*, but rather with the *oeuvres,* i.e. with the handmade objects. Yet, is it possible to label this attitude, which refuses (partially or *in toto*) the universe of (industrial) *products* in favor of *oeuvres*, as an illustration of a kind of “conservatism” or conservatism attitude?

Conservatism as a world-view or ideology favors traditional values and opposes progressivism. These traditional values are not limited to the private sphere, but include all of society’s institutions: religion, education, family, economic institutions, etc. We can mention a rare example where craft has participated to a conservative ideology. It was the case of a political party created in France in 1953 which called itself the “Union for the Defense of Tradesmen and Artisans”. This conservative craft movement – which represents the exact opposition of the progressive movement of “Arts and Crafts” in the 19th century – was transformed into an extreme right party after its dissolution in 1962.

Although we can talk about the “conservationist” aspects of today’s craft sensibility, they have nothing to do with global conservative values, with the *conservative world-view* or with a “total ideology” in the sense of Mannheim. Craft sensibility also has no relation with a global social movement or a political party. Moreover, its claim is limited to our relationship with daily objects and freely chosen lifestyles. Therefore, we may rightly say that reactionary craft sensibility is independent of any codified moral values. It is rather related to personnel ethics and personnel experience. It is about “how we must live with daily objects”. The dilemma which “reactionary” craft sensibility has to resolve is: should we live with closed-objects, like “products”, with their frozen functions which also condition their users? Or should we live with open-objects like the “oeuvres”, sources of rich symbolism and which permit users to give personal meanings to them, also enabling an intimate relation between object and user.

Throughout history there have been many attempts to “engraft” a moral to craft. The sophists wanted it to be used for the formation of a “good” citizen. Plato required that craftsmen and artists recognize the values of the higher or transcendental order – like “good” and “beauty”. The Middle Ages considered craft as a servile (*Artes mechanicae*) profession. The Renaissance wanted for those who exercise craft to also have the right to enter into the exclusive club of *virtuose* gentlemen. Finally, the 18th century got rid of craft, maybe because there were no more moral values left to be distributed, as all had gone to the fine arts and technology... Nevertheless, craft survived after the 18th century without any need of morals.

Before concluding we would like to underline once more the importance of the word “power”, by which we tried to identify craft in the beginning of our article. This idea was already emphasized by Aristotle as *poietike* and later on by Collingwood as “power to produce”. Moreover, we must remember that even the origin of the English word craft is itself driven from an Old Norse word *kraptr*, which literary means strength or power.

We hope that our article has helped to clarify that craft is not only *power*, but also has certain *craftiness* ... since as we have seen through the use of three different strategies, craft has survived up to now. It is as if this craft power knew how to *hide* itself underneath legitimate competences. Furthermore, it has also used a *camouflage* strategy by composing itself with other competences. Finally, from time to time craft has *manifested* overtly – in manifestos, in the *figures* of the objects, and in the manifestation of craft sensibility. Perhaps it is precisely because craft has used different strategies of resistance, that we can still talk today about The Persistence of Craft.

III Case Finland

Introductory Remarks around Innovation and Education

We have presented theoretical remarks on the history of craft as tekhne or ars and their later existence in forms like Arts and Crafts. These ideas have faced the rapid technological development since Enlightenment and forward up to movements like Industrial Design, AI etc. In order to test these views, we discuss them in the Finnish context. Today the main inspiration for that is the fact that our publication forum and potential activities (of CTD) are hosted this time in Finland (HAMK).

Finnish culture is considered to be young from the Western point of view due to the fact that Finland was located in periphery behind Sweden. We have some vernacular examples of high-quality design and innovations since Enlightenment but ideologically well-documented design starts in 19th century and especially during Arts and Crafts movements in the form of National Romanticism. This short period was theoretically argued due to the careful study of Carelian houses (1900-1) by Yrjö Blomstedt (1871–1912) and Victor Sucksdorff. The movement wanted to rehabilitate Finnish achievements since far history using the Kalevala, the Finnish national epic (1849), as an argument. In craft world the main manifestation of the movement happened in the Paris World Fair 1900.

The Finnish pavilion at the Paris 1900 World Fair was designed by architects Gesellius, Lindgren and Saarinen and contained integrated artworks from the sector of fine arts. (Gallen-Kallela/ Blomstedt, 1931) The original pavilion exemplified continental Art Nouveau outside, and the national pathos was concentrated inside. Soon the architects wan also the competition of The National Museum of Finland (1903), which is the extreme case of National Romanticism. The same museum is of course the place where to start the lesson in Finnish craft tradition. Before this it is maybe the time to answer to the slogan of our paper represented by W. Morris ((1889); 2020) :

> *Past times: are we reactionists, then, anchored in the dead past? Indeed I should hope not; nor can I altogether tell you how much of the past is really dead. I see about me now evidence of ideas recurring which have long been superseded".*

In 1921 Alvar Aalto wrote (1972, 12/ Lahti, 2004, 8):

> *Nothing old will be reborn anew. But it does not either completely disappear. And, that, what once has been, is always born again in a new form."*

The education of architects had its first days in Finland around 1824 (Helamaa, 2000) but only stabilized in 1879 when The Polytechnic Institute was established. Gustaf Nyström (1856–1917) was one of the key teachers in architectural education (since 1879). He, however, presented Swedish speaking tradition and the old school of Neo-Renaissance. New winds were promoted by another famous teacher Onni Tarjanne (1864–1946) who started teaching in 1889 from purely Finnish background. In the side of practice, he designed in 1902 the Finnish National Theatre in extreme nationalism but turned toward white Vienna Jugend (i.e. Vienna Secession) already in 1903 in Takaharju Sanatorium preceding even the becoming functionalism.

The three young architects of the Finnish pavilion came from the same course (started 1893) in Helsinki Polytechnic (later Aalto). Eliel Saarinen (1873–1950) created two carriers first in Finland and then in the USA.

Armas Lindgren (1874–1929) was also an important architect. Both became influential design educators, Saarinen in Cranbrook (Christ-Janer, 1951) and Lindgren in Helsinki (Blomstedt, 1951, 180). Lars Sonck (1870–1956) started 1894 one year after Saarinen and won important church competitions very early in Turku and Tampere and later in Helsinki. He also got II prize in Töölö town-plan competition in 1889 and joined with the winner (his teacher) Gustav Nyström to make this masterpiece of Jugend in 1906. (Korvenmaa, 1997.)

There were also women students since 1879. The most famous of them included painter Helene Schjerfbeck, but especially Wivi Lönn (1872–1962), a future architect in world scale as well (Helamaa, 2000). Lönn started her studies in 1894 like Sonck. Both studied in Technical Institutes before Polytechnic, which explains their success already during study time. Lönn execised theatre planning in the office of Tarjanne. First, she won school competitions and the Tampere Fire Station competition (1907), also a master peace in National Romanticism. Somewhat later she won the shared II prize with Armas Lindgren in the international competition of Estonia Theatre (1909–1913). Their work is the realized one.

From the side of early Arts and Crafts it is worth to mention the Iris factory (1897–) led by Louis Sparre (1863–1964) and A. W. Finch (1854–1930), a famous person also as a pointillist. (Byars, 2004.) Besides The Polytechnic Institute (later Aalto), higher education in art and design had started in Finland in the "Institute of Industrial Design" (Taideteollinen korkeakoulu (1871–)). A central figure in arts and crafts education was Arttu Brummer (1891–1951). Brummer was also directing many other important institutes in design like the Museum of Applied Arts founded already in 1873. His wife Eva Brummer (1901–1989) was also a handicraft activist. (Byars, 2004.) From other teachers we may mention Paavo Tynell (1890–1973) who became a renowned lamp designer well ahead of his time.

Eliel Saarinen became the most important Finnish architect as regards world reputation and influence during and after Art Nouveau. He also continued his carrier up to modernist and toward International Style with his son Eero Saarinen (1910–1961). They both worked also on the side of arts and crafts and industrial design. (Byars, 2004.) Important connections of Eliel Saarinen include participation into the City Beautiful movement (e.g. Camillo Sitte).

The Golden days of National Romanticism and International Art Nouveau were soon over. Both were based on craft but now industry of serial mechanical production came into front. Eliel Saarinen was in good position in the USA to react on this revolution with Eero Saarinen and collaborators like Ch. Eames. In Finland the command was taken by Aino (1884–1949) and Alvar Aalto (1898–1976). (Kinnunen, 2005; Schildt, 1985; Lahti, 2004.) In age they are located between the generation of Eliel Saarinen and that of Eero. The connections between all persons mentioned above were also close.

One reason for the early success of Finnish Functionalism was a close relation to Germany and Bauhaus (Whitford, 1984). First master peaces were creations inspired from that direction. In fact, Lazlo Moholy-Nagy (1895–1946) visited Finland before WWII to discuss design theory. Quite soon after the functionalist revolution Finnish architects and designers in close co-operation with industry took their destiny to their own hands. This meant the innovations around ARTEK (Art + Technics) founded in 1935 by A. & A. Aalto, M. Gullichsen and N. G. Hahl (Byars, 2004) and in the markets of design in general. Famous collaborators of ARTEK included Maija Heikinheimo (1908–1963) and Pirkko Stenros (1928–). Besides Germany, inspiration came from Sweden, also. In architecture Gunnar Asplund and in design Gregor Paulsson (1919/1986) are good names to be mentioned here.

After WWII we saw the rise of Finnish Design as one genre under Scandinavian Style. Furniture, dining tools, lightning and glass design were the most important branches of success in Periodical Design Fairs. Lisa Johansson-Pape (1907–1989), Ilmari Tapiovaara (1914–1999), Antti Nurmesniemi (1927–2003); Kai Frank (1911–1989), Bertil Gardberg (1916–2007); Helena Tynell (1918–2016), Yki Nummi (1925–1984); Gunnel Nyman (1909–1948), Tapio Wirkkala (1915–1985), Timo Sarpaneva (1926–2006) and Nanny Still (1926–2009) are good examples of success since mid 20th century. (Byars, 2004) They were all students of Arttu Brummer.

Very soon after the middle of the century another firm in textile and clothing design, Marimekko (1951-) (founded by Armi Ratia (1912–1979)) took a leading role as flagship of the lifestyle of the 1960s. Important textile designers of the period include G. Skogster-Lehtinen (1906–1994), Rut Bryk (1916–1999), Maija Isola (1927–2001), and Vuokko Nurmesniemi (1930–) (Byars, 2004). The amount of notable Finnish designers, active since 1960, is too large for all of them to be mentioned here. (See Korvenmaa, 2009.) Our intent is to discuss thinking behind their work in its critical points (Franck, 1978).

Modern design has its special roots already in the “Friends of Finnish Handicraft” society, founded in 1879 by the famous painter Fanny Churberg (1845–1892). The main sector of the society was textile design. Collaborators included many names already mentioned in this article, like Akseli Gallen-Kallela, Helen Schjerfbeck, Eliel Saarinen, Eva Brummer, Rut Bryk and Timo Sarpaneva. We may also mention Impi Sotavalta (1885–1943) working in the society between 1917–1939. She made wall-textiles, turned to “functionalism” and preceded Finnish modernism already in the 1920s.

Finnish design has survived from the most radical changes relatively well. The national ethos is not so clear anymore due to the global movements reacting to global challenges and even crises. Computation and AI were considered in the beginning in the early 60s as positive promising visions. Finland got also in this sector a good start, and Otaniemi CAD-lab was recognized among the ten most important labs in the world (Radford, 1991, 2; Helamaa, 2000, 69–). Digital design has been studied in many institutes, first of all in Media Centre Lume established since 1995 in Arabia, Helsinki (designed by Heikkinen-Komonen Architectes). Democratic ideas like user participation have been strong in housing design and urban planning (Kukkonen, 1984; Maarttola, 1998). Green movement is maybe the most challenging in design, and sustainable design has its role in industry as well (clean tech). New problems and crises arise, and today we envisage again the health problems like Covid-19. This calls back the forgotten days of tuberculosis and the Paimio Sanatorium of Alvar and Aino Aalto (1936) (closed in 1972).

Aesthetics (Scruton, 1980) and art theory in purely theoretical sense was studied first of all in University of Helsinki. Good start in the side of theory can be seen since the book Origins of Art, which Yrjö Hirn (1870–1952) published in London in 1900. (Rantavaara, 1977, 1979.) Most important books for designers included those discussing the origins of art and aesthetics in general (Aalto, 1972). Later Ragnar Josephson wrote in Sweden his book Konstverkets födelse (1946), which was the key source for designers in the 50s (Erik Kråkström in discussion in 1985). Also, phenomenology started to give inspirations around 1950 (Keijo Petäjä in discussion in 1985) as regards how to make artworks (see Heidegger, 1950; Bachelard, 1957; Pallasmaa, 2003). For practising planners and designers the book *Rakennustaide renessanssista funktionalismiin* (Building Art from Renaissance to Funktionalism) by Kyösti Ålander (1954) was important source of inspiration. Besides art theory, also art history of Finland has a strong connection to design culture in the study of old monuments, churches and city plans see Nikula, 1981). One important thing bringing together design and aesthetics is without doubt the active emergence of environmental aesthetics (Sepänmaa, 1988) and art education (Oksala, 1976; Routila, 1986).

Hidden Craft in Finland, Basic Instincts

The idea of design without named designers and without documented know-how can be detected in the vernacular culture of Finland exhibited in the Seurasaari Open-Air Museum in Helsinki. The importance of these roots has been clearly noticed by Sigfried Giedion (1888–1968) (Byars, 2004), who in his Space, Time and Architecture (1952) nailed finally Finnish reputation in design on the modern world map. (Pevsner & Honour, 1971) In fact, the idea of silent knowledge was discussed already by Elias Lönnrot (1802–1884) who compiled the Kalevala – the Finnish national epic. (Oksala, 1986.) Alvar Aalto considered Lönnrot as the most remarkable Finn (discussion in office 1968). Lönnroth was a physician and promoted the idea that humans have their day-mind and night-mind. This gave Finns a good vaccination against the over-rationalism to come.

In one of his famous "Bent wood experiments" Alvar Aalto composed a "hundreds of years old grey pine fragment" with ARTEK detail. In larger scale his first atelier home was composed of an office part of white stone (functionalism) and a wooden black sleeping area. In West we may recall the opposition achieved with the names of Apollo and Dionysus and in global context the opposition of Yan and Yin. Elissa Aalto (1922–1994), the second wife, told often, that Alvar had strange tendency against totalitarian plans and when things were in too good order, he introduced a surprising effect which had to be accepted. This can be seen in the transition from white functionalism to red-brick style and in the use of strong white contrast keeping alive the contact to sources of inspiration.

In Finnish the original word for both Planning and Design (interpreted as dichotomy in English) was "suunnittelu" which means in Greek "tropy > entropy" "direction > directing" (Meurman, 1947, 9). This may mean concrete direction or tolerant one between two extremes but also direction of life. In information aesthetics and modern ethics but also in ecology as well it is noted that humans tend to avoid monotonous and chaotic environments, totalitarian and anarchic life and prefer natural biodiversity. (Aalto, 1972; Oksala, 1986; Radford & Oksala, 2018.) Alvar Aalto applied these principles on the level of instinct and emotion. He was educated in Jyväskylä, the Athens of Finland, and probably had heard such things, but nobody knows for sure because such wisdom is a certain kind of know-how kept away from the eyes of the potential competitors.

The education in the oldest Finnish grammar school, Lyceum of Jyväskylä, gave a good start for Aalto. As Vitruvius states both "Theory and Praxis" are needed. Poetics (by Horace) was well known in Lyceum and also by the private tutor of Alvar in art. This fellow, Jonas Heiska, was the first artist of the county and experienced in aesthetics. This education can be seen in the writings of Aalto. In one of his first essays in design theory, Aalto used famous tropic expression "form is a mystery" (Lahti, 2004, 7, 14.) showing preliminary understanding of tacit dimension of kowledge. Later he refers to Socrates and tells that he cannot answer the question "How to make good Architecure" – because "I do not know". (Aalto, 1958 ;1972; Oksala, 1986.)

The essence of the hidden craft was discussed in Finland between László Mohol -Nagy (1895–1946) (Byars, 2004) and Alvar Aalto when Lazlo presented the "new" Bauhaus-ideology in which the play had its key role in art education. After the lesson Aalto took out from bookshelves the book of

Yrjö Hirn (see above) discussing the similarity of childrens play with art and his surprise tactics started a fruitful dialogue.

Tacit knowledge came back to design discussion due to the influence of M. Polanyi (1966) (as mentioned before). In 1986 a Swedish professor Olle Wåhlström promoted the importance of hand-drafting and tacit knowledge behind it (1986/1988) as related to the coming ICT and AI time. (Cf. Linn, 1986/1988) In fact, Jaakko Ylinen had brought to the table similar question (1968) in his writing "Architectural space and form" where he cited an article in which architectural drawing was connected to bodily memory (cf. Pallasmaa, 2002).

Hidden and visible, emotional and rational should be of course in balance. The growth of design knowledge after WWII was noticed in Finland in building knowledge institutes and SAFA. This also led to special programs like "Knowledge-Based Design" (Gero & Oksala, 1989). We may gather around this idea the progress in informational, conceptual and cognitive design study (Oksala, 1981; Pallasmaa, 1981; Mänty, 1984; Stenros, 1992; Lehtonen, 1994; Eskola, 2005; Launis, 2006; Nyman, 2008). The amount of scientific design studies is today very extensive and can not be discussed here in detail. Architectural education was started also in Oulu and Tampere. Interest toward science grew inside design institutes. Design is also thought in many Universities of Applied Sciences, like HAMK, around the country. (Helamaa, 2000; Oksala, 2017.)

Ambient Craft in Finland, Success in Applied Art and Industry

Most important designers evidently have their own design theories as folk theories of craft or more manifest ones. Sometimes these arouse in surface in discussions. Reima Pietilä (1923–1993), famous for his designs like Dipoli at Otaniemi Campus with Raili Paatelainen (1926–2021), told to the Finnish author of this article in 1986, that all buildings that they have designed are experiments in relation to theory which is the real work. (Pietilä, 1964, 1972, 1988.)

The rise of Finnish design happened in connection with industrial building (Hankonen, 1994) and industry in general. In many cases art and theory were to be smuggled into project. There were also important firms like Nuutajärvi (1793), Arabia (1873), Iittala(1881), Artek (1935), Marimekko (1951) (Byars, 2004) and so on in which design was under direct care of government. The list of international and national awardwinning organizations of success is large. (Takala- Schreib, 2000, 102-)

One of the key problems of industrial design was to balance individual and collective taste and quality with the efficiency offered by industry. Alvar Aalto again developed his own philosophy of how to balance individual and collective forces and how to make this with the aid of “Elastic Standardization.” (Aalto, 1972/Oksala, 1986.) The social importance of this visionary mission was underlined by the fact that even the Prime Minister (later President) Risto Ryti was one of the promoting persons. Later in the 60s the trends of standardization and anonymous minimal design became in front due to the influence of Ulm-school and international systems design. One important figure promoting team-work and anonymity was Kaj Frank. The ethos of the time became in front in his words (1978)

“A tool designed for use should not seem ready and finished. Its non-completeness is the message to the user, an impulse to thinking and action.”

The idea of Finnish life style (Wickberg, 1974) and that of Denmark, Sweden, Norway, and Island have been integrated under the names Scandinavian democracy and design. (Cf. Blomstedt, 1951; Pevsner & Honour, 1971.) How such concepts are born is often difficult to express, but acts tell better story. Eero Saarinen has acted as one of the most important promoters of Scandinavian design already in the middle of the20th century. He designed only two buildings in Finland and much more in the USA, but it is not very well known that he acted in the jury of Sidney Opera Hall and Toronto City Hall. There, Jörn Uzon from Denmark and Viljo Revel and the team (Castren, Lundsten, Valjus) got first prizes. Today the modernistic term Scandinavian design lives in the notion of “Nordic Noir” as expression of Film but also of Design. White functionalism of the Stockholm Exhibition (Linn, 1998) has its vital and curvy after-variations in black.

The most vital style in Finland is still the late-modern of Helsinki, but postmodern regionalism has left its signs around Finland. The flag-bearer was the School of Oulu (“Oulun koulu”). This direction let all colors (of the rainbow or Auroa Borealis) flourish on the borders of smooth anarchy (Sassi, 1986; Helamaa, 2000). The highly artistic movement has its advantages on emancipation, but problems due to the lack of prior skills in intended handwork. Reima Pietilä (Member of Finnish Academy) and professor in Oulu also took distance to his own pupils around the movement. The school of architecture in Tampere had a strong science and discourse profile in the beginning. Helmer Stenros (1929–) and his team unified architectural theory and environmental psychology (Stenros, 1984, 1987). DATUTOP series became one of the leading discourse forums in environmental design in the country. Tampere also soon challenged other schools in design competition market (Helamaa, 2000, 118).

Postmodern inspirations became important also in small scale on the side of interior and furniture design. Some names from the younger generation may be mentioned here like Eero Aarnio (1932–), Yrjö Kukkapuro (1933–), Simo Heikkilä (1943–) and Stefan Lindfors (1962–) in furniture and Oiva Toikka (1931–2019) in glass design. (Byars, 2004.) Postmodern philosophy started an unforeseen, active and critical discourse in design schools. Key themes included national vs. global, Arts and Crafts vs. industry, ecology vs. environmental crisis. (Ahola, 1980; Lapintie, 1993; Periäinen, 1998; Takala-Schreib, 2000)

The cavalcade of profane motive-richness of environment is propagated in participative design. The consumer can decide not only at the level of furniture and small things but also in apartment markets what is to be done. In extreme, we can use the term Design-It-Yourself (De.I.Y). When this is connected to Do-It-Yourself (D.I.Y), we face again the problem of craft quality. All selfactivity is in principle good and honest, but the problem concerns the duty to protect citizens from short cut decisions. The most difficult problem is visible in urban planning, where the effect of decisions culminates only after decades and more. Then the layparticipant is typically a politician "Pro Populi".

It is hard to evaluate the success of recent urban design in the key places of Finland like Helsinki (Radford & Oksala, 2018) at once. It is, however, easy to say that Old Center of Helsinki and the Un-built Center of the 50s are completely on other level than all that funny stuff that has been made around the year 2000 finally on the site. The key buildings are interesting products of highly esteemed architectural competitions, but where is the higher vision. The town plan is probably more an office work than an ingenious "Master Plan"? Urban design in this crucial point had the opportunity to collect ideas born by urban competitions trough an era of 100 years. The most essential ideas realized fortunately have strong connotations to the genial notes presented by P. E. Blomstedt (1900–1935), like the trough going green sector with central piazza before the Parliament (Blomstedt, 1937/ 1951, 65–, 112).

The amount of remarkable Finnish architects in the 20th century is too large to be commented here (see Wickberg, 1959; Helamaa, 2000; Cerver, 2005, 78, 370, 424, 478, 524, 590, 742, 888). Some illustrative examples can, however, be given. Cerver mentions in his *Atlas of Modern Architecture* some works of architects like Esa Piironen (1943–), Juha Leiviskä (1936–) and Arto Sipinen (1936–2017) and also works of offices Hyvämäki – Karhunen –Parkkinen, Gullichsen – Kairamo – Vormala and Heikkinen –Komonen. From these eleven names three, that is Christian Gullichsen (1932–2021), Risto Parkkinen (1938–) and Arto Sipinen started their carriers in the office of Aalto. Architects and designers often discuss about new promising actors. There it is best to advice to follow competition success. The organizing institutions of competitions or exhibitions like SAFA and Ornamo have guaranteed a certain quality of the most important projects. We have referred to the success on this front trough the article, but keeping track of development is here left to activists. (See Helamaa, 2000; Takala-Schreib, 2000; Radford & Oksala, 2018.)

One problem in design is the role of teamwork. It has its glamour as a word since Bauhaus (Giedion, 1954; Frank, 1978). All this has something to do with national life and work styles. Co-operation of various specialists means progress in principle but not always in practice. Today the amount of negotiations and bureaucracy is so over-flowing that design is by obligation left to ambient and even questionable level. Short sighted economic cost-interests are conflicting with quality, although in promotion speeches design is mentioned under friendly connotation for advertisement reason. The situation is comparable to that of commercial industrialism (criticized by Louis Sullivan himself).

Finnish industry and technology is focused for example on forest and metal industry, ship building and telecommunication. Of course, many other areas like building industry have their place in the picture. For example, car industry has been limited in comparison to ship industry, but exceptions can be found, like cargo-cars, trams or military vehicles and licensed car fabrication. This all means that remarkable design innovations can be found first in the areas mentioned. Design of wood products (furniture, sauna (Radford & Oksala, 1986; Särkikoski, 2012, 218)) has still special value. In addition, household tools in steel (Fiskars), electrical home-devices, cruisers and their interiors and mobile phones were long time notable examples of ambient design activities. In this setting we should mention the (ICT) design of paper factories or forest machines. In the daily life, mode and cloth design are of high ambition especially in atelier or studio level, where the craft assimilates today with high-tech (e.g. HUT) (Takala-Schreib, 2000).

One reaction telling about the challenges above is the unification of economic, technical and industrial-art Universities of Helsinki under the Umbrella notion of Aalto University. This reflects in a nutshell the idea of our own project as unification of commercial craft, technology and art as design. It is hard to give an account on design institutes due to the continuous organizational changes. Association of Art-industry (founded 1875) presented “ambient design”, as we call it, but in 1911 “Ornamo” was founded to defend the role of Arts and Crafts in a more manifest sense. Today the trend is unification as can be seen in the collaboration between the museums of architecture and design. The number of design museums and schools in the whole country is remarkable and cannot be discussed here (Turku, Tampere, Oulu, Hämeenlinna and Jyväskylä as well etc).

Craft and Design Manifestos in Finland

The alienation of design and technology from human life has as one index the decadence of handwork in large areas. In fact, to manifest means to show ideas in concrete fabrication of artifact. **1.** Skill is manifest in products themselves. **2.** This all needs some promotion (Wright, 1941) and oral or textual manifestos. Important design manifestos in written form can be found during the whole 20th century. (Conrads, 1966; Bonsdorff, von, 1988.) Due to historical reasons, most of them are issued in western countries, but some recall the connections to the wisdom of the East as well. Although Finnish design praxis is nearly over-presented in encyclopedic publications (Byars, 2004), Finnish manifestos are not well-known.

The first important manifesto around Finnish Craft movements after 1900 was "The Fight Text" (1904) published by Gustaf Strengell (1878–1937) and Sigurd Frosterus (1876–1956). In the small manifesto the National style of Helsinki Railway competition entry (First Prize, 1904) of Saarinen was shown as ridiculous. (Högström, 2004, 10–12) Instead, writers promoted Art Nouveau in Brussels or Vienna spirit. Frosterus was Doctor of Philosophy specialized in color theory. He also continued his carrier as famous architect throughout the years. Strengell in contrast become famous via his writings. He discussed artworks on the level of city, building and home (1922, 1923 a, b).

The Fight Text (above) is an excellent example, how a manifest can indluence real desing. Eliel Saarinen was awaked and noticed the above mentioded critique by colleagues Strengell and Frosterus. He invented his own style, soon acknowledged in the USA (II Prize in Herald Tribune competition etc.). Saarinen had not time to write in his busy yars. Decades later Eliel Saarinen was to write the most systematic books of art theory, as a person of Finnish origin. They include *The City* (1943) promoting among others the idea of healthy environment. The notion is still valid in the time of sustainable development or even Corona virus. He also wrote one of the most advanced books on design, *The Search for Form* (1948). These writings sum up his lifelong experience since 1900. Saarinen mentions as the most important source for his thoughts the wellknown book by O. Spengler (1918) called *The Decline of the West* [as mentioned before]. In fact, Spengler visited Finland in 1924 giving two speeches in Helsinki and one in Turku (Spengler 1918/2002, introduction). In the big picture we may say that planning or design theory and the destiny of the World go hand in hand . Alvar Aalto proposed (in discussion 1963) that: "Architecture manifests human creative potentials *(power)* in culture." In this sense, it supports surviving on all continents.

In general level, manifestos like *City Beautiful and Garden City ideals* created by William Morris (1834–1896) (Byars, 2004) or Ebenezer Howard were internalized in Finland, as is evident in the case of Eliel Saarinen or Lars Sonck et al.. (Nikula, 1981, 17, 127; Mikkola, 1984). One pupil of Saarinen, Otto-Iivari Meurman (1890–1994), working in the Finnish office (1914–15), continued on this line. Meurman was the first professor in urban planning (HUT) in Scandinavia and worked for the urban plan of Tapiola. (See 1947.) This large project got highly positive attention throughout the world, in the 50s and even in the 60s. Most remarkable part was the Centre around artificial water theme designed by Aarne Ervi (1910–1977). (Lahti, 2006, 124–) Other important architects behind the plan were A. Blomstedt (1906–1979), V. Revell (1910–1964), H. & K. Sirén (1918–013, 1920–2001), and somewhat later A. Ruusuvuori (1915–1992). (Cf. Pevsner & Honour, 1971)

Today the identity of the Forest City Tapiola is unfortunately mainly spoiled due to commercial pressure. Also, ideologies like Compact City or Communication City were aroused against the Garden/ Forest movement in the early 70s. The design of suburbs turned in the late 60s from free form to gridicon one (Eaton, 2003), but what was unfortunate, mostly toward gray monotonousness (Hilbersheimer, 1963). Efficiency and quantity became in front in solving problems of housing during the migration boom from country to town (Hankonen, 1994). The countermovement was rapid to come, and color finally returned into new urban milieu around the 90s (e.g. Huopalahti), but the opening of the Pandora's box had already led to commercial Fun, as well.

Pikku Huopalahti (1986–2000) is considered today the most important concentration of postmodern Mumin-houses (see Tove Jansson 1914–2001 and Tuulikki Pietilä 1917–2009) approach in Finland. The city plan was designed by Matti Visanti (1945–) in Helsinki City Planning Office. In this project the ideas of G. Strengell (1922) concerning "Town as artwork" were rehabilitated. The first part of the residential area and main street "Korppaanmäentie" give skeleton to the plot of the daily drama. The city grows from a single small beach stone, via old vernacular terminal building and beach piaza up. Piaza and the main street are separated with a gate consisting of Thick (right) and Narrow (left) towers. At the end of the street interval, we come to traffic junction marked with Street-end tower. "The Main Street is almost All Right". Then the passenger may continue up to a "mountain like" Terrace-Tower. (This poetic expression is from the official text in the city plan). From the strategic four tower buildings the Narrow one and Biophilic Terrace-Tower (competition entry) are works of Reijo Jallinoja (1941–). The Thick and Street-end towers are designed by Ilkka Niukkanen (1948–) and Tarkko Oksala (1946–). (See Laapotti et al, 1976; Niukkanen & Oksala, 1986.) The free traffic-net and built-up boost of geography connect Pikku Huopalahti to Tapiola tradition, but compactness, roof landscape, and tile-colors tell about a new spirit. Interruption of the modernistic tradition was radical, and we may even look to the direction of Wivi Lönn and the sources of her inspirations from Scotland and from Mackintosh (McKean & Baxter, 2003, 15, 18, 22) without forgetting the "Play with the Mumins" .

The basic ideas behind Tapiola were "Genius Loci" and Green. Forest as a focus has today been extended more clearly towards the healthy climate. The concept of regionalism has been enlarged toward international co-operation, manifested in research projects like "Cities designed for winter" (Mänty & Pressman (eds.), 1988). Problems concern more and more the whole human habitat (Bonsdorff, 1998). This all leads toward multiple discussions concerning our environment as un-built or as the real global village.

In certain sense, a lot of the interest in urban and rural design has turned into the direction of telecommunications and Smart cities (cf. Aalto, 1932/1972, 34), also in Finland after the Nokia phenomenon. Telecommunications is emancipative in general. Design is today also often ICT, User interface and AI service design. Telematic maps help in environmental orientation of pedestrians, mini-vehicles or cars. Transportation waits also its drone-applications and driver-less vehicles of all kinds. It is also possible to avoid other people by using Corona virus phone applications. Distances and properties or hierarchies of classical urbanism have loosed their significance, but crises may open new synthetic traffic innovations in advance (Majurinen & Oksala, 2009).

The longterm crisis tangential to design after recent pandemic is still the ecological one. It concerns erosion and pollution, water conditions and climate change. W. L. Thomas discussed basics of this problem in global level already in 1956. Erwin László (1932–) (Seppänen, 1998), one of the founding members of the Club of Rome, visited the Athens of Finland in the early 60s. Other summer festival speakers of "Jyväskylän kesä" in these years were Richard Neutra (1892–1970), Viktor Papanek (1925–1999), Sigfried Giedion (1888–1968) and Richard Buckminster Fuller (1985–1983) (Byars, 2004). Alvar Aalto as a Finn had also his famous socio-ecological speech – ending to the words SOC, "Save our Cities". He was renowned with Lewis Mumford (1895–1990) as a pioneer of regionalism. In fact, Erik Ahlman had translated the Culture of Cities written by Mumford already in 1946 into Finnish to prepare rebuilding of the country.

Design emerged as a target of public interest in Jyväskylä summer-festivals bringing together performing and descriptive arts. Tapio Periäinen (1929–) was mainly responsible for the "Design Division". Majority of the important national and international names mentioned above openly manifested their conceptions of good design. The reputation on these free ideological markets brought to Periäinen leading role in Finnish design organizations, like Finnish Design Forum (1975–94). Anne Stenros continued his work through the end of the Millenium. Design promotion happened in connection with exhibitions like "Finland Designs" (1980–1998) (Takala-Schreib, 2000, 79) besides the tradition of "Finland Builds".

The secret pioneer of Finnish Green movement was Pauli Ernesti Blomstedt (1900–1935) (1951). He died very early and his ongoing projects were realized under the command of his wife Märta Blomstedt (1899–1982) who continued pioneering functionalism. Pauli had an important role in promoting the Helsinki Central Park running the length of Helsinki from the still rural northern border region into the heart of the City. He created the programs of architectural ethics (Bright, see next paragraph) and healthy environmental design (Green, see next paragraph) in harmony with the contribution of Eliel Saarinen. Blomstedt also listed the key definitions of functional design from Plato to Hippolyte Taine (in 9 cases) in the spirit of our own paper.

The work for environmental care has been continued since the early 90s, for example in adopting the manifesto of "Sustainable Development" (Lasker & Oksala, 1993/ 1994) into education program of HUT (Aalto) under the special slogan "Green, Blue and Bright Developments in Environment". This slogan refers to the conditions of forests + parks, sea + air and human intelligence + AI. (Oksala & Lasker, 1994/1996; Oksala, Farre & Lasker, 1995/1996). Since the decades of these early manifestos our world has completely changed and accepts more and more the green values, but the question still remains, if the challenges are too big. (Periäinen, 1969, 1996.) The Corona crises has shown, anyhow, what kind of advances in the climate front can be achieved via the Slow or Smart Cities moment. (Shon et al., 2015) The course of development has to be moderated. The role of traditional life or High-ITC is in our own hands.

Epilogue: A Meta-manifest For the Case of Finland

We have discussed as case the story of Finnish design since 1900, starting it from the Finnish Pavilion in Paris World Fair and continuing up to the middle of the 20th century and somewhat more up to 2000. To limit these thoughts, we used three viewpoint – craft as hidden, ambient and manifest. Phenomena do not appear from nothing, and it is fair to open the curtain of 1900. The grey eminence *(éminence grise)* behind Pavilion-project was the famous painter Albert Edelfelt (1854–1905), who wanted to give revolutionary space for younger but be silent also for diplomatic reasons. According to P. E. Blomstedt (1930) Edelfelt surprisingly wrote a manifesto outside of his own profession, namely in architecture (1898). This strong manifesto was against old eclecticism, and it was promoting (new) Art Nouveau. Edelfelt was angry about the alienation of architecture from other arts and crafts and said:

“Building art is that art, which should care and lead all others and for which it is necessary to go in front, if we wish the whole (new) movement to have future. --- The new style, which is under birth, wants simplification and deepness. It wants that the form should emerge out of the intimate thought of the craftwork itself” (Edelfelt, 1898).

These ideas are in balance with thoughts of Aristotle (1984) and Socrates (Rolland, 1921, 292) but not copies at all. Power of these words (logos) is easy to understand. They contain the seeds of Finnish craft thinking. Blomstedt understood that 32 years later, but so did Alvar Aalto in 1958, 60 years after the words of Edelfelt. In his 60th birthday he wrote into architectural magazine (ark) a self-interview having the same ethos against eclecticism of that day (Aalto, 1972, 104–105; Oksala, 1986 329–). The point was against commercial cavalcade-milieus which alienate from the (small) human (being). Aalto writes:

“And building art – the real one – can be found only there where this small human is in the focus, his tragedy and comedy –both.”

What is needed is a deeper education of love and compassion between humans and love reaching also our home district in small and large. Hämeenlinna, the hometown of HAMK, was also the place of childhood for Armas Lindgren, one of the designers of Finnish Pavilion in 1900. Later he dedicated his life to craft education. The secret (origin and seed) behind the professional education in arts and crafts given by Armas Lindgren for the next generation was his sensibility towards a very small medieval cathedral from his childhood called Hattula Church. The description of this craft work in his lectures was so impressive year after year that Aalto family, his pupils, wanted to show the mysterious target to László Moholy-Nagy. Spontaneous delight soon fulfilled the space and sustained. Later the daughter of László and Sibyl got as her given name Hattula – in total Hattula Moholy-Nagy.

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Eero Kallio

Skilled Human – Designers' Skills

Introduction

In dividing the world we live in into a natural one and one created by humans, we are inevitably facing the human connection between the ***natural world,*** which is operating by the laws of nature, and the ***artificial world,*** which is using these laws to satisfy human needs. This artificial world is created by human technology.

Technology has a connection to the natural world, as it obeys natural laws. At the same time, it has a connection to the artificial world, as the creation of technology originates from human needs. This dual connection makes technology interesting. In this article, I discuss the ways in which human action connects the natural and artificial worlds within the realms of craftmanship and design.

Human skill – designing – is a connector of these two worlds. Human skills are the interface over which we interact with these two worlds. In our everyday lives, we do not designate a difference between the natural and artificial worlds. Human skill constantly operates in the interface of nature, technology and culture. This article discusses craftmanship, the designing skill and its meaning for creating artefacts. What are the many roles of human skill as a connection between the realms of nature, human action and technology?

Designer's Skill

Having expertise and knowledge are common words used to describe someone who is highly skilled in performing certain difficult tasks. When acting intentionally to create something, we are experiencing this kind of skillfulness. When creating new things, artefacts, we are working between natural laws and human needs. This work combines knowledge of human needs to the knowledge of causal connections of the natural world. This article is about skill and its role as a connector between natural laws and human needs. It is about the design and creation of something new. In the end, we should be able have an insight of the aspect of skillfulness behind the design and the designer.

Craftmanship is considered a basic manifestation of skillfulness. In the beginning, I will discuss the nature of a craftsman's knowledge. The aim is to clarify the essence of the maker's knowledge and its connection to practical problem solving. This kind of knowledge is connected to its possessor – it is the craftsman's knowledge.

My second topic is the artefact and its dual connection – the connection to the world of natural laws and to the world of human intentions. This chapter clarifies the processing of artefacts to meet human needs. It is about the connection between natural laws and human needs. This discussion aims to clarify the fascinating connections between the natural world, the artificial world, and the human who works between these two worlds.

The third section of this article is about design. In it, I will discuss the nature and the aim of design: about gaining an acceptable alternative – since in the real world we rarely have the methods foractually finding the optimum (Simon 1996, 120). Compared to craftmanship, design is about making the connection between natural laws and human intentions visible. By contrast to craftmanship, design is something that also makes the experience explicit.

The aim of my article is to discuss the connective role of human skills. I will begin by examining the connection between knowledge and skill. The notion of the maker´s knowledge is the key to studying the connection. Understanding the dual connection of the artefact and especially the role of the human actor as a connector between these two worlds emphasises the meaning of the skills and experience: Understanding causal connections and being able to utilise them in creating artefacts. By describing the essence of the craftsman´s skills and skill acquisition, we are ready to examine the gestalt of the designer and the designer´s skills.

Craftsman´s Knowledge

According to Aristotle, practical and theoretical reasoning are parallel processes. Theoretical knowledge and practical action have an inalienable connection. Knowledge has not only a connection to the character of the action but also to the reasons behind the action – to the intentionality of the action. A single event produces a single experience which is not yet exploitable. Several combined events are creating a picture about the effects of the causes, but they are not yet enough to tell why the effects are following the causes. Only causal knowledge explains why certain effects come about and how they are connected to the causes. The awareness about causes and effects makes experiences evolve into knowledge. (Mutanen, 2016)

Richard Sennett (2009, 9–12) describes traditional craftsman's skill as an ongoing dialogue between head and arm: the synthesis of practice and deliberation. On one hand, it is the capability to use tools and on the other it is knowledge about achieving the objective.

Knowledge about skill is often divided into knowing that and knowing how. The first one refers to theoretical knowledge and the latter to practical knowledge. According to Ryle (2009, 18) one always uses a bit of both when one does something. The basic challenge is that theoretical knowledge does not provide a full perspective on how to do something. Vice versa, it is not fully possible to describe "know-how" in a descriptive way – how could one, for example, describe the difference between a good and a bad joke? (Ryle, 2009, 18–19)

This division is complex because of the connection between knowing that and knowing how. In the recent discussions concerning "knowing how" there is a clear disagreement about the grounds of knowing how: is the idea of "knowing how" based on propositional attitudes or on other abilities (Breivik, 2014). Is knowing how simply a form of knowing that?

The so-called "intellectualist explanation" of knowing how suggests that there is always theoretical knowledge behind the intentional action. Practical and ethical implications of theoretical knowledge are diverse. What if an agent has false knowledge but is still able to carry out the desired action? Anti-intellectualism explains "knowing how" as an ability. This means that propositional knowledge alone is not sufficient for knowing how – one must be able. There could also be an important difference between knowing how to do something and being able to do it. Becoming paralyzed may affect being able to walk, but one still knows how to walk. (Breivik, 2014; Boesch, 2019)

The idea of tacit knowledge gives an important vantage point to the discussion concerning knowing how. The idea about knowledge that one cannot express points out one important aspect of knowledge. There is a kind of knowledge that is connected to the person who carries it and is not able to make it explicit. The origin of this kind of knowledge is intrinsic. It is based on experience and bound to its subject. One important feature is that it is connected to expectations regarding the feeling of experiencing something: "*Knowing how to execute involves knowing how it should feel, the bodily feeling and maybe also what the emotional involvement should be"* (Breivik, 2014).

The idea of the maker´s knowledge covers both the theoretical and the practical knowledge. The main idea can be summarised as an idea that one can possess the kind of theoretical knowledge that one can bring forth (Hintikka 1974, 80). Maker's knowledge includes knowing that and knowing how: theoretical (knowing that) and practical (knowing how) knowledge are inalienable (Hintikka, 1974, 86–88).

Instead of building a wall between the natural science and the human sciences, they can both be approached through theories of a manmade, artificial world through the concept of a maker´s knowledge. Maker´s knowledge has an important connection with practical reasoning. Hintikka (1974, 84) elaborates on the concept of maker´s knowledge regarding practical or intentional knowledge, which are often understood as practical reasoning.

Maker´s knowledge has a close connection to intentionality. By contrast to speculative knowledge, which is derived from known objects, maker´s knowledge is connected to the reason of actual processing or doing. When the artisan is creating his or her artefact, we can observe all the phases of the work process, but we cannot tell why he or she is working that way. There is still a certain goal toward which he or she is aiming. There is a long causal chain and a true intention behind it. The craftsman is an expert in his or her own area. The craftsman's focus is directed towards a personal aim. The knowledge and experience a craftsman possesses are bound to the artefact. He gains more experience every time he creates a new artefact, but the experience is limited to this certain subject (cf. Martini, 2019, 17–118). The craftsman's competence is focused on solving a certain, known problem.

A craftsman´s skill or ability can be analysed from the viewpoint of habitual action (Pollard, 2006). When reaching the level of a highly experienced and skilful actor, the manufacturing of an artefact does not need ongoing attention. Repetition has then developed one´s skills to the self-acting level (Pollard, 2006). The cycle of habituation and repetition improves the action to something that the agent does not have to think about. In a social setting, the apprentice is not only imitating his master but also improving and exercising his own skills. By intentional exercising and monitoring his own performance, one learns – or habituates – their action.

Breivik (2014) describes the skill acquisition of expert athletes in a broader way – it is not just habitual behaviour: "*At high skill levels, the execution of know how is thus an all-embracing activeness involving a person´s cognitive, emotional and motor abilities and resources*". A craftsman would in this framework be called an expert when he achieves a high skill level in his area of expertise. This expertise should be evaluated in two different ways: as backward-looking experience and as forward-looking competence. Experts then should have experience in their field of expertise and be competent in using their experience in solving new problems (Martini, 2019, 117).

Craftsmanship is about developed expertise in a specific area of proficiency. It is acquired by experience. The knowledge concerning this expertise is refined intrinsically. The background of knowing may have connection with propositional knowledge. Nevertheless, the central part of the capability is attached to its carrier – it is knowledge attained by its maker. Gaining this kind of experience or knowledge is a process where the creator makes expertise (knowledge) by exercise. In the beginning, it may demand some examples or theoretical knowledge. When getting more sophisticated, one begins to adjust their performance by internal guidance.

Internal guidance does not mean anything supernatural. It is about a gut feeling. It is something you already know, or you can do. An experienced professional is able to perform complex operations without specific attention. Being skilled is closely connected to this – being skilled in something enables one to focus attention on something more important: a craftsman doesn´t have to think about how to use tools and may focus on the fragile material he is working with; and the football player is able to concentrate on the situation on the field because his ball control works like automation (Breivik, 2014).

When discussing the maker's knowledge or practical knowledge, we must remember the inseparable connection between theoretical knowledge and practical knowledge on an individual level. While an individual's understanding about causal dependency evolves, his capabilities regarding practical knowledge improve (Hintikka, 1974, 86). Theoretical reason, then, is free from the real world. Experienced world has a restraining essence when one is operating from his practical reasoning. Theoretical reasoning expands possibilities to exercise practical actions by reasoning the upcoming actions and their possible effects. The conceptual structure of cause and effect creates awareness of the possibilities to reach the intentionality behind the maker's knowledge.

Artefact and Dual Connection

We all live in the world of technical artefacts. Artefacts are objects made by craft/skill by human beings, *supporting them in fulfilling their practical needs and ends* (Kroes, 2012). Technical artefacts have a dual nature. They are man-made physical constructions and objects carrying a designated function; something which connects them to the intentional human action (Kroes, 2002). An artefact is something that is created because of a human need. The reason for the existence of the artefact rises from its functionality and especially from the goals it is made for. Still, it is an artefact with a structure created by the man. From the outer environment, it presents itself as something that fulfils its goal and from an inner environment it is described as a physical system.

Functional explanation means that we are giving an explanation of something by reference to its purpose or function. This kind of explanation differs from the methods of natural sciences, which explain how things are without dividing them into the inner and outer environments. Birds and planes being able to fly can be explained by natural laws. There is no reason for a division between an inner and an outer environment. For example, why do animals in the Arctic have white fur? When explaining this we are shifting to an explanation by functionality: their white colour helps them to survive in that kind of environment. This is only a statement but when we support it with the notion of natural selection, we turn it into an explanation. (Simon, 1996, 7)

The dual nature of the artefact means that it has a connection to the world of causal connection where it works as a physical object and to the world of human beings where it works through intentional acts of human agents (Kroes, 2002). We are used to working with the former physical conceptualisation employed and developed by the physical sciences. The latter intentional conceptualisation of the world underlies most of the social sciences. The problem appears when these two give competing explanations for the same kind of phenomena.

The technological explanation bundles artefacts, physical structure, and functional explanation. Functionality, which is explained in an intentional language, must be translated to the terminology of structure. The functionality of the artefact exploits natural laws, but the operating principles are bound to the use of the artefact. Natural science is not able to explain the functionality of the artefact before it exists. Technological objects' physical essence and their functionality can be explained with causal connections. For example, a piston moving up and down in a cylinder and the energy it produces can be described as a phenomenon with several features. This description is not enough for deductive reasoning to investigate the functionality of the artefact. This phenomenon can produce several outcomes in different uses. On the other hand, it is also impossible to derive the structure of the artefact just by knowing the functionality. (Kroes, 1998)

> *A technological explanation, therefore, is not a deductive explanation; it connects structure and function on the basis of causal relations and pragmatic rules of actions based on these causal relations.* (Kroes, 1998)

The relation between cause and effect has been discussed through the ages without reaching consensus. In this context, it is sufficient to state: When an effect is caused by another effect, the first one must always be followed by the second, which is consequently caused by the first one. Understanding cause-effect relations enables predictions – after the first phenomenon, the effect it causes is predictable. Experiments in natural sciences are a process of intentionally causing cause-effect conditions. With the notion of technology, we are signifying the knowledge we possess about applying cause and effect in practice. (von Wright, 1961, 177–178)

We consider a phenomenon explained when its causes have been discovered. Natural sciences constitute a system of causal laws. These laws explain how the universe works – all things that happen have some cause. When we turn our focus to the human and society, the notion of causation becomes much more difficult. Individual intentional and social action does not form a deterministic system like the natural sciences do. (von Wright, 1961, 178–179)

G. H. von Wright´s concept of technical norm defines factual statements about the relations between means and ends. When we have a causal law that '*X* causes *A* in situation *B*' we can predict that if *X* happens in situation *B,* it may cause *A*. If the *X* may be chosen by *us* (not by *nature*), the causal law can be converted to a technical norm: *"if we want to achieve aim A, and the situation is type B, then we should bring about cause X".* (Niiniluoto ,1993)

In the context of human sciences, causality is used to represent the cause-effect relationship with respect to human action. When focusing on human behaviour, the role of experience and the context where the agent is operating must be emphasised. In comparison to computer software, humans are likely to act against the rules (Hughes, Kroes & Zwart, 2005). Human beings have the ability to reason, which makes their cause-effect relationship differ from the relationship between the physical objects. Human reasoning creates a possibility to make several different choices in similar situations. Human cause-effect relationships can tell us why someone has done something, but it is never a guarantee that this will happen again. Interaction between physical objects is purely causational, whereas human behaviour bears in itself a significant amount of intentional deliberation (Kroes, 2002).

According to Aristotle, the deliberation related to practical knowledge – practical reasoning – focuses on the means, not on the ends. Because acting or crafting are both focused on reaching an objective, deliberating on the objective itself is not the issue in this context. The objective is based on a presumption like healing the patient or creating the desirable legislation. Deliberation thereby focuses on the ways to reach the objective. Practical reasoning is about choosing the best alternative via deliberation. This process is a linear way to achieve understanding about reaching the objective. (Hintikka, 1974, 89–90)

Designing and the Designer´s Skill

Designing is about devising a course of action which is aimed at changeing existing conditions to something desirable (Simon, 1996, 111). Designing is an intellectual activity aimed at creating a road map or several possibilities to achieve this goal. Unlike craftmanship, designing is about making the path of creating the artefact visible.

> *On the other hand, design science is the activity of generating instrumental knowledge for production and manipulation of natural and artificial systems. Design science produces knowledge which may then be applied within scientific design.* (Niiniluoto, 1993)

Simon (1996, 118) divides designing science into two main topics: 1. Utility theory and statistical decision theory – the logical framework for rational choice among given alternatives and 2. Deducing the optimum alternative.

The computation of the optimum alternative works only in simple cases. When applying utility theory to real-world cases, we must have the tools for actual computations. Even with the traditional rational chess playing case we will encounter the limitations of the computational capacities: In a simple game, winning is about keeping the gearing ratio positive. The process of playing is aimed at exploiting every move in an optimal manner. This kind of computation is not possible within an existing computer's capacities – even the latest chess computers work by evaluating situations within their limited computing capacity. The problem with computation of the optimum alternative is that real-life problems should be solved in the current situation and by real humans or computers. (Simon, 1996, 118–119.)

The latter topic refers to challenges concerning available computation techniques. This perspective concentrates on usage of available counting techniques in comparing possible courses of action. In the real world, the pursuit of an optimal solution is not a realistic objective. In practice, we are forced to choose between good and tolerable alternatives – and we choose the one that seems to be suitable in our current situation. The optimal alternative is more like a theoretical ideal than a practical possibility. Therefore, the comparison between the possible alternatives turns out to be even more important than pursuing the optimal one. The key point is then, how the possible alternatives meet the given criteria of a design task. (Simon, 1996, 119–121)

In a situation where we are searching for an optimal solution to a problem, it is necessary to understand the connection between the observation and the action. Simon (1996, 122) suggests that behind the intentional action, there should be a double connection to the external environment. A system must have the receiving, afferent, connection and the efferent, which is the operant connection. In addition, the system must have a kind of memory system which records information about changes in environment and about the actions that the systems itself has done. According to Simon, achieving objectives is about how the system can build connections between the actions and changes in the external environment. A system can accumulate knowledge about the changes in environment caused by the intentional actions. This kind of systemic design process is useful in all kinds of planning, where the aim is to create courses of action aimed at changing existing situations into preferred ones (Simon, 1996, 111).

Designers' skills are measured by how structure and functionality are combined. In the designing context, the focus is on the structure: What must be created to gain the preferred functionality. The preferred functionality is described by the known cause-effect relationship. In the utilization context the focus is on how to achieve the preferred objective – the reason why the designing task is performed. Designing is about creating possible courses of action for how to achieve the objective. The reason for designing is to create suitable alternatives to gain the preferred outcome – it must connect the structure, the theory, to the real world, to functionality (Kroes, 2002).

Along with designing the alternatives, it is essential to evaluate the suitability of the possible courses of action. According to Simon (1996, 118), it is possible to apply utility theory, statistical decision theory and different kinds of deduction techniques for choosing the best (most applicable) alternative. Mathematical theories have very limited applicability to complex real-life situations. When the problems get more difficult and the deduction becomes harder, the significance of human skills and experience grows even more crucial (Mutanen, 2016).

Conclusion

This brief study on human skill and experience brings us back to the maker's knowledge. Development of the skills is bound to a certain individual – it is impossible to experience something on behalf of someone else. If I want to gain more theoretical knowledge, I have to study. If I want to become a more skillful football player, I must practice. And probably part of becoming a better player also entails some theoretical knowledge. Nevertheless, the essential is the agent – all the skill and knowledge one can utilize is bound to oneself.

When taking steps from craftmanship to designing, we must look back to the essence of the artefact. The artefact is about natural and human causalities. It is a manifestation of the intention-driven functionality and a nature-driven structure. It is something that gets its meaning through human needs. The artefact connects its maker to the theoretical knowledge of natural worlds' causalities and to the intentional knowledge of human needs. This is something which cannot be explained by just one of the pieces.

An artefact can be explained by designing, which is a process that makes the connection between the structure and the function visible. Designing is an attempt to connect the structure and the function. The major difference between design and craftmanship is that the designing process cannot be tacit. Designing could be simultaneously seen as a process that makes something visible and a process where the designer gathers more experience about designing. The outcome of the process is a plan, the designing of something, and during the process, the designer develops their personal knowledge about designing.

There are also some similarities – the designer is also a kind of craftsman. When performing design, he is making some planning visible. At the same, he is becoming more skilled as a designer. In the end designing is a process bound to intentionality and causal connection. To become more skillful as a designer is to better understand the process that connects these two.

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Hiltrud Schinzel

How to Conserve Ideas Expressed by Design? Theoretical Reflections on the Conservation of Design Object

Introduction

In order to reflect a problem in theory it is necessary to strive for a certain objectivity. Often during research in a new field one question leads to another and an overview easily gets lost. Attempts for problem solving might resemble the cutting off of one snake from Medusa's head, with many new ones growing out of the wound. Therefore, it might be useful to start theoretical reflections by searching for analogue situations on a meta-level.

For this aim, let me seduce you to enter the world of Greek myths, and here the story of Orpheus and Eurydice. Both were as intense in love as we contemporaries are with design and lived as happily together as the creator and user of design does when the objects are new and functioning as they should. Unfortunately, Eurydice was stalked by an unloved admirer, she fled, fell down, a snake bit her; she died and had to descend into the dark underworld. Evidently, she died much too early, as early as many synthetic materials do and the cause of their death might look as arbitrary as Eurydice's. Orpheus could not stand the pain, but, as a gifted musician, he had many chances. He bewitched all guards of underworld and even god Hades by his music. This talent must have been as efficient as inventions of science and engineering. He was permitted to take Eurydice back to life under one condition: she had to follow the sound of his music through the darkness of death land, yet he might not turn round to see if she could follow, until they were in the light of life again. This journey might be compared to the attempts of research and experiment to save synthetic materials, which have to follow the rules of science. Nevertheless, they often are in an experimental state and outcomes cannot be predicted. When Orpheus entered sunny upper world, he turned back to look whether Eurydice had followed. Unfortunately, she was still in the dark – he had been too early in turning round and she had to go back again.

In design context this myth can be considered as illustrating a kind of Janus-headedness:

1. One might say, Orpheus had not enough patience, and insofar as he did not obey the given rules, it was his fault that she had to go back. In design context we might call this the "Try and error method".

2. Another interpretation is, that death cannot be conquered, which in human experience is quite true for any material including synthetic in the long run. In design context this means that we cannot avoid final loss of both: material and content.

Both interpretations are fitting for efforts in conservation to save synthetic objects. It is evident, that the qualities of synthetic materials are that complex and research and experience with them so young that patience and time is needed for the development of serious problem solving. It is highly probable however, that not in all cases further research might help to find solutions, in some cases there might be no chance to save a synthetic material anyway; there will be short term use, and, perhaps, long term remembrance (example: plastic rubbish in oceans).

In any case the life of an aged synthetic design object, whose fragility forbids its further functioning and whose optical changes reduce and/or change its aesthetic appearance, is rather similar the non-functioning of dead Eurydice as beloved wife. Her stay in a shadowy underworld is comparable to a design object in a contemporary rubbish-deposit. Orpheus did not succeed leading Eurydice back; insofar our chances are better than his. We evidently can change the environment of a design object. It can be transported from death in a deposit into life in an environment of care and respect. Yet this new life differs from its prior functional one.

An object's bad- or non-functioning comes to the fore most pointedly in its original environment of being used. If it cannot be used any more, it generally is thrown away. Any function must come to an end by its installation into a context of historical presentation; that means being exposed for being looked at as an historical artefact. By this change a new and different life for the object can begin. In a way this state is near to that of the object displaced for selling, before its being used. In the context of selling, it should be as attractive as possible, how it should look like after having lost its function is the topic of the following considerations.

Let me start with quoting the British artist Tony Cragg (in Schinzel, 2001), who made many art objects out of used consumer goods of plastic material, which he found at the banks of the river Rhine, where they had been thrown away. Cragg, fortunately, gave us insight on why he did this:

> *We now surround ourselves with so many new materials, plastic materials, that we can't possibly have that understanding, that same metaphysical relationship to them (complete: as to natural materials and objects). If we work on the premiss that the quality and nature of our environment and what we are surrounded with is actually having a very direct affect on us, on our sensibilities, perhaps even our emotions and intellect, then we have to be more careful with these objects and spend more time learning something*

> *about them. A precondition for working with man-made materials is, that they are equally worthy of carrying significant meanings as natural materials...and as such belong to a huge category of materials/objects which are integral to the physical, intellectual and emotional lives of man. There is a lot of work to be done to actually make a mythology for this (plastic) material over and above its extremely practical and utilitarian value.... Objects cannot be judged on physical form alone, not even on metaphysical qualities either. Often the criteria we use must also involve categories external to the object.*

For to make *a mythology for plastic materials*, we have to preserve the semantics of the objects and the traces of their history. For conservation practice this means, very roughly, that polishing the objects to a state resembling them being new is out of the question. Degraded material should be conserved as far as possible, but traces of aging and use should be left on the objects.

The question remains, however, how to conserve the function of the design object, which in a way is *external to the object*, as Tony Cragg stated, and which gets lost in the new environment of presentation. This functioning is a part of the works originality, although it might not be a visible one. It is of historical importance and linked to the concept of its creators.

Function might also be linked to aesthetics; this can be a consciously intended act of the creator or a rather unconscious by-product. In any case there is a bond between aesthetics and function in a design and architectural object, which is different from an artwork. An artwork is created to be looked at as an art pour l'art piece, to exaggerate a bit. In design as well as in architecture in many cases (for instance ergometric design) the ideal functional form is linked to its optimal aesthetic design.

Therefore, for a design object a lack of function means an essential handicap insofar as the loss of original function in the new context of presentation for the sake of a public's historical consciousness, paradoxically, includes a loss of historical as well as aesthetic values. The same is the case with aged artworks, yet here the loss is not so obvious. To point out differences, we must analyse.

The artwork as well as the design object might be defined as an artefact consisting of material and content. In the artwork the material is usually classified in media which are linked to a certain technology. Material and medium are to a greater or lesser extent also linked to content. There exists a great variety and complexity of contents for artworks, yet all are materialized reflections and therefore ideal.

In contrast to this, both the design object's and architecture's main content is a certain function, which is linked to the choice of material too. I quote Greg Andonian, an architect: *"Architecture is structuring in order to sustain nature – stand up against its threats"*, design is structuring in order to make human living rich, easy and comfortable. *"Discoveries in science are discoveries of the laws of nature and have been used to develop technology, which has been used to improve human being's living conditions, which includes fighting the threats of nature".* Because of their functional aims, which concern nature and our environment as a whole, both "*architecture* (and design in general) *are primarily involved by ethics and politics".* (Andonian, 2006)

Artworks and design objects degrade sooner or later to a greater of lesser degree and need to be conserved. Let me introduce a definition of restoration of fine art here, which in the following shall be critically looked at as to its being applicable to the design object.

As regards the relation of material and content in an artwork under conservation aspects might be called the mind and matter problem. Both partly keep stable, partly undergo changes in time. The constant as well as the changing material and textual components of the artwork come to the fore and are made conscious by an artwork's adaptation to the contemporary viewer during conservation treatments. Conservation resembles the actual summing up of the artwork's material state as well as of its ideal contents at the time of implementation of restoration. In this context the conserved artwork may be defined as a collage of materialized historical time. (The definition is an analogy to Keith Cottinghams description of his digital photos: "The illusion of photographic authenticity allows me to combine different, even contrasting contexts. In that way the artwork does not become the collage of an image, it becomes a collage of reality, presented as a coherent and realistic photograph." (Quoted in Butin, 2002)

It is important to note that restoration today does not mean to regain a former state. An international meeting at the British Museum in 1999 with the title: *"Reversibility, does it exist?"* (in Schinzel, 1999) made quite clear that going back is not possible for restoration-materials nor for material and content of any object. Time is not reversible in real life and real material. We might simulate going back with new technology, but as long as we treat an object's real material we fail (this might be another interpretation of Orpheus story: if we look back, we notice that the past no longer exists). It is important to note that because we may go back to the past virtually in memory provided by simulation, there is less necessity to do this in reality. This is a certain relief for the conservator, but does not solve the problem, as in exhibition history up to now no substitute could replace the fascination of the real object.

If conservation treatment is a collage of materialized historical time, the restorer is forced to select which remnants of time he/she chooses to conserve and to what degree this should be done. There are differences between design object and artwork, concerning what should be selected as summarizing an object's most important features.

Most artworks are just looked at; their function is to provoke emotions, associations, reflections etc. in the spectator by mere sight. *"One can use an object or an image in the way philosophy has used words to describe things, to express ideas",* says artist Tony Cragg. The design object does the same, but its primary aim is to be useful for man's comfort in living. This as a rule is the reason for its creation. Insofar, it has been designed for a contemporary user, its adaptation for a later museum viewer by conservation includes a change of concept. This is not the case for the artwork, which has been meant for being looked at exclusively from the outset.

Traces of time are both traces of ageing material and traces of use. Traces of use can be found on the design object, whereas on the artwork they are usually lacking, because it should not be touched, sat on, moved etc. Traces of mechanical use generally (exceptions can be found in contemporary art like kinetic art, interactive art etc.) are involuntary (like damages caused by change of place by transport and other risks) and have no historical importance for the artwork. The design object is designed for being used. Its traces of use are important, because they document its function and at the same time change its appearance. Vital in many cases is not only the fact that the object was used, but also who used it at which time, and if and how the original use changed in the passing of time.

The meaning of an artwork, its interpretation, changes too during the flux of time. Interactive art like installations show quite clearly that the meaning of the artwork is not restricted to the original artistic concept, that its perception varies according to the ruling *zeitgeist* and consequently new meanings are added to it constantly with each viewer. Its topical interpretation may be made visible by conservation treatments.

To show an artwork's various interpretations we need not to touch it. We can document them externally to a high degree with the help of art history and many technical tools. Sometimes we can see misinterpretation of the work in traces of former restorations, striking examples might be the fig leaves on antique sculptures.

The interpretation of the design object is mostly given by its function and its use, it is not as difficult to describe and as mysterious as might be the case with an artwork. In this respect the design object is less complex than the artwork. Yet, to document function and use, we need different and more complex methods than those fitting for art-interpretation. The process of creation, research on materials, cooperation of creator and researcher with engineering and industry necessary for production, experiments, failures, successes, its spreading and use after coming on the market, all this is important for the understanding of the design object's function. Documentation of all these givens is necessary for the representation of its historical status.

Today documentation shifts from the written word to other means of expression, most of them visual, which corresponds to the dominance and impact of images in our contemporary environment. The complexity of the design object's documentation can be demonstrated by the analytical work of the concept artist Joseph Koshut, who for instance shows a real chair next to the chair's photograph and its verbal description in a lexicon. In case of a design object the term conservation therefore should not be restricted to solely treating the material; it got to include presentation and documentation. In a museum context, the function of a work cannot be conserved by interfering with its material alone; other means need to be developed for this aim.

Nevertheless, all expanded documentation will not substitute the lack of function, because documentation is able to preserve the historical value of a work only, but not its aesthetics. The aesthetics of a design object is not only visual; its tactility in most cases is at least of the same importance.

New forms of presentation of industrial design have already been found and combined with documentation (example: Tupperware Exhibition at Design Museum Gent 2006). They provide a new, purely aesthetic experience of the objects, which does not replace former function, because experience of use is different, but provides a substitute for experience as such. Experience of function is not often provided in design exhibitions; still it could be done in many cases with the help of a copy. Such ways of regaining original tactile experience for the visitor can be found in technical museums and sometimes in exhibitions of pre-historical cultural goods.

This leads us to another feature of the design object, its reproducibility. Often it is much easier and cheaper to reproduce an industrial object than to conserve it. This phenomenon can be found in contemporary art too, where many objects are no longer produced by handicraft, but industrially and with the help of different experts. This fact has influence on the understanding of the term authenticity, which needs to be enlarged or mutated for industrially produced artefacts. In contemporary art, which uses new media and technology, the meaning of being authentic is restricted to legal copyright and no longer connected to the aesthetic value of handicraft. This might be the same for a design object.

Often an artist updates his/her work(s) when a copy is asked for and/or necessary when the bought copy has degraded. This is the case with photographs and the like, one medium well known for its survival problems being video. Here a great discussion is taking place today about the "original" original. Which one might it be in case of many different copies from the same time and how should it be named, as the term original in this context has no longer its traditional meaning. In design we might speak about the prototype, of which a number of pieces still might exist, presumably with different traces of aging. Analysis of the differences between the term"original" (Appropriation Art' for instance criticises the traditional concept of originality) and its "relatives" like replica, copy, multiple, serial (art), pastiche, substitute etc. will be necessary to clear up matters here.

Reproducibility has its advantages for the practical conservation of design objects. There usually exists more than one piece of the first production. Consequently, one may have the opportunity to select the most fitting for conservation and presentation. Furthermore, experiments are often necessary, for conservation contains more risks when working on a unique specimen as is generally the case with fine art (one exception is the work of Fabrizio Plessi, whose concept of design resembles that of an artwork).

A glance aside at archaeology shows that this science faces similar problems to those which conservation has with reproducible contemporary art and design objects. Although in our case the problem is complexity, simply expressed as "the too much", and in archaeology the problem is loss of information, the not enough, structurally there exist comparable circumstances. There is the problem of a lively presentation of relics of consumer goods and vivid demonstration what for and how they were used (here conservators could also compare problems concerning presentation and documentation of large industrial complexes and environments with archaeological sites, for instance their integration into landscape, sharing and spreading of population in the area, accessibility to water and other human needs etc.). Another problem is the question which might be the 'most original' original of many slightly different copies e.g. in roman portraiture. Then we have the problem with antique sculpture, where the Greek original is lost, and only Roman copies are left. These generally turn out more or less different yet the appearance of the Greek original should be deduced from these Roman copies. There are problems of original settings of urban design, setting of sculptural groups (e.g. Bernard Andreae's research on the Polyphem group off Sperlonga) in different environments etc.).

Most of the terms mentioned have been in use in this field already for a long time and some might have been analysed (scientific research in the field of "Kopienkritik" (critique of copies) might give hints for clearing up our terminology). For visual as well as other kinds of documentation archaeology has developed methods and rules, which we could prove for being applicable. Arguments over centuries (famous example is the Laokoon group) on the degree of complementing of applied as well as fine art objects are linked to archaeological research and fashions. They are often documented in scientific publications. The influence of these arguments on exhibition concepts, techniques and fashions, their advantages and disadvantages, could be instructive. In this long tradition we might find analogies, but also differences, both may make our contemporary situation more transparent, and, last not least, we could learn a lot from historical errors (famous examples are the Aegina figures and the Barberini faun, presented in conservation context (Wünsche, 2003)).

In which way and how far a related research field like archaeology may help, can only be proved by experience. For today one of the main challenges for conservation of design objects is, how to conserve the experience of its function, its use. There are big contrasts in perceptions and conceptions between the hard and soft sciences and culture. One trend is being addicted to often irrational emotions and greed for experience, demonstrated by so-called event-culture. In contemporary philosophy one is inclined to relate these items to barbarism of a new middle-age. The other is a desire to structure and regulate life according to strict rules. Precondition for further evolution seems to be the worship of the god technology. This attitude might be a last remnant of positivistic ideas of the 19th century based on rationalist ideas of the Enlightenment. A combination of both trends should solve our problem. Imaginable would be a cyberspace-experience conveying not only the design object's use, but also its historical context including personalities, fashion, socio-political vibrations etc. This of course is a dream today, because it will need a lot of historical as well as technological research and funds for its realization, yet it is "a dream that money could buy".

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The following articles are peer-reviewed

II
CRAFT APPLICATIONS IN THE DIGITAL AGE

Gunnel Nyman was an important pioneer in finding the general ethos of modern glass design in Finland. This can be seen in her drop glass thematic and its variation. (Photo: Tarkko Oksala)

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Antony Radford

The Perception of Craft in a Digital Age

Introduction

This essay considers the nature of 'craft' in a digital age, and the relation of craft to the concept of responsive cohesion. It considers 'craft' as a verb: does the notion of 'hand crafting' extend to the use of stylus and keyboard? How much can automated generation be incorporated in a process of crafting? It considers 'craft' as a noun, with questions of perception and interpretation: when does a human invest an object or process as having a craft character? Can an object be considered 'crafted' if it derives wholly or partly from artificial intelligence and numeric-controlled machines? These are questions without clear answers, depending on how craft is defined and how objects and processes are perceived.

From the 1970s the technologies of digital media and numeric controlled machinery have become increasingly pervasive during a transition from the 'modern industrial' age (beginning in the mid-19*th* century) to the current 'digital age'. As a label for our times, the 'digital age' is an extreme simplification, but so are familiar labels such as 'stone age' and 'iron age'. This essay will focus on the role of responsive cohesion in the perception of craft and craftworks in the digital age. The term 'responsive cohesion' was coined by philosopher Warwick Fox and is the core of his Theory of General Ethics (Fox, 2006). Responsive cohesion recurs in interrelationships between makers, tools and the objects they make, and between those crafted objects, their users and the wider world. I shall use the term in the following sections, and then comment on its place in ethics in relation to the place and role of craft in the contemporary world.

Definitions of craft typically refer to skills in planning and making, and things that are produced with or require such skills. Although craft has been used to label a distinct phase in the history of industrial production (Victor & Boynton, 1998), this definition transfers seamlessly from handiwork to industrial production to digital media and numeric-controlled machines. Skill is certainly needed in digital design and production (Bruton & Radford, 2012). The *perception* of craft is more complex and contested. Despite the broad scope of 'skill in planning and making', we tend to think of traditional craft: a skilled craftsperson working with their hands in a workshop or studio making useful things following time-honoured processes that are imbedded in local culture (Boden, 2000). The craftsperson independently engages with the final product with some freedom but not necessarily great originality. Examples are pottery, weaving, carpentry, leatherwork and brewing.

A crate of small objects

In my studio, I have a crate on a wall containing a collection of small objects (figure 1); each cell of the crate is about a 5cm cube. The action of placing objects in one of the boxes frames and equalizes them, so that the silver pepper pot (top left) has the same apparent status as a rock (bottom right).

Figure 1. A crate of small objects. All photographs are by the author except where stated.

The hand-made bowl of a clay pipe (third row, right hand side) and the small pot (fifth row, middle) are pre-industrial examples of traditional handicraft. The crate itself is hand crafted (I know, I made it) using a contemporary manufactured product, MDF (medium-density fibreboard). The stainless steel salt and pepper pots (second row middle) are mid 20th century industrial products. The sub-surface laser engraving in a crystal cube (third row, left) and the grey selective laser-sintered lattice-sided cube below it (fourth row, left; it contains loose letters) are products of digital modeling and fabrication. Which of these are craft products? I shall return to this question at the end of my essay, but there is no clear answer. Perceptions of craft depend on who perceives and what they regard as craft. Meanwhile, I want to discuss the relationships between the objects, the crate, and me.

The objects are not random or arbitrary. They are chosen because they are evocative, specifically evocative for me when I look at them. The silver salt pot (top left) is a family heirloom. The stainless steel ones are part of a 'cylinder line' range of tableware designed by one of Denmark's foremost modernist architects, Arne Jacobsen; I bought them when I worked in Copenhagen for a year in 1970 as an apprentice architect learning the craft of architecture. The crystal cube was given to me on a visit to the South China University of Technology in Guangzhou in 2014. I respond to these objects. But the way I respond is subtly different each time I see them. Sometimes I think of their form irrespective of function or history, sometimes I think of their personal relationship with me, and sometimes I think of their materiality and the way they were made. Sometimes I re-arrange the objects in the crate. The arrangement is not arbitrary, but neither does it follow obvious rules of age, type, size, or whatever. The arrangement has a less obvious but simple aim: it is to make the 'whole' as good as possible, where the 'whole' includes the crate and its contents plus me looking at the crate. The choice of individual object, in which box it is placed, and how it is placed, are all less important than that they work together to make a good 'whole', where the relevant whole is the combination of objects + crate + me.

Fox (2006) compares extremes of discohesion and fixed cohesion with the relational quality of responsive cohesion. If the individual objects were arbitrary, if they were randomly pushed into the crate (not even one in every box) and I did not relate to them, we could hardly expect any kind of cohesion in the whole. If cohesion is entirely absent, there is discohesion. If I had followed strict rules (the objects had to be identical, arranged in a precise matrix, and never altered, so that I always respond to them in much the same way) then the 'whole' might still be cohesive but the richness of the ways in which the parts respond to each other, and my response to them, would be reduced. There would be a shift towards fixed relationships between the parts and fixed cohesion in the whole. My aim (and I hope the result) is a more interesting and complex kind of cohesion, responsive cohesion. The whole holds together by the mutual interaction of the parts. Admittedly, in my crate there is some rule-following (notably the regular grid of the crate itself and symmetry in many of the objects), in accord with research showing that both order and complexity are needed for human aesthetic appreciation (Van Geert & Wagemans, 2020). I hope there is no discohesion.

Makers, Tools and Objects

In craft work (Sennett, 2008) there must be some kind of responsive cohesion between a human and a tool, with each continuously responding to the other so that the 'whole' (human plus tool) works effectively. Skill and experience with a tool (or tools) is a core part of hand craftsmanship: carpenter and chisel, painter and brush, embroiderer and needle. The tool seems to be an extension of the body; the mind does not think what the hand must do to manipulate the brush, the hand and brush become one, a brush-hand (Pallasmaa 2009, p. 48). In traditional craftwork there is also some kind of responsive cohesion between a human and the crafted object. The human gives form to the object, and the developing object 'talks back' to the human; Donald Schön characterized any reflective practice as a "conversation with the situation" (Schön, 1984). For the craftsperson, this 'conversation' is enjoyable, engaging, addictive. Juhani Pallasmaa writes that "When I see the total correspondence and unexplained affinity of a craftsman's persona, his/her hands and his/her workshop environment, I am deeply moved", noting the unity of professional world, hands and place, and the "marriage of an individual and craft, responsibility and pride" (Pallasmaa, 2009, 50).

Much has been written about digital craft. One of the first books was *Abstracting Craft: The Practiced Digital Hand*, published in 1997. In it, Malcolm McCullough discusses the interaction of maker and tool in digital craft:

> *As a point of departure, consider the example of a skilled computer graphics artisan if we may use this word. His or her hands are performing a sophisticated and unprecedented set of actions. These motions are quick, small, and repetitive, as in much traditional handwork, but somehow they differ. For one thing, they are faster; in fact, their rates matter quite a bit. They do not rely on pressure so much as position, velocity, or acceleration. The artisan's eye is not on the hand but elsewhere, on a screen.* (McCullough, 1997, 19)

McCullough (2015) describes the changing role of the hand in digital work as interfaces matured.

The eye is on the screen, because that is where the action is. In traditional handicraft, the eye is not so much on the hand but on the point where the crafted object is changing: the hands on clay for a potter, the edge of a chisel on wood for a carpenter, the tip of a soldering iron for a metalworker. While I type, my eye is on the cursor as letters appear, not on my fingers on the keyboard. The cursor is an extension to my fingers, more distant than the tip of a chisel at the end of a shaft but similarly responding instantly to the actions of my muscles. I have a cursor-hand.

For a 'computer graphics artisan' making computer graphics (or a virtual reality scene, or a computer game) there is a similar connection between craftsperson and product as in traditional handicraft. The crafted product is digital and the craftsperson is working directly on a product that is digital, like a woodworker working directly on wood and a metalworker on metal. However, when the final product is not digital but physical, the image on the screen is an intermediate stage inserted between the craftsperson's action and the end product. This is a significant difference, because an important characteristic of traditional craft is the direct connection between craftsperson and the materiality of the product. Pallasmaa (2009, 55) writes that "The work of the craftsman implies collaboration with his material". In the digital sphere, there is still responsive cohesion between a human and a tool, but the tool now is working on a model or description of the object and not on the object itself. The designer and end product are separated, so the responsive cohesion is between the human, the tool, and a model as substitute for the crafted object.

Consider a traditional craft furniture maker. He or she may use drawings, may even use a model or prototype to test and explain how the finished piece will look. There are components to be crafted and then assembled, following a well-established sequence of activities. Consider a digital craft furniture maker. He or she will make a digital model using computer software, then send the data from that model to a selective laser sintering machine for an aluminium chair, or a numeric-controlled laser cutter for a plywood chair. In the first case, the object is crafted directly, while in the second case a digital model is crafted that is then used to make the object. Production in the digital age is about the flow of information: "design prototypes become design specifications, then process models, then machine instructions" (McCullough, 1997, 179). The "sensual and tactile connection between imagination and the object of design" is broken (Pallasmaa, 2009, 65).

There is a long history of computers in art (Wands 2006). "The genre of 'computer art' began in the 1950s, when long exposure photography was used to capture images created by an oscilloscope manipulating electronic waves on a small fluorescent screen. .... By the 1990s, the term computer art was fading, and computers were becoming a mainstream part of arts and entertainment" (Avila & Bailey, 2016, 6).

Figure 2. Dean Bruton (1951-) 'Dean, Judy and Dog', 16w x 13h x 5d cm. ABS 3D print, 2012 (left); 'Viv102', 60w x 50h x 28d cm. Stone/cement block, 2020 (right). Photographs by Dean Bruton.

As an artist who has made sculpture via 3D modeling / 3D printing as well as hand sculpting directly on a block of material (figure 2), Dean Bruton comments that "I found the process fun at first but consider the plastic artefacts bland but strangely intriguing. The output is so mechanical, there is no chance of variation whilst the print is in action." There is no opportunity for the artist to respond interactively with an emerging 3D sculpture and its materiality, only with 2D images of the model. "This contrasts with … involvement of interpretative manipulation within the relational cohesion … a closer connection to the medium and materials compared to digital design tools." For him, in painting too "The fun is in the hand crafting of the paint surfaces and the manipulation of the subjects' light and space" (Bruton 2020). Taipo Wirkkala compared traditional craft to industrial production in similar terms. "The craftsman has the advantage that at every stage of the work his material is in his hands to feel and command. In industry, the material is constantly subordinate to some preplanned law and machinery and once the job has begun it is difficult to make changes" (quoted in Pallasmaa, 2009, 56).

Contemporary architecture typically requires both digital craft and handicraft. Two buildings that push the boundaries of traditional craft skills illustrate this combination. In Australia, architect Frank Gehry's design for the brick external wall of the Dr Chau Chak Wing Building (2014) (figure 3) for the University of Technology, Sydney, required skilled digital modeling in his California studio after design development using physical models. The digital model was used to make drawings to be interpreted by skilled bricklayers on site in Sydney. In an interview included in a documentary about Gehry's architecture (ABC, 2015), one of these bricklayers described his enjoyment of building the unusual walls, the pleasure of coming to work knowing it would be challenging. If in craft we expect a direct connection between a craftsperson and a product, the designer crafted the digital model and the bricklayer crafted the wall.

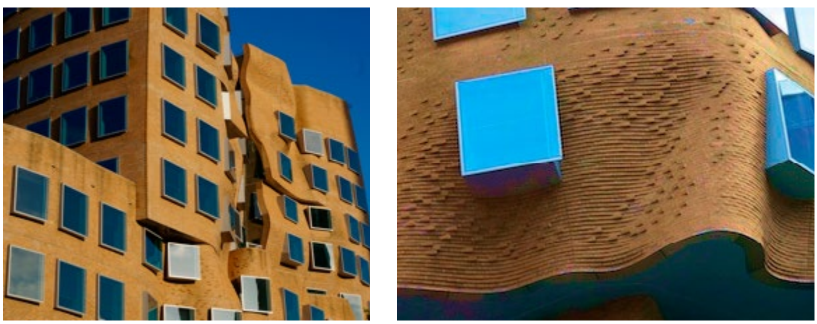

Figure 3. Dr Chau Chak Wing Building, Sydney, Australia, designed by Frank Gehry.

In China, architect Ma Yansong's design for the interior of the Grand Theatre foyer of the Harbin Opera House (2015) (figure 4) required digital modeling in the office of MAD Architects in Beijing and skilled carpentry on site in Harbin. "Ma's formal and spatial manoeuvres here seem driven by a sensibility that is far removed from algorithmic techniques of tracing movement vectors or iterating attractors that underlie the methodology of parametricism. It appears sculptural, in the old-fashioned sense of shaping matter to infuse it with life. Ma: 'I don't want to make those lines very cold or mechanical or computer-generated. I want to give them a hand-crafted quality... a sense of life. But at the same time, I want to keep a certain level of abstraction'" (Worrall, 2016, 73).


Figure 4. Harbin Opera House, Harbin, China, designed by Ma Yansong (MAD Architects). Photographs by Julian Worrall.

Instances and Series

These two buildings are unique, but in traditional craft a product is often one of a series with small variations between them. Members of a series of African wooden whistles and snuffboxes vary according to the piece of wood from which they are made and deliberate choices of their makers (figure 5). Part of the responsive cohesion between the carver and emerging object is the way in which the maker responds individually to each piece of wood. Members of a set of nine digital objects (they were never made physical) vary using parametric modeling. The responsive cohesion between maker and object is about reflecting on and reacting to emergent forms to set parameters for the next form. The product is digital, so the craftsperson is working directly with the product.


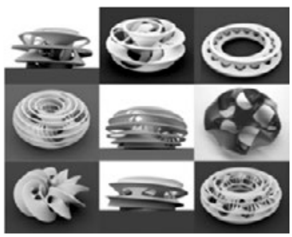

Figure 5. Whistles and snuffboxes hand crafted in East Africa (left); Parametric variations of a digital object by Xiong Lu (right).

Using most current design software, designers can save multiple versions of files or store partial alternatives on separate layers and flip from one to another. A more radical change is the development of software that will work directly and simultaneously on whole fields of possibilities instead of individuals, because this is a mode of working that is impossible in traditional art and craft. Then "parameters can control any feature of a model, that is, can be used to effectively switch between models. Thus two alternatives can result in arbitrarily different design configurations" (Woodbury, Mohiuddin & Cichy, 2020, 51).

Whether working with individuals or fields, every instance can be traced to the choices and actions of a human. The operators in a parametric model are essentially sets of rules by which alternatives are generated. Such rules are set by humans using skill and experience to exploit a sophisticated tool. What if the software operates with neural networks that "learn" to perform tasks by analysing lots of examples without being programmed with task-specific rules? Computer systems might generate whistles and snuffboxes having been "taught" to do so by finding commonalities and permissible variations in a large corpus of examples. In painting and music, these techniques have been used to generate products that are not easily distinguishable from those of human painters and composers (Avila & Bailey, 2016, 6). The identities of the 'craft people' are then diffused. They include those who made (crafted) the examples used to 'train' the software, the person or team who wrote (crafted) the software and selected the 'training set' of examples, along with the person or people who used the software as a very sophisticated tool in some kind of collaborative process to generate and select the products. The user (or viewer or listener) may not be aware of its origin.

Craftworks and Users

Humans can develop a lasting relationship with things (Quibell, 2016). To be valued, there must be some kind of responsive cohesion between that thing and its user. More than just its form and functionality, a traditional craft object appeals by 'talking back' to its user. It shows how it was made, the skill and experience of the craftsperson.

> *Since the thing is made by human hands, the craft object preserves the fingerprints be they real or metaphorical of the artisan who fashioned it. These imprints are not the signature of the artist; they are not a name. Nor are they a trademark. Rather, they are a sign: the scarcely visible, faded scar commemorating the original brotherhood of men and their separation.* (Paz, 1974, quoted in McCullough, 1998, 10)

A craft object is not routine, not mass-produced, not ignorable, not ordinary. There are assumptions of individuality and of time and care invested in the crafting which gives the crafted object value, prompting a repeated sense of wonder, of pleasure in use, and enhancing a sense of living.

The imprecision of the crafted object, with its ambiguity and hence accessibility to many interpretations, also facilitates responsive cohesion between the object and a human. Architect Geoffrey Twibill, in 1988 one of the early adopters of digital media in architecture, commented on doing design drawings with a computer drafting system:

> *A bit of a disaster really. The design drawings looked ugly. The Councils didn't like them, saw them as some kind of technical thing – trees looking like pyramids and so on. The client didn't like them either; the first sketches had been done in 2B pencil, very soft, but the developed design versions looked hard. They preferred the first versions and turned down the second. We had to do it all again by hand.* (Radford, 1988, 60)

Now this can be faked; a computer program can make 'hard' CAD drawings look like hand drawings, and they would presumably get the same reaction from the client as 'real' hand drawings. If a neural network generates the data to cause a numeric-controlled machine to make an object that looks and works like one of my African whistles, my response to it will presumably be the same, at least if I do not recognize it as a fake. Faked handcraft is usually obvious, but appropriating the craft label without obvious subterfuge is common: multinational brewers sell 'craft' beers as if they are small-scale local products and there is a long history of non-Indigenous people mimicking Indigenous people's craftwork. Without overt faking, appropriating the associations of craft products is even commoner. IKEA's range of domestic products do not claim (and are not mistaken) to be hand crafted, but many of their designs are evocative of Swedish tradition and handcraft.

I have referred to architecture that pushes the boundaries of traditional crafts. The brickwork in the Dr Chau Chak Wing Building in Sydney and the woodwork in the Harbin Opera House needed skillful bricklayers and carpenters, but neither is constructed using the conventional knowledge and techniques of those crafts. The bricks are clamped with steel rods to a frame that holds them in place, and without the frame the wall would collapse. While designing the Indian Institute of Management (1974), the American architect Louis Kahn famously talked of asking a brick what it wanted, and the brick said it wanted an arch (Wurman, 1986, 252; Srivastava, 2009). I cannot image a brick wanting to be clamped to a frame. The wood strips in the Harbin Opera House are glued to a shell of glass reinforced gypsum, not screwed to a timber framework. Looking at them, we can surmise that the surfaces were designed with computer modeling and we can admire the skills of those involved, but unlike traditional brickwork and carpentry, looking at them does not reveal how these walls are built, and that feels like a loss of integrity in the expression of those crafts.

The architecture of Murcutt Lewin Lark's (architects) Arthur and Yvonne Boyd Education Centre in Riversdale, Australia (1999) (figure 6) was designed and documented without digital tools (the engineers did use computer-aided design and drafting). The expression and precision of the building testifies to the craft skills of the builders, applying their skills in conventional ways. The building's 'users' can occupy and explore, and enjoy its qualities of function, art and craft. Verdy Kwee's digital version was built using the same architects' and engineers' drawings as the physical building but with different intent and very different skills. This version's users can also explore, by 'taking apart' and 'slicing through' the building to reveal and focus on its elements. The responsive cohesion between object and users in the physical and digital versions are both apparent but different, and neither can replace the other.

Figure 6. Physical (left) and digital (centre and right) versions of the Arthur and Yvonne Boyd Education Centre (1999), designed by Glenn Murcutt, Wendy Lewin and Reg Lark, Australia. Centre and right images by Verdy Kwee.

Sometimes craftspeople do craft digital models, personally supervise their translation into physical elements using digital machines, and assemble the resulting parts. A small shelter (figure 7) designed and built in 2019 by students of the School of Architecture at the South China University of Technology, guided by Xiong Lu (who crafted the parametric digital objects in figure 2) is an example. Whereas the hard edges of the Arthur and Yvonne Boyd Education Centre contrast with its natural setting, this structure appears soft and organic. Its construction is not immediately obvious, but it looks hand made. There is a concrete surface, but it is cast on fabric formwork and appears fragile, without the thickness and mass that we expect of concrete. The shelter is very much a product of a digital age, using parametric modelling in its design and both robot arm milling and laser cutting in its fabrication (AGF, 2019). The frame and modules vary without the exact repetition expected in mass-produced industrial products, and more like the variations on a theme found in the branches and leaves of the plants in the surrounding garden. People engage with it, and few would say that it is not a crafted product.

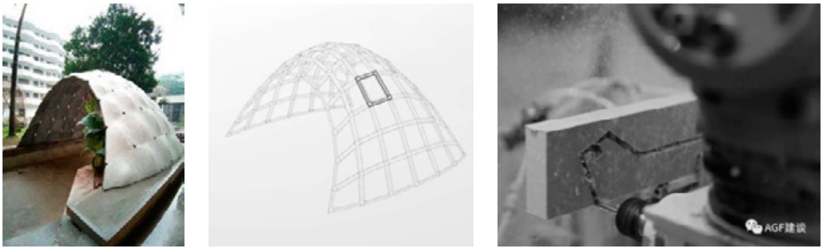

Figure 7. Small shelter in South China University of Technology, Guangzhou, China (left); a module highlighted in a digital model (centre); a robot arm milling a groove on one side of a module (right) (images by Xiong Lu (left) and Miao Bowen (centre and right)

Craft and its Contexts

There is some kind of responsive cohesion between traditional craft and its specific physical, social and environmental place, where the parts contribute to and reinforce the whole. Isis Brook (2019) draws attention to the difference between place and space: place is geographically and culturally distinctive while space is indistinguishable emptiness. Local craft is a part of a place's cultural distinction (Tuan, 1977). This is recognized in the desire to protect labels such as champagne, Parma ham, and feta cheese. The Arts and Crafts movement (neither art nor craft is subsumed in the other) at the turn of the 19th and 20th centuries was a reaction against the blandness, lack of variety and placeless-ness in the products as well as what was perceived to be a de-crafting of production with associated losses in the dignity and satisfaction of the producers.

> *The handcrafted object reflects not only an informal economy of energy (as opposed to one of process efficiency), but also pleasure. Its production involves some play, some waste, and above all a kind of communion. Its long life continues to enhance its qualities through use and contemplation .... As an object it represents and serves its culture; its daily handling is a humble act of participation in that culture.* (McCullough, 1997, 10)

Industrialization distanced the object from the designer. It replaced hand tools by machines that were expensive, often complex, and carried out repetitive and inflexible processes. Efficiency could best be achieved by concentrating machinery in factories. The result distanced the designer from the product, separating the people who design from the people who make, elevating the status of the designer and downgrading the status of the maker. Digitization takes this further, facilitating globalization. There is little additional cost in dataflow across the world over dataflow across a studio. Dean Bruton's sculpture 'Dean, Judith and Dog' was modeled in

Australia and 3D printed in France. Communities of digital craftspeople rely less on local contact than on global communication and the internet.

In Fox's work, the achievement and promotion of responsive cohesion is the foundational value in his Theory of General Ethics (Fox, 2006). The goal of making the 'whole' as good as possible is captured in a 'Theory of Contexts' which asserts that responsive cohesion in a whole (a part with its contexts) is more important than responsive cohesion in any part, although both should be sought. The largest and most important 'whole' is the natural or biophysical environment, because that sustains all other systems. The next largest 'whole' is the social environment. Craftwork and the products of craft are not exceptions. Given the social and environmental challenges that exist in our globalised digital age, the 'skills in planning and making' in good craft should sustain those who do craft, those who use craft, and their social and physical contexts in the wider world.

Conclusion

If we focus on craft as the use of skill and experience, and objects or activities that are produced with or require skill and experience, then craft continued through industrialization and into the current digital age. Indeed, we can argue that the scope of craft is enriched and expanded beyond the limits of 'hand-craft' to include the products and processes of industry and digital media. The skill involved in generating craft-like products via a neural network can be recognized and appreciated. But this is not the perception of craft held by most people. The idea of craft has connotations beyond skill and experience. The label suggests care and pleasure for a maker who connects with the materiality of a final product that carries the mark of the maker. The products are unique, although they may be one of a series of similar products. They are local.

I live in a country town where every year there is a week of 'open studios' where we can visit places where printing, photography, woodblocks, metalwork, painting, weaving, and other arts and crafts take place. Art and craft often overlap, and most are operated by people motivated by pleasure rather than profit. I have yet to encounter a studio with a 3D printer, but there are studios where images have been created or photographs modified with computer software and the people involved consider themselves to be artists and craftspeople. I expect soon to come across small, cheap, 3D printers. Whereas industrial products are almost inevitably standardized and obviously the product of mass production, the products of digital craft can share the cultural identity and 'unique instance in a series' quality of handcrafted products.

Early in this essay, I posed the question of whether all the objects in my studio crate (figure 1) could be perceived as craft objects. Using craft as a metaphor, the answer is arguably 'yes'. Even an animal bone (row 5, left) can be metaphorically 'crafted by nature', although the idea of water crafting the smooth surface of the rock is less acceptable. Using craft as a term for 'produced with skills in planning and making' by a human, the answer is 'most'. Using craft to include the additional need for an object to 'carry the marks of the tools', the answer is still 'most'; with a little knowledge of relevant technologies we can see how they were produced, although the industrial and digital products distance the objects in the crate from the pre-production physical or digital models crafted by their designers. Adding a requirement to be able to see local cultural origin, many of the industrial products remain. We can recognize Danish and Finnish design (row 2, centre and right) and the characteristic styles of their makers. The digital products are excluded; the culture of digital design is international, without clear local distinctions. Adding a requirement for handicraft, only the products of traditional craft remain: Estonian woodwork, Chinese ceramics, Vietnamese raffia work.

The perception of craft in a digital age depends on what is craft and who perceives, and both are variables. However, there is always an expectation of interactive mutual relationships, of responsive cohesion, between makers, tools, and products, and between products (carrying traces of the makers and the tools) and their users. In craft, as in all human activities in the contemporary world, there is an additional responsibility to consider the impact of processes and products on wider social and environmental contexts. The ideal (and possibly idealistic) digital craft artisans will exploit the potential of computation, dataflow and digital fabrication to make things that carry their marks, give pleasure to people, and contribute to better personal, local and global wholes.

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Ewa Grabska, Iwona Grabska-Gradzińska & Teresa Frodyma

The Role of Typography in Visual Design

Introduction

The intention of our study is to investigate the relationship between three key domains: craft, technology and design. The study itself is based on the concept of visual design and illustrated by examples of selected aspects of typography. The key domains, on the other hand, are driven by visual perception – from a creative perspective. However, in order to understand the interaction between the user and the designed object, we need to look into the process, which consists of numerous 'acts of attention' often referred to as visual queries. It leads to the concept of dynamic perception, which is the resultant of external graphic information and a constructive mental process (Ware, 2008). Such dynamic perception is often associated with the concept of favourable circumstances which influence perception of particular objects considerably. Needless to say – the way they are perceived depends on the perceptive abilities of the individual, his/her experience and other skills.

An interesting example of the combination of the craft and design process is evolution of the font shape stemming from the craftsman's creativity to the algorithms of the UTF encoding. The evolution relates to a variety of tools used to create text (from chisel to computer) and the need to consolidate a different set of signs (e.g. alphabets in different languages) into one, visually coherent whole. Coexistence of craft and design in the evolution of the font design is visible also in terminology – the term ***font,*** which is used nowadays, is seldom related to a metal typesetting, but it is mainly understood as a general lettering design, i.e. typeface. Although the ***font*** comes from the word ***fount***, which referred to the ***foundry*** where metal fonts were cast, any conceivable association between letters and their functionality or legibility have been effaced over time (Austin & Doust, 2007). Designing patterns with literal motifs represented by interesting fonts is very popular nowadays.

It is known that our reality has been represented by images across millennia. First images appeared on cave walls while nowadays we watch pictures mostly on computer screens. In the age of Internet, designers often use visual design as a cognitive tool to amplify their mental abilities. While searching for a relationship between craft, technology and design illustrated by typography, we will inevitably come across basic concepts of typography such as a letter, word or block of text, which, in modern times, have been restored to a form or image-like element by our gifted designers.

Technology and Typography

Handwriting tools

The shape of every single sign of writing is closely connected with the handwriting tools and later on, technology of replication and digitalisation. History of writing distinguishes a few stages of writing systems: mnemonic, pictographic, ideographic, logographic (word or phrase), syllabic and alphabetic (elementary sound). Different systems mean different number of signs, sign complexity, sign sets (open or close), etc.

Let us consider two variants of these systems to show the differences and their consequences.

The Chinese writing system was developed about 4000 years ago (Diringer, 1968, 98) and is based on a sign as an equivalent of the word or phrase (logographic). Currently, there are over 50 000 signs in the Chinese system (Majerowa, 1987, 294). The enormous number of different signs makes each sign very complex. Elements of each sign are characteristic due to the use of a soft brush (Frutiger, 2015, 160; Majerowa, 1987, 294). Brush motion and circles and arcs are converted to straight lines. It is not possible to hit the brush, you have to make brush strokes, which is clearly visible in the picture. It is difficult to change the direction of movement without interrupting it. Lines enlarge while going down. These shapes can be compared to the older shapes of Chinese signs when they were drawn on silk with a bamboo stylus (Diringer, 1968, 540).

The idea of basing the writing system not on its physical properties, but on the sound of speech (alphabetic system) started in Phoenicia, where the previous ideograms were replaced by the symbolic signs related to sound. The example of such a process is shown in the Figure 1. This idea reduced the number of different characters, which allowed their shapes to be simplified. The Latin alphabet is derived from Phoenician, Greek and Etruscan alphabets. Since the number of sounds used by Romans was not very large, only 19 characters (later increased to 26 signs) were used, which represented the entire language system. While diffusing through the Europe, the other "barbaric" sounds were added in several ways: by redefining original letters (e.g. "c" in Polish, Czech), combining two or more of them to express one sound or adding a diacritic symbols as a dots, dashes and hooks to their Latin base (as in the word "church", which is "č" in Czech,"cz" in Polish and "tsch" in German) (Diringer, 1968, 553).

Figure 1. The idea for the letter "a" starts from the pictogram of an ox head, then Phoenician letter aleph, derived from the meaning "ox", Greek and Latin intermediate shapes, to finally show the letter "a" from Caroline tradition (in the lats picture). Graphic designed by Teresa Frodyma (Frodyma, 2010) on a base (Frutiger, 2015).

The character's shape refers to the tool. The tool for forming the shapes of Latin letters is a chisel either for monumental writing (with recognizable angular shapes) or for everyday texts: a stylus on wax tablet, a brush on the walls, a cane pen and quill. The chisel causes the line cross-section to be formed into V-shape grooves which end in thin, perpendicular segments called serifs to flatten the line. The width of the line is based on two sizes: thick or thin.

Initially, the text's direction was vertical in China and horizontal in the Roman Empire. The direction was not specified: there are inscriptions written down from left to right, inversely and boustrophedonically, i.e. imitating the movement of an ox during ploughing (name comes from "ox" + "turn"). Nowadays, the direction is most often unified horizontally from left to right, both in Europe and in China – where there is contemporary European influence (Majerowa, 1987, 302). The rectangular shapes of text blocks, their proportions, the idea of a margin as a text protection against touching, the margin size, etc. – were standardized in the Great Library of Alexandria (Bieńkowska, 2015, 34).

The print invention

The most important idea behind Gutenberg's invention was not that his fonts were movable – since he was not the first visionary who did something similar, but the adjustable hand mould which allows an easy and precise replication of the shape of any font in heavy duty metal casting. They were identical, easy to recreate and relatively cheap. The necessary elements of the invention were a modified wine press and a printer ink.

As far as visual design was concerned, Gutenberg was not innovative – he reproduced the appearance of handwriting and page layout of the manuscript. For that purpose, he went as far as preparing many more different metal types than the number of alphabet letters to simulate the diversity of handwriting.

The time for visual design in prints came later on, when the similarity with handwriting lost its meaning. The shapes of letters started to be composed on a base of geometrical dependencies, following the rules of readability. While the founder's vision and effort were important, craft soon became technology, thus rendering technical aspects such as alloys and quality of paper paramount. Growing capabilities were also echoed in the fashion. For example, didone typeface designed by Giambattista Bodoni about 1780 A.D., drew attention to an extreme contrast between thick and thin lines, especially hairline serifs, which was technologically possible, and thus very popular (Tomaszewski, 1996).

Unification and Automatization

First period of the history of printing, letterpress printing, not only accelerated the craftsmen's work but also rendered them replicable. That, however, did not constrain the individuality of each design both on the level of font shape (founds of unusual characters were possible) and layer design (leading as a distance modifier among page elements thin strips of lead that were inserted between lines of type in the composing stick to increase the distance between them). The act of printing was very quick, but preparing the page for the print – quite the opposite. The advantage of the technique was possibility of adjusting any element manually. Disadvantages – there was no other possibility than adjusting the page manually, and the typeset was limited to the specific language, actually, the specific set of metal fonts distinguished only visually. The next phase of the technology development was to automatically prepare whole lines of text (e.g. linotype) but this system was not as adjustable as manual one. Later the identification base on binary encoding was introduced and the signs start to be digitally resolvable, but in limited range of Latin alphabet.

Full solvation of this problems is contemporary digital encoding and digital printing. First of all, the Unicode standard provides consistent encoding, representation, and handling of text expressed in most of the world's writing systems. Digital desktop publishing and typesetting software applications allow to use algorithms to automatize the typesetting with taking into consideration context and conditional rules, what largely cover the human decision, but final adjustment can be still made by expert. Last, but not least the tag systems description, especially Text Encoding Initiative (TEI) gives the possibility to append semantic information to the typesetting, especially manuscripts and old prints specific features.

The new technology can also extend the perception of the text, for example while using QR-codes to create augmented reality using cell phones (Argasiński & Woynarowski, 2019).

Visual Design and Typography

Our research of the relationships between craft, technology and design often refers to the world of art, typically in a visual form, as one of the important sources for explaining the role of this coexistence. Typography defined often as design to facilitate reading and reception can also be considered in the visual art world that expresses human creative skill and imagination.

Shape of the sign

Let us consider the following example based on Chinese language. Written Chinese contains characters which do not constitute an alphabet. In Chinese writing system, a character can represent one syllable of spoken Chinese and may be a word or a part of a word. The characters are often composed of parts that may represent physical objects, abstract notions, or pronunciation. The formalized Chinese writing system based on the concepts of strokes and radicals. Strokes present the basic gestures used to write Chinese characters, while radicals are the building blocks of all Chinese characters.

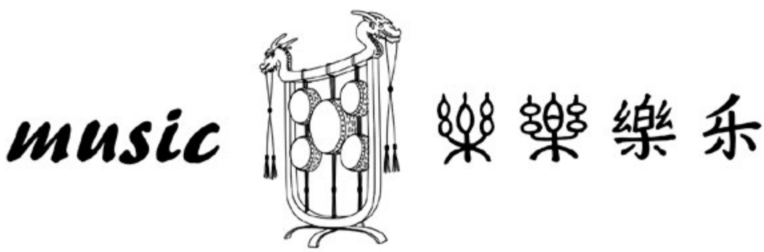


Figure 2. Stages of transformations of the concept of music in ideographic writing. Graphics drawn by Wojciech Grabski on a base (Donnini, 1988).

In Chinese language the symbol 乐 means *music*. The prototype for this symbol was the instrument consisting of five drums as the five tones of the musical scale on a stand of wood.

In other words, the abstract concept of music from the symbolic level is transformed into the practical levels that includes musical instruments. Figure 2 presents the main transformations of the concept music into the word “music” in Chinese language. In this figure the most right is presented simplified character, preceded by traditional ideograph. It turns out that the symbol for music pronounced differently also means joy or pleasure, because music is a source of gladness (Donnini, 1988).

Textblock as a visual design tool

In European alphabetical systems there is no such a direct connection between shapes and signs. In the past there were alphabets based on picture identification, e.g. the picture-based Phoenician alphabet, but later Greek and Latin systems, despite derived from the mentioned one, are based on phonemes so each letter responses to sound, not visual idea of the object. On the other hand, there is another field of design exploration: shapes of textblocks. Each word consists of letters, succeeding to create a line and then block of text. Their size and shapes are often used for visual organization and hierarchy of the text, but sometimes the shape of the text block is one of the forms of artistic expression.

Figure 3. Separate rectangular block of main text and two columns of comments in the system called ***modus modernus*** (Nicolaus <de Lyra>, 1488).

Figure 4. Block of text in the modern book used in artistic manner. (Danielewski, 2000)

The blocks shown in figures 3 and 4 show the way of structure organization using textblocks, with no reference to real world shapes or any others symbolic representation. The other, graphical forms of text are more often used in the poetry. One of the famous collection of poems based on the idea of essentiality of the poem's visual shapes is *Calligrams* written by Guillaume Apollinaire and published in 1918 (Apollinaire, 1925/1973). The lyrics are the interesting form of ekphrasis, were the same peace of art is a drawing and ekphrasis describing itself (see figure 5).

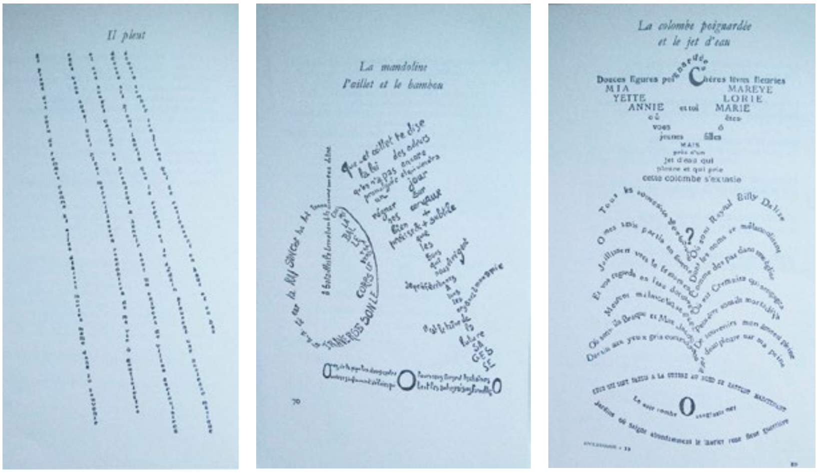


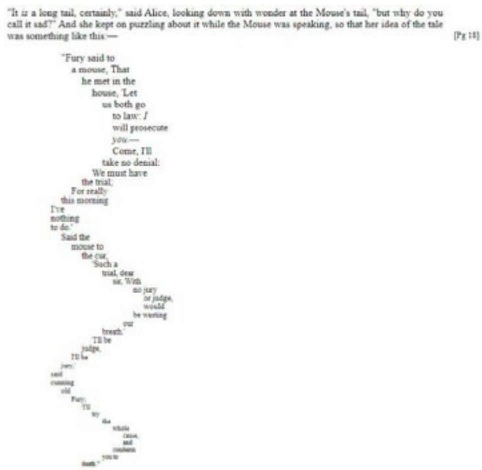
Figure 5. Examples of Guillame Apollinaire calligrames published in ***Calligrammes: Poems of Peace and War 1913-1916*** (Apollinaire, 1925/1973, 64, 70, 74).

The similar idea was used in the book by A.A. Milne, *Winnie-the-Pooh*. (Milne, 1926/1993) The thought of the Piglet, one of the characters, while being carried away by Kanga is shaped in the way of jumping element (see figure 6).

If this is flying I shall never really take to it.

Figure 6. A.A. Milne's character way of thinking formed in the way of jumping.

Another example of this way of visualization within the text is shown in the Lewis Carroll's novel *Alice's Adventures in Wonderland* (Carroll, 1916/2006). Example is presented in the figure 7.


"It is a long tail, certainly," said Alice, looking down with wonder at the Mouse's tail, "but why do you call it sad?" And she kept on puzzling about it while the Mouse was speaking, so that her idea of the tale was something like this:— [Pg 18]

"Fury said to
a mouse, That
he met in the
house, 'Let
us both go
to law: *I*
will prosecute
you.—
Come, I'll
take no denial:
We must have
the trial;
For really
this morning
I've
nothing
to do.'
Said the
mouse to
the cur,
'Such a
trial, dear
sir, With
no jury
or judge,
would
be wasting
our
breath.'
'I'll be
judge,
I'll be
jury,'
said
cunning
old
Fury;

Figure 7. The Mouse's Tale from ***Alice's Adventures in Wonderland*** (Carroll, 1916/2006).

In the 20th century, architecture and visual arts began to have an impact on lettering and typographic design. Typography has been placed in the context of "pure" art. Then, as the first field of design, typography was revolutionized by the computer, thanks to which it took a central place in design. Modern designers freely combine typography, lettering and image (McDermott, 1999). For example, the shape of the letter can be used as an item of real world representation because of the visual similarity. Figure 8 presents a poster of the play "Mary Stuart", where the author, Polish artist Władysław Pluta, used letter "r" as an executioner's ax and letter "a" as a trunk, which is an allusion to the Mary Stuart death (Pluta, 1996).

Figure 8. Poster "Mary Stuart" designed by Władysław Pluta.

For designers with experience in typography and looking for similarities, the alphabet can be a playground where letters transform into things and vice versa (McAlhone & Stuart, 2010). Figure 9 shows a visualization of the word *fire* composed of the letters of the word. The use of letters of a word to express its meaning represents a limited language for solving the complex issue. But, the conditions of the problem suggest design decisions, which make it easy to find a solutions (Wilde & Wilde, 1991).

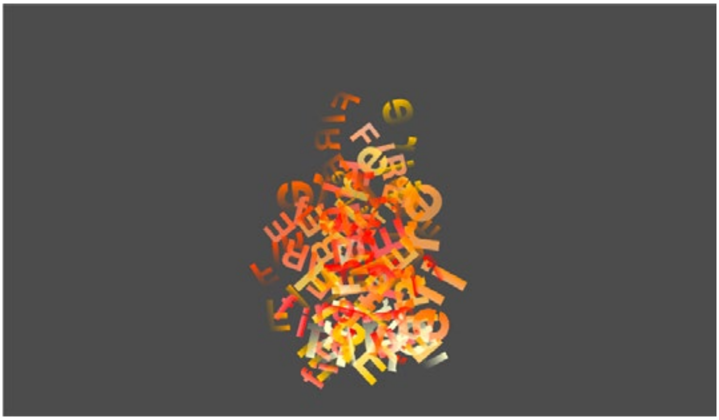


Figure 9. Visualization of the word fire designed by Wojciech Grabski.

Designing patterns with letter motifs is another example of breaking the association of letters with functionality and readability. When choosing an appropriate typeface that best expresses the style of the design, practical knowledge of typography can be useful (see figure 10).

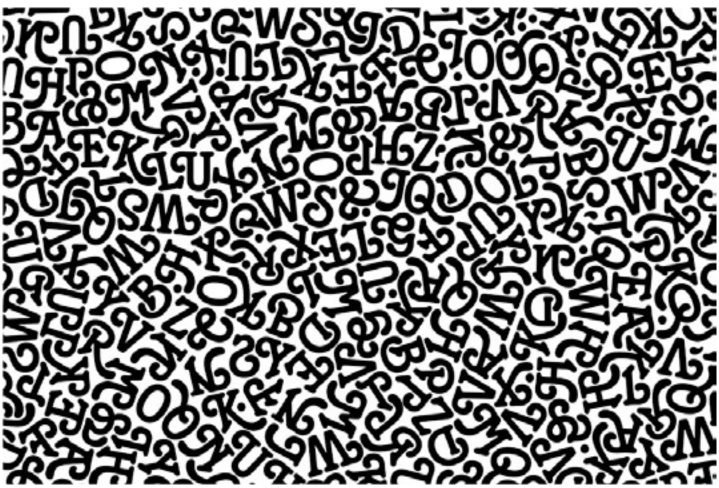


Figure 10. The pattern with the use of Tango BT font designed by Wojciech Grabski.

Translation of Plastic Arts into the Visual Shape of Poem

Let us consider a typical ekphrasis, e.g. poem inspired by painting. The contemporary artist, Bronisław Linke (1906–1962), presented in 1951 an oil on canvas titled C*annibalism*. It depicts an extremely close-up scene of a huge human mouth ready to eat a sandwich with a small frightened man as a piece of meat among onion rings. In 1980 the poetic ekphrasis (entitled *Sandwich with the Human*) was written by Jacek Kaczmarski (1957–2004) and presented with the music of Przemysław Gintrowski (1951–2012) in a form of a song (Kaczmarski, 2010; Kaczmarski et al., 2014). Its lyrics consists in broken rhymes, which is an extremely rare example of a visual text organisation in the field of poetry. They correspond with the story of the sandwich preparation: using a sharp knife for cutting the bread, vegetables, as well as adding butter and herbs. The main cannibalistic activity is cutting – thus the main visual typographic character is a hyphen, which strikes the word and divides it into two pieces. The hyphenation of the text emphasises the jagged phrases (Grabska-Gradzińska & Wasilewska, 2011). Additionally, this unusual division avoids traditional longer lines of text by forming crescent-shaped verses. These sets of 9-line strophes with short first and last lines give us a repetition of rounded shapes.

Let us translate the first two strophes of the poem:

A sharp knife
goes through the bread
with **bread-**
crumbs sprinkling
I sink deep **in-**
to the fat and tears

That's the **on-**
ion yellow ring
pins me down
from the head
up to the nerve root
spices, salt
they are put
into nose **pep-**
per too
I don't want to
Be **gob-**
Bled down

These are typographical means of expression – it can be noticed that hyphenations are the only visual elements which disappeared during reading out loud, and in the song they are replaced with a peculiar rhythm and syllables accentuated in an unusual amphimacer metrical foot (Gajda, 2009). When we appose it with the painting, we can notice that this is a typographical equivalent to the graphical cuts and roundings in the composition: extreme close-up with body part cuts, cross section of a slice of bread and the rounded shape of open mouths, onion rings and nails. The visualization is presented in Figure 11a and the corresponding text shape in Figure 11b.

Figure 11 a, b. Cuts and rounds represented by oval shapes and dashed lines, designed by Iwona Grabska-Gradzińska on a base (Grabska-Gradzińska & Wasilewska, 2011, p. 228).

Since all the typographic tricks disappeared while listening to the poem, how does it work as a song? In the music there is a lot of dramatical pauses after the vocalised stress on the last syllable (in polish poetry it is rather a rare situation, introduced here by the hyphenation) and repetition of the one characteristic motive: triton and halftone (e – ais – h) expanding and growing in intensity during the song (Gozdecka, 2017).

Conclusion

The purpose of our considerations has been to draw attention to the inspirational role of typography in discussing the most important design problems, such as the essence of creativity, the vitality of craft skills or the role of computer technology in design. Typographic design reflects the most important technical innovations. The typography itself, firmly rooted both in the traditional approach and oriented towards new challenges of both pure art, and new practical applications, can be treated as a significant tool for any graphic designer.

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Özlem Karakul

Traditional Craftsmanship in Architecture, Conservation and Technology

Introduction

"Craft" is defined as "a certain type of making, in which objects are created by hand through the skilled use of tools" in the ICCROM Report (2004, 5) on craft and conservation. Actually, before Industrial Age craft was a term meaning all products based on hand worksmanship (Sözen & Tanyeli, 2010, 329). The differentiation between "art" and "craft" in artistic activities emerged through the Renaissance period and after, until the 20th century (Sözen & Tanyeli, 2010, 329). Craft is generally distinguished from fine art by the function of the end product; craft objects are created for use, not for contemplation as in fine arts (ICCROM, 2004, 5). The creation process of craft objects is carried out with hand and the skilled use of tools by craftsmen and necessitates a particular skill, knowledge and know-how, involving an act of creation (ICCROM, 2004, 7). The creativity in the formation process of craft warrants the originality of the craft product.

Building crafts as a branch of traditional craftsmanship means the crafts related to the building activities. What is involved, is creating by hand through the skilled use of tools by building craftsmen expressing their specific knowledge, techniques, and know-how about local building culture in architecture (Karakul, 2018). After the introduction of modern building technologies, the decrease and interruption of traditional building processes restricted the area of implementation of building crafts into the restoration practices of historic buildings. Because of the decrease in demand, the number of practitioners, i.e, building craftsmen, noticeably decreased. Thus the knowledge, skills and techniques of building crafts started to disappear causing the degradation of intergenerational transmission between master and apprentice. In rapidly changing conditions, the decrease of the demand for building crafts with the interruption of traditional building made it necessary to define the appropriate practice domains for building crafts to sustain their life.

As highlighted in the UNESCO 2003 Convention for the Safeguarding of the Intangible Cultural Heritage, the conservation of traditional craftsmanship necessitates providing an accurate documentation, transmission from generation to generation and the continuity of the practices carried out by practitioner craftsmen. The accuracy of documentation can be achieved by understanding craftsmanship holistically, considering both its tangible and intangible aspects (Karakul, 2018; Brizard, Derde & Silberman, 2007, 5). New technologies can play a significant role in the identification, documentation, preservation, promotion, and education of traditional craftsmanship with its different aspects holistically. The recent developments in documentation technology, especially digital technology, facilitate the accuracy of documentation and contribute to the achievement of holistic conservation. Furthermore, digital technology also facilitates understanding and training process of traditional craftsmanship both for the general public and apprentices of traditional craftsmanship. This study discusses the significance of the use of new technologies in the holistic documentation and conservation of traditional craftsmanship accepted as a domain of intangible cultural heritage, focusing particularly on building crafts.

International Documents on Conservation of Building Crafts and Traditional Craftsmanship

In the 2003 Convention for the Safeguarding of the Intangible Cultural Heritage adopted by UNESCO[1] "Building crafts" or "traditional craftsmanship" concretized in traditional architecture is determined as one of the domains in which intangible cultural heritage is manifested The knowledge, skills and creativity of building masters concretized in traditional architecture can also be accepted as intangible aspects of building crafts as a branch of traditional craftsmanship. Craft differentiates from other forms of intangible cultural heritage because its product is a tangible one, like architectural ornaments.

The UNESCO 2003 Convention described the intangible cultural heritage with all its dimensions and explained safeguarding measures, such as, "the identification, documentation, research, preservation, protection, promotion, enhancement, transmission, particularly through formal and

non-formal education, as well as the revitalization of the various aspects of such heritage." As all other elements of intangible cultural heritage, the conservation of traditional craftsmanship also necessitates an accurate

1 The UNESCO 2003 Convention defines "intangible cultural heritage" as "the practices, representations, expressions, knowledge, skills-as well as the instruments, objects, artifacts and cultural spaces associated therewith- that communities, groups and, in some cases, individuals recognize as part of their cultural heritage"; and, emphasizes the domains of intangible cultural heritage as (a) oral traditions and expressions, including language as a vehicle of the intangible cultural heritage; (b) performing arts; (c) social practices, rituals and festive events; (d) knowledge and practices concerning nature and the universe; (e) traditional craftsmanship". See the Convention for the Safeguarding of the Intangible Cultural Heritage. 32nd Session of the General Conference. September 29-October 17. Paris. from http://unesdoc.unesco.org/images/0013/001325/132540e.pdf)

documentation, the continuity of practice and its transmission between generations for its safeguarding.

In the 2003 Convention, UNESCO also established the Living Human Treasures System[2] for safeguarding of traditional craftsmanship, organizing craftsmen, and transmitting their knowledge to new generations. UNESCO determined that the 2003 Convention is mainly concerned with the skills and knowledge involved in craftsmanship rather than the craft products themselves. Safeguarding was discussed only in terms of the activities of craftsmen related to producing craft and passing their skills and knowledge onto others, not as preservation of craft objects[3]. Although the transmission process of crafts has been thoroughly analyzed by UNESCO Living Human Treasures System, the usability and adaptability of crafts to contemporary life and architecture have received much less attention. Regrettably, the perception of the work of building masters as the practitioners of building crafts has been limited into the restoration practices. Therefore, the scientific effort to define new practice areas other than restoration for craftsmen to implement building crafts needs to be increased.

On the UNESCO's official website, the decline in the numbers of the practitioners of traditional craftsmanship is recognized as one of the biggest threats to the viability of intangible cultural heritage. In this regard, Article 2.3 of the UNESCO 2003 Convention emphasizes "transmission" as one of the safeguarding measures aiming at ensuring the viability of this heritage. Because the conservation of intangible cultural heritage necessitates the continuous practice and the transmission of the knowledge to future generations, living practitioners need to be identified and the appropriate ways for practicing need to be provided. Therefore, already before the 2003 Convention, in 1993, UNESCO launched a new program introducing the concept of "Living Human Treasures"; and, afterwards, prepared a guide entitled Guidelines for the Establishment of National Living Human Treasures System (UNESCO 2002).

After drawing up the general guidelines of this system, UNESCO also encourages Member States to establish their national systems of "Living Human Treasures" and formulates the specific "guidelines for the establishment of national Living Human Treasures System"[4] to be followed by the States. Within these guidelines, a preliminary measure for safeguarding the intangible cultural heritage is to ensure its identification by drawing up national inventories. But, after this identification stage, it is significant to guarantee that the bearers of heritage, like master craftsmen, develop their knowledge and skills and transmit them to younger generations. In

2 See http://www.unesco.org/culture/ich/index.php?pg=00061&lg=EN

3 See https://ich.unesco.org/en/traditional-craftsmanship-00057

4 See https://ich.unesco.org/doc/src/00031-EN.pdf

national contexts, these measures necessitate finding and organizing living builders, some of whom will be given official recognition, creating appropriate conditions and institutions for practicing master-apprentice relationships, documenting their knowledge and integrating these practices and documentation into the conservation practices.

Within these guidelines, "transmission", "documentation" and "promotion" are highly emphasized as the measures for a sustainable safeguarding of traditional craftsmanship. Considering transmission, training as formal or informal education is significant to ensure that the knowledge and skills are transmitted from craftsmen to young people or apprentices. According to the UNESCO 2003 Convention, Each State Party needs to establish a specific educational and training program within the communities as well as non-formal means of transmitting knowledge. The new technology needs to be used as a tool for training people and raising awareness about the different aspects of craftsmanship.

As regards "documentation", the appropriate documentation of the knowledge and skills of craftsmen using available methods, like collection, cataloguing, transcription, is needed, as also stated in Article 13 in UNESCO 2013 Convention. Furthermore, the establishment of the inventories of institutions, archives, documentation systems, and museums, and the training of collectors, archivists, documentalists, and other specialists are recommended within the guidelines. The new technology needs to be integrated into the documentation processes to achieve a holistic understanding of craftsmanship.

In relation to "promotion" it is recommended in the guidelines to ensure public awareness about the importance of intangible cultural heritage and its safeguarding by (1) regularly organizing performances, demonstrations, exhibitions; (2) enabling research and publishing of printed, audio, video and multi-media documents related to the intangible cultural heritage and its bearers; and (3) integrating intangible cultural heritage into educational curricula. Considering "promotion", new technology needs to be used both in exhibitions and publishing of the documents related to craftsmanship.

Besides these conservation measures, "revitalization" is also highlighted within the UNESCO 2003 Convention. It is especially significant for the disappearing elements of intangible cultural heritage. For various reasons, e.g., rapid change and technology, certain elements of intangible heritage can change and disappear. Then, the revitalization of these disappearing practices with their genuine qualities of the relations of tangible and intangible values is needed for their conservation. New technology can contribute to the revitalization of heritage elements by using multimedia integration, digital museum and virtual representation technologies.

Considering the UNESCO documents, the most significant issues in the conservation of traditional building craftsmanship can be summarized as follows: (1) the holistic documentation approaches for traditional building craftsmanship, (2) the awareness rising about local building culture and building masters on the society, (3) the development of specific approaches for the revitalization of master-apprentice relationship as a way for the continuation of knowledge, (4) the improvement of the active participation of the masters to the building and conservation activities in historic environments (Karakul 2015, 153).

An Integrated Approach to the Conservation of Building Crafts

A discussion on the conservation and sustainability of building crafts in relation to technology needs to understand local building culture within an integrated approach with its constitutive elements composed of tangible and intangible aspects, including their relations throughout the formation and change process of the traditional architecture. The integrated approach of this study is mainly based on the comprehension of the genuine qualities created by the mutual interrelations between tangible and intangible values of building crafts, specifically, architectural qualities and traditional craftsmanship.

Building crafts through architectural process

Building culture[5] as part of culture, which is a complicated and changing whole, can be dismantled into its more concrete components, both tangible and intangible ones, to be understood systematically (Karakul, 2011). The intangible aspects of building culture include certain "structuring structures" and the cultural expressions within it (Karakul, 2011). The structuring structures in building culture, composed of the technology and knowledge of the local builders, have the formative power on the intangible values concretized mainly on the building technology and vernacular architectural language in a historic environment. The integrity of building culture is constituted by the interrelations between the elements of intangible cultural heritage, like traditional crafts composed of techniques and know-how, technics (Pultar, 1997, 27–32) and methods, skills, craftmanship, and the elements of tangible heritage, like, the use of building materials, construction details, building elements, architectural elements, and decorative elements (Figure 1).

5 Culture can be divided into three groups according to their expression types over the built environment as 'living culture', 'building culture', and 'value systems', each of which has also two constitutive parts as the 'structuring structures' and intangible values (Karakul, 2011).

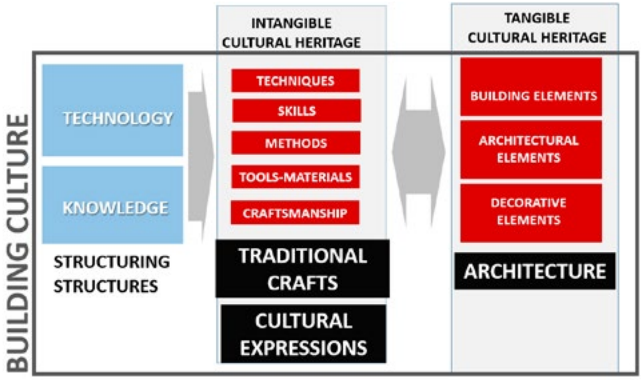

Figure 1. The intangible and tangible elements of building culture (Karakul, 2018)

The term 'traditional craftsmanship' physically reflects the skills and know-how of craftsman or artist. Culturally, it possesses expressive aspects conveying various hidden meanings attributed by craftsman and local people (Karakul, 2015). In this respect, it can be stated that traditional craftsmanship meets both 'functional' and 'expressive' needs. Functional needs are related to the physical and mechanical aspects of the building production process. These include bringing building materials to construction sites, and after processing, putting them into their place in the building, and techniques and tools particular to this process related to technical skills of craftsmen (Blagg, 1976, 154; Marchand, 2007, 82). On the other side, expressive needs are related to "mental representations" (Marchand, 2007, 191) of craftsmen conveyed to the physical characteristics through design process. The expressive aspects of craftsmanship are the reflection of the cultural values, values judgments and the worldview of builder and society, and at the same time, they also include the individual diversities and creativities (Aran, 2000, 122).

Architectural process in tradition

The traditional architectural process can be defined as a complex and changing process through which different tangible and intangible elements of traditional craftsmanship have continuously been interrelated to produce local and contextual architecture for centuries (Figure 2). The mutual interrelations have created a unique and authentic architecture formed by local environmental specifics and the needs of inhabitants through the hands of local master craftsmen. The formation process of traditional buildings can be divided into two parts, design and construction process, to understand the variety of crafts interrelated with architecture.

The design process expresses an envisaging phase of the formation process of buildings which is mainly carried out by the mental schemata and knowledge of builders and technology (Karakul & Bakırer, 2018) (Figure 2). With regard to the design process, Hubka (1979) states that folk design method is carried exclusively in the mind of builders and continued by tradition –the handing down of information by word of mouth, observation, replication and apprenticeship. Rules and traditions in folk design method are in the minds of its builders as a kind of highly abstracted architectural grammar, or schemata. Certainly, the transmission of the knowledge of masters to their apprentices assures the continuation of the local building tradition. Hubka (1975, 28) also stresses that the native builders share a strategy for generating design out of schemata as a continuous process of composition and decomposition within a vocabulary of existing building forms. In every stage of the production process of architecture from spatial organization to spatial characteristics, architectural elements and decorative elements, the mental schemata of craftsmen develop the appropriate solutions by evaluating the needs, expectations of people, cultural practices and expressions and environmental characteristics.

Throughout the formation process of traditional buildings, the design process carried out by building craftsmen directly affects the relations between architectural properties and building crafts through construction process. For example, the construction process of traditional buildings in Anatolia is mainly constituted by two processes: the construction of structural system and building elements, composed of foundations, walls, floors and roof; and non-structural system, composed of infill walls, architectural elements, decorative elements and finishing materials (Figure 2). The structural system of traditional buildings is generally determined by building masters having the knowledge of traditional building craftsmanship within the limitations of environmental conditions and local building materials. In Anatolia, traditional buildings are generally constructed by the use of three structural systems, i.e, stone masonry, timber frame system and mud-brick masonry.

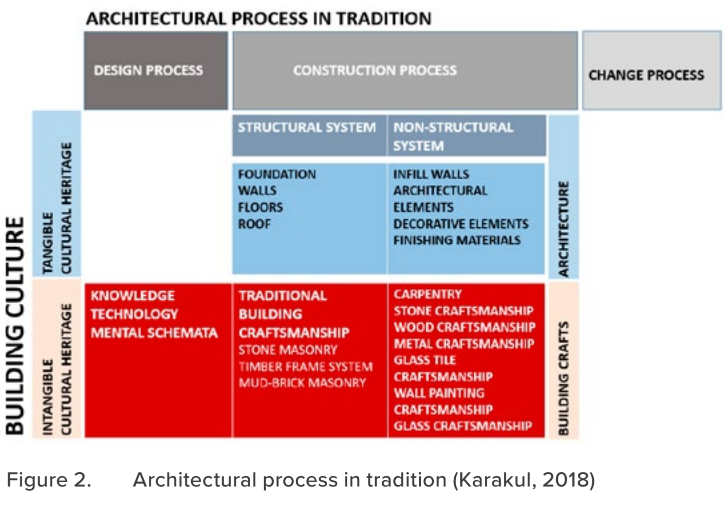

Figure 2. Architectural process in tradition (Karakul, 2018)

After the construction of the structural system, the non-structural system of the buildings is formed by the craftsmen having the knowledge on different craftsmanships. While the construction of infill walls is carried out by building craftsmen constructing the structural systems, architectural elements and decorative elements are generally constructed by the craftsmen experienced on different craftsmanships, particularly, stone, wood, metal, glazed tile, glass, wall painting craftsmanship. Throughout the construction process, after the construction of structural system and infill walls, architectural elements, like doors, windows, cabinets, lattice, and railings are made by carpenters and metal craftsmen (Figure 3). Lastly, decorative elements, like architectural ornaments, geometrical and floral ornaments on the edges of architectural elements and building elements, are made.

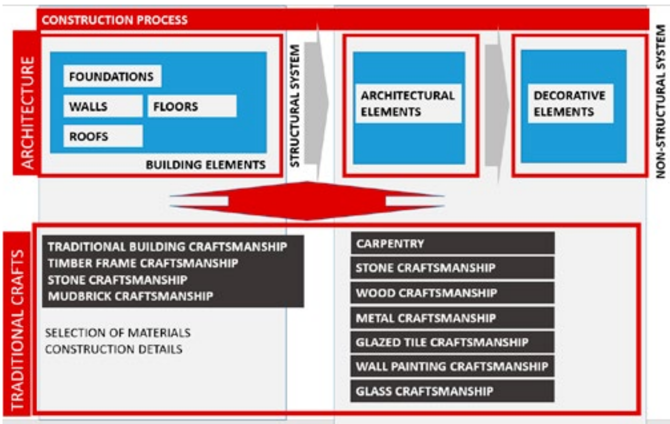

Figure 3. Interrelations between building crafts and architecture through construction process (Karakul, 2018)

Change process in building technology and conservation problems

Historic environments have been radically changed because of the interruptions in building tradition and the new developments in building technology throughout 20th century. In the early period of 20th century, the drastic changes in building technologies and the lifestyles of the societies began to emerge. Accordingly, the role of local builders on conveying the cultural expressions of societies into architecture by using traditional craftsmanship was considerably changed. The variety of the traditional buildings produced by craftsmen considering local cultural and environmental features have been replaced with the monotony of new buildings produced in uniform architectural language.

The rapid change in building technology and the value systems of craftsmen affected on the implementation of building crafts in architecture and the attributed cultural expressions. The change in building technology, the knowledge and value systems of craftsmen caused by technological, economic and cultural change of historic environments has deeply affected the relations between crafts and architecture (Karakul, 2018).Throughout the transformation process, with the introduction of new building technologies, certain building crafts, like traditional building craftsmanship, have completely disappeared; some crafts, like metal craftsmanship, carpentry, wood craftsmanship, have changed as regards their implementation, tools and the materials used. Besides, new and contemporary interpretations of crafts have started to be implemented by craftsmen and artists.

Nowadays, the interruption of the traditional building process has restricted the area of implementation of building crafts into the restoration practices only (Karakul & Bakırer, 2018). In rapidly changing conditions, the decrease of demand for building crafts brought with it the need for defining the appropriate practice areas for the building crafts. Building masters and the craftsmen experienced on building crafts have still been working within the restoration practices and carried out crafts by the use of traditional techniques, methods, tools and materials. However, the craftsmen have been obliged to compete with the products and practices of modern industrialization (UNESCO, 2005). Nowadays, most craftsmen are still using traditional skills with traditional technology; they have to struggle with machines and time (UNESCO, 2005). So, for the conservation of building crafts, what is needed is to define new domains in which craftsmen and craftsmanship can be benefited in contemporary life besides restoration practices.

Technology and the Holistic Conservation of Traditional Craftsmanship

The measures of the conservation of cultural heritage can be separated into two domains that are linked with tangible and intangible cultural heritage respectively. Focusing on traditional craftsmanship, as emphasized within the guidelines for the establishment of national Living Human Treasures System and UNESCO 2003 Convention, "transmission", "documentation", "revitalization" and "promotion" are highly accentuated as the measures for a sustainable safeguarding. While these measures are reconsidered within the holistic approach of the study, both tangible and intangible values of the craftsmanship need to be evaluated to develop specific conservation measures. The study tries to investigate the effects of digital technology on the conservation measures of the different aspects of craftsmanship.

The developments in technology during the last decades have deeply affected the domain of cultural heritage, specifically in museums and archaeological sites (Tabone, 2019, 47). Since 1990's digital technology has made remarkable achievements in the conservation of cultural heritage (Zhou, Geng & Wu, 2012,5). Considering the safeguarding measures, namely, "transmission", "documentation", "revitalization" and "promotion" as mentioned above, digital technology contributes to all of these conservation measures. Particularly focusing on traditional craftsmanship as the main theme of this study, both the tangible and intangible values of craftsmanship can be documented and taught accurately with the integration of digital technology into the safeguarding measures.

Zhou, Geng and Wu, (2012, 4) divide the digitalization technologies used for cultural heritage conservation in five groups:

> *(1)integrated storage and access techniques, (2) categorization and digital archives of cultural heritage, and digital techniques to build cultural resource databases (3) virtual museums, virtual reconstruction and rehabilitation of cultural relics, digital simulation and visualization technology of the cultural spaces and procedures (4) the technology to recreate the lifestyle, practice, consumption, currency, transmission and the continuity of the traditional craftsmanship, (5) the pattern and technology to display and the transmit the digital cultural heritag".*

From these digitalization technologies, the first two ones are especially significant for the inventory and documentation of both tangible and intangible cultural heritage. The third one is a digitalization technology which is related particularly to the revitalization of both tangible and intangible heritage aspects in museum context. The fourth one makes it clear that the digitalization technology contributes especially to the revitalization of intangible cultural heritage. Digital technology also facilitates displaying and transmitting the digitally documented cultural heritage.

Digital technology and the holistic conservation of traditional craftsmanship

As regards its effects on tangible and intangible cultural heritage, digital technology can be divided in three main groups described as follows by Zhou, Geng and Wu (2012, 8) (Figure 4): *"digital information acquisition and processing technology, information databases and digital exhibition platform, virtual representation technology to restore cultural heritage*. The study at hand evaluates the different aspects of digital technology in the context of conservation measures determined for the different aspects of traditional craftsmanship. As described above, these measures are transmission, documentation, revitalization and promotion, introduced within the UNESCO Convention and guidelines (Figure 5).

Traditional technologies used for safeguarding intangible cultural heritage are mainly written text, audio recording, video, and photography. These have been used considerably for documenting and conserving the intangible values of traditional craftsmanship a long time. Video and photography have also been used for the documentation of tangible heritage and the tangible aspects of traditional craftsmanship. But, because of the deterioration of video and tape recordings over time, a long-term preservation of the recordings has not been possible. By means of digital technology, both tangible and intangible aspects of traditional craftsmanship can be easily preserved within information databases.

Information databases and digital exhibition possibilities have emerged as a digital museum approach integrating many kinds of intangible cultural heritage elements using the new technology such as multimedia integration, digital photography, and virtual reality (Zhou, Geng & Wu, 2012, 8). Especially extended reality technologies, specifically augmented reality, virtual reality and mixed reality technologies enable to make cultural heritage digitally accessible anywhere. Extended reality technologies provide to create environments including real and virtual and human-machine interactions generated by computer technology within museums. Extended reality technologies have been utilized in the domain of cultural heritage for education, exhibition, the reconstruction of lost experiences, virtual museums, and explorations (Tabone, 2019, 48–49).

The digital museum approach also facilitates the documentation and promotion of tangible values of the cultural heritage. Focusing on traditional craftsmanship, the documentation of techniques, skills, knowledge, tools, and craftsmanship of the craftsmen together with building elements, architectural elements and decorative elements helps to conserve them holistically. Especially for the intangible aspects of craftsmanship, digital technology helps to document and revitalize them accurately.

Virtual representation technology is especially significant for revitalizing intangible cultural heritage alongside the comprehension of the tangible values of the cultural heritage. It allows to understand and reproduce the original integrity of the relations between tangible and intangible values within each context . Considering traditional craftsmanship, this technology helps to explain the production process of craftsmen, the transmission process of knowledge between master and apprentices by reproducing it realistically. In this sense, digital museums present specific contexts embodying the holistic conservation of tangible and intangible cultural heritage with the use of text, recording, image, video, and virtual reality.

TECHNOLOGY IN CONSERVATION		INTANGIBLE CULTURAL HERITAGE	TANGIBLE CULTURAL HERITAGE
TRADITIONAL TECHNOLOGIES		Written texts Audio recording Video Photography	Architectural drawings Photography
DIGITAL TECHNOLOGY	DIGITAL INFORMATION ACQUISITION	Detailed information Database mapping	Digital photography 3D Scanning
	INFORMATION DATABASE	Digital museum Multimedia integration Virtual reality	
	VIRTUAL REPRESENTATION TECHNOLOGY	Virtual scene modelling Virtual scene coordination	Virtual technology

Figure 4. Technologies used in conservation developed following Zhou, Geng and Wu's approach (2012) by the author.

			CONSERVATION OF TRADITIONAL CRAFTSMANSHIP							
			INTANGIBLE VALUES				TANGIBLE VALUES			
			TRANSMISSION-EDUCATION	DOCUMENTATION	REVITALIZATION	PROMOTION	TRANSMISSION-EDUCATION	DOCUMENTATION	REVITALIZATION	PROMOTION
TRADITIONAL TECHNOLOGIES		Written texts		●		●				
		Audio recording	●	●		●				
		Video	●	●		●		●		●
		Photography	●	●			●	●		●
		Architectural Drawings					●	●		●
DIGITAL TECHNOLOGY	DIGITAL INFORMATION ACQUISITION	Detailed information		●		●		●		●
		Database mapping		●		●		●		●
		Digital photography		●		●		●		●
		3D Scanning					●	●		●
	INFORMATION DATABASE	Digital museum		●	●	●	●	●	●	●
		Multimedia integration	●	●	●	●		●	●	●
		Virtual reality	●	●	●	●		●	●	●
	VIRTUAL REPRESENTATION TECHNOLOGY	Virtual scene modelling	●	●	●	●				
		Virtual scene coordination	●	●	●	●				

Figure 5. Relationship between technology and the conservation of traditional craftsmanship.

Technology and the transmission-education of traditional craftsmanship

Transmission as a safeguarding measure for intangible cultural heritage means the transfer to future generations of the practitioners' knowledge of different elements of intangible cultural heritage. Particularly focusing on traditional craftsmanship, transmission is related to the transfer of knowledge, skills and know-how between master and apprentices for the continuity of craftsmanship. Education, both formal and non-formal, has a significant role in the transmission process of traditional craftsmanship. Technology emerges here as an educational tool for the transfer of knowledge. Using online learning resources and creating virtual context for revitalizing the original working environment of craftsmen can help to understand the know-how and methods used by craftsmen in the past.

Museums are appropriate places for public education to promote the sustainability of intangible cultural heritage utilizing digital technologies (Kim, Im, Lee & Choi, 2019, 6). The application of digital technologies in museums enriches visitor's museum experience allowing hands-on experience and enhances interactivity in museums contributing to the education of cultural heritage (ibid. 6). Especially the use of VR technology with a head-mounted device to immerse into virtual reality contributes to active participation of visitors and educational effect of museums (ibid., 9). VR technology is also used for training and education of various elements of traditional craftsmanship, since it makes possible active participation of users through the craft production process in virtual environment (ibid., 14).

When living building masters perform their traditions, skills and craftsmanship within museums or educational institutions, visitors or apprentices learn from them the process of production. On the other hand, especially for the disappearing craftmanship, using the participatory methods hand in hand with technologies as a learning tool provides a more direct interaction in terms of learning and transmission for researchers, apprentices and people to understand the knowledge of craftsmen. Actually it is thought that modern technologies cannot replace human interaction in the transmission of intangible heritage, even though they can contribute to the processes of dissemination among young generations (Alivizatou-Barakou et al., 2017, 6). Playful learning technologies appeals to students' curiosity and willingness to learn the different elements of cultural heritage. The use of mixed reality technologies also encourages the interaction with the cultural heritage elements improving the visitor's experience. Virtual elements such as "guide maps, descriptions or virtual-human characters" support the users in visualizing and exploring heritage elements and provide new knowledge (Tabone, 2019, 49). These virtual elements also facilitate the reconstruction of historic collapsed or ruined buildings , and enable to visualize and interact with the reconstructed views of both tangible and intangible cultural heritage (Tabone, 2019, 50; Cosmas et.al., 2003). They also allow users to obtain information about the construction techniques of the historic buildings and traditional craftsmanship during the exploration.

Figure. 6. Digital technologies used in Archeoguide project (Source: Brizard, Derde, Silberman, 2007, 7)

Technology and the documentation of traditional craftsmanship

Documentation as a significant safeguarding measure needs to be carried out for both tangible and intangible cultural heritage, even though each requires using different methodologies. In the case of the traditional craftsmanship embodied in architecture, the documentation of tangible features can be done by using architectural documentation methodologies. On the other hand, the documentation of the intangible values, like the techniques, skills and know-how of the craftsmen, can be carried out by using ethnographic research methods and photographic and audio-video documentation (Karakul, 2011, Alivizatou-Barakou et al., 2017). The documentation of the intangible aspects of traditional craftsmanship also benefits greatly from new technologies to get across the process of production with the used techniques, methods, tools and know-how of the craftsmen.

The documentation of the intangible values of traditional craftsmanship necessitates to deeply understand the production process of craftsmen. To understand and document the process of production accurately, virtual reality technologies facilitate the reproduction of traditional craftsmanship with regard to the working process of craftsmen, the use of materials, techniques and tools, their know-how and skills realistically (Zhou, Geng & Wu, 2012, 12).

Digital technologies can be used in museum exhibitions to increase the accessibility of intangible cultural heritage and thus to contribute to the public understanding of the elements of it. They enable three dimensional and realistic experiences in which the users can feel and interact with multiple senses (Kim et. al., 2019, 2). Considering traditional craftsmanship, digital museum can contribute to all conservation measures by providing the revitalization of the original environment of the working process of craftsmen and the construction process of historic buildings. Digital museum can include the different elements of traditional craftsmanship as to the process of production with the help of new technologies, such as multimedia integration, digital photography and virtual reality (Zhou, Geng & Wu 2012, 10). Besides, virtual museums simulate physical museums and cultural heritage sites with their tangible and intangible elements (Tabone, 2019, 51).

On the other hand, for the revitalization of the tangible values of craftsmanship embodied within the ruined historic buildings, digital technologies provide new possibilities using different ways of exhibiting. The reconstruction of historic buildings including expressing the original context and the characteristics of the building and the different craftsmanship embodied within can easily be made by using digital technologies (Tabone, 2019, 51). Digital photography and 3D scanning facilitate the documentation of architectural complexes, buildings, and their tangible features, like the architectural ornaments, structural systems, and construction techniques by craftsmen.

As mentioned before, the holistic conservation approach of this study necessitates the evaluation of the information about tangible and intangible values obtained by using different methodologies together. The digital technology plays a critical role in this elaborate evaluation of information obtained by using different methodologies together to develop the accurate and holistic conservation approaches. In the evaluation of the documentation of the different aspects of traditional craftsmanship, virtual reality technologies and multimedia can be used effectively.

The digital technology also facilitates online archives and databases as a part of national inventories, raising awareness of the importance of traditional craftsmanship among local communities. They may contain photographic and audio-visual documentation and use participatory and interactive tools to give experience of the implementation process of crafts.

Technology and the revitalization of traditional craftsmanship

Revitalization is especially significant conservation measure for the disappearing and radically changing elements of intangible cultural heritage. The critical issue in revitalization is to conserve and sustain the genuine qualities of the relationships between the tangible and intangible values of the heritage element. New technology can contribute to the revitalization of both kind of values of craftsmanship by using multimedia integration, digital museum and virtual representation technology.

Considering the revitalization of the tangible values of craftsmanship, the digital reconstructions of historic buildings can benefit of 3D modeling displaying the construction techniques and the materials used by building masters. Since the 1990s, the digital reconstructions of archaeological remains have been used to regenerate the historic buildings within their original context virtually. A digital reconstruction made at the archaeological site of Ename in Belgium is one of the first digital applications combining live video with overlaid 3D reconstructions to allow viewers to understand the history of the site (Brizard, Derde & Silberman, 2007, 13).

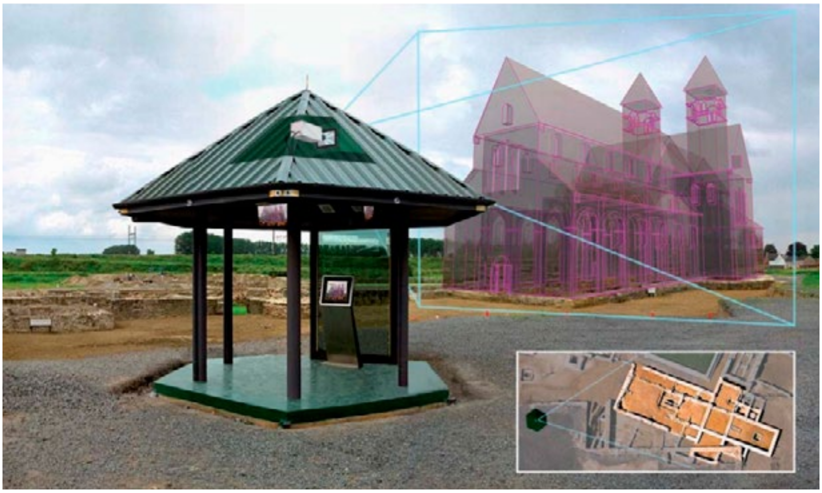

Figure 7. Digital reconstruction at the archeological site of Ename (Brizard, Derde & Silberman, 2007, 3)

The revitalization of the intangible values of traditional craftsmanship can be achieved by using digital virtual reality technologies such as multimedia virtual scene modeling and virtual scene coordination display, through which the production process of craftsmen and transmission of their know-how can be accessed(Zhou, Geng & Wu, 2012, 10). 3D visualization technology, specifically, motion capture technologies can be used for the detailed documentation of hand and finger movement during the creation process of craftsmen (Alivizatou-Barakou et al., 2017, 23). Digital museum can also contribute to the revitalization of the different aspects of traditional craftsmanship with the help of technologies, such as multimedia integration, digital photography, and virtual reality (Zhou, Geng & Wu, 2012, 10).

Particularly, VR technology facilitates the revitalization of traditional craftsmanship as regards master-apprentice relations in virtual environment providing active participation of users to the construction process of traditional buildings. The users can follow building master's guidelines to make building materials using hand controllers and choose an option among different activities in construction process to practice (Kim et al., 2019, 14).

With regard to the documentation and revitalization of the tangible elements of architecture and traditional craftsmanship, such as architectural elements, decorative elements, digital technology, specifically virtual representation technology, can contribute to the reproduction and promotion of a destroyed building, like a temple (Zhou et al., 2017, 19).

Technology and the promotion of traditional craftsmanship

Promotion as a significant safeguarding measure for both tangible and intangible cultural heritage aims to raise awareness about the values of cultural heritage. Focusing on the promotion of traditional craftsmanship as a branch of intangible cultural heritage, it is recommended to ensure public awareness about its safeguarding by (1) regularly organizing performances, demonstrations, exhibitions; (2) enabling research and publishing of printed, audio, video and multi-media documents related to the traditional craftsmanship and its bearers; and (3) integrating traditional craftsmanship into educational curricula. Digital technology can be used in exhibitions and museums to provide different ways of exhibiting, for example by using multimedia creating a virtual reality environment to raise awareness of tangible and intangible aspects of craftsmanship. It also contributes to the preparation of research and publishing of the documents related to craftsmanship and developing educational understanding of the traditional craftsmanship.

Discussion and Conclusion

The technological developments have not been comprehensively applied in the conservation of intangible cultural heritage. This might be due to its relatively new identification within the UNESCO 2003 Convention in comparison to tangible heritage. This situation has caused to proceed with conservation processes of tangible and intangible cultural heritage separately differentiating the effects of technology on them. However, the conservation process needs to be carried out holistically integrating tangible and intangible aspects of cultural heritage. So, the effects of technology over the conservation process need to be investigated with regard to the use of new technology for the conservation of both tangible and intangible heritage elements.

Throughout the conservation process, four safeguarding measures, transmission/education, documentation, revitalization, and promotion, as mentioned above, are highlighted within the international documents. This study advances that technological developments, especially the rapid improvements in digital technology, have contributed to the processes of transmission, documentation, revitalization, and promotion of both tangible and intangible heritage values. Digital technology that has been developed in recent years has contributed to the conservation of cultural heritage and its study in different ways. The role of digital technology is especially significant when aim is to unify conservation studies still unfortunately divided in two separate domains as the study of tangible and intangible heritage. Particularly by focusing on traditional craftsmanship, this study detailed the different aspects of technology used through the processes of conservation of both its tangible and intangible values. On all accounts, it tried to integrate them in a holistic perspective.

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Ariel Aravot

A Student Work in an Art/Craft Studio From “Interlace” to “Contain”

Introduction

This article presents the course of study in a glass studio as experienced in one course by one student. The studio is a core component of craft and design education. While there is much discussion of studio teaching, there seems to be less information about the learning experience in the studio. A student’s point of view can shed light on connections between the learning experience and other simultaneous experiences, between theoretical teaching materials, practical work and relation to the context. This article presents such a student experience evidence. It is structured as a diary, with titles indicating the contents of key stages throughout the course, including: Patterns of interlacing, Interlacing as topic, A studio research question, Glass precedents, First test in glass, Between the object and myself as maker, Interlacing as metaphor in Ersilia, Images of Ersilia, ‘Inter’ as being with others (Gehl), Meanings of ‘interlacing’, Association to Merleau-Ponty, Kiln work and hot blowing work, Learning from a glass master, The site for my site-specific installation, The site-specific installation: Contain. The article is concluded by a short reflective text as summary.

The studio is the most common core component in higher education of design, craft and art. (e.g. Crowther, 2013; Salama, 2016) For many decades now the boundaries between these three domains have become liquid, unstable, context-dependent and virtually irrelevant (e.g. Sennet, 1997; Adamson, 2010), and in general their studios have acquired similar pedagogical structure and scope (Schön, 1987; Wang, 2010).

The studio is characterized, among other things, by teaching through guidance by professionals or artists, self-work of students and mutual learning of students from each other. It is regarded as a highly effective educational framework of many pedagogical advantages (e.g. Dutton, 1987; Carpenter, 2013; Grant Long, 2012; Salama & Wilkinson, 2007). It joins practical and theoretical study and promotes the student’s skill and creativity as a combination of know-how and concepts. “...the design studio [is]... the backbone of that education and the main forum for creative exploration and interaction...” (Salama, 2016).

The learning processes in the studio are complex. Frequently they evolve around questions, not unlike research questions in scientific work. Indeed, studio work in the academic studio is sometimes related to as research by design (Joseph, 2004; Sengers, 2006; Zimmerman, Stolterman & Forlizzi, 2010). The student is expected to develop a personal theme, and to relate the creative work to theoretical and conceptual platforms. The result of the student's comprehensive effort has to show relevance to contemporary issues, either environmental, social, cultural, politic, economic etc. Learning processes in the studio have been described as including specific challenges and highly emotional involvement. (e.g. Sachs, 1999; Austerlitz, 2007).

However "the students' ideation process is mostly invisible to the teacher, since they develop their project between each critique session in a process of trial and error." (Wang, 2010, 180). This article presents precisely that invisible process in its specificity: the course of study in a glass studio, as experienced in one course by one student. It is based on my work in the glass studio: "Scale, Space and Body", coordinated by Nina Erichsen, Fall, 2018 at the Royal Danish Academy of Fine Arts, School of Design, Bornholm. In that semester I was a third year exchange student from the Ceramics and Glass Program, The Bezalel Academy of Art and Design, Jerusalem, Israel.

A reconstruction, the process is presented in a quasi-diary form, with emphasis on the major stages in the development of my material project (in glass), their affinity to theoretical texts that were recommended during that semester and the relations of both these aspects to some events and characteristics of my life outside of the studio. Although the process had many iterations and cyclical facets, it is presented in a linear form for reasons of lengths limits of the text. Especially non-linear were the connections between the theoretical bibliographical texts of the studio and my creative work. Frequently I had feelings, emotions or insights that only later received their grounding or interpretation in the ideas expressed in the course recommended references. Other insights were related to texts that I had read on earlier occasions. My work was an associative sequence, guided by my teachers and other students. I only unfold my own experience, not the encounters with other studio participants. My narrative is neither an evaluation nor a critique of the process I underwent in the studio, but a descriptive evidence that might be useful in understanding the counterpart of the learner in the studio.

The Studio Course

Patterns of interlacing

As an exchange student with no previous acquaintances, I was rather bewildered at the beginning of the studio. All was new and all people were strangers for me. I looked over and around, and it was then that I noticed the acoustic slabs on the ceiling, with their intricate patterns of wood wool made of thin spruce wood chips and attached by cement. They looked familiar, and they reminded me of patterns of interlacing, that had always intrigued me both as *form* and as process. The previous year at Bezalel, Jerusalem, I had produced a homage to Shakespeare’s *A Midsummer Night’s Dream* by an installation entitled *”metamorphosis”*, related to the transformations from a tree in the forest to wood in the carpentry and through “magic” – to a musical instruments. It was very much in vein with Focillon’s position that connects form, matter and technique or process, although when creating the installation I was not aware of the theoretical affinity, which were to be discovered later in the semester (Focillon, 1934 in Adamson, 2010, 362)

Interlacing as topic

When in Copenhagen on my study trip assignment to find inspiration, I took many pictures of plants, trees and bushes. Following, I decided to adopt *interlacing* as the experimental topic of my semester project.

Forms in the glass medium

My interest in the idea of interlacing went hand in hand with my experimentation with glass as material. Coming from the area in the world where glass was invented, I was fascinated by this material that had been around for more than 2000 years. I was aware that for the recent hundred years and more, most glass work was industrial. In my view it lacked passion in it. Most developments provided synthetic materials that gave similar results in shape and met predetermined functional purposes. In contrary of that I thought of the making of objects in technologies of human blowing or casting, i.e. old processes that gave the objects more individuality and their makers' touches. Such processes resulted in forms, in the sense that a form "always goes beyond the practical function.... [and has the inherent power to] reach us most directly and deeply" (Arnheim, 1954, 96).

A studio research question

I had to formulate a research question to guide my proceeding work in the studio. Given my decision to adopt the concept of interlacing and my hope to create a form in glass, my question was: How can I create interlacing in GLASS, both as FORM and as PROCESS?

To answer my question I proceeded in parallel: working with glass and conducting research of the idea of interlacing. I advanced associatively, one finding leading to the other.

Glass precedents

In English *interlacing* is related to lace: delicate, pliant. In Hebrew – it is related more to intertwining, spinning or twisting together. Combining the idea to glass as material poses a challenge. I searched for precedents.

The last work I looked (Figure 1) manifests the twisting and intertwining of glass, as expected by the concept 'interlacing'. The thin threads caught my interest.

Figure 1. Vision Award produced by Tom Jackson https://cdn10.bigcommerce.com/s-xg5j30s/products/125/images/421/2P04AGS22_colored_art_glass_award__92795.1446586519.1280.1280.jpg?c=2

First test in glass

The first test in glass was grabbing a bunch of canes with color inside, twist them to get a random pattern, gather transparent glass over them and blow it. This technique was difficult to control, but I liked the result: some strings spread and became blurry.

Between the object and myself as maker

I really felt that an exchange was taking place between “the objective qualities of materiality” and myself, a craftsman-artist-designer-maker in the making and my will. (Adamson, 2010, 4)

Interlacing as metaphor in Ersilia

At the back of my mind *interlacing* was also a *metaphor* of people and their interrelations, and to places. Italo Calvino wrote about Ersilia, that envisaged such relations as threads.

TRADING
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4

In Ersilia, to establish the relationships that sustain the city’s life, the inhabitants stretch strings from the corners of the houses, white or black or grey or black-and-white according to whether they mark a relationship of blood, of trade, authority, agency. When the strings become so numerous that you can no longer pass among them, the inhabitants leave: the houses are dismantled; only the strings and their supports remain.”

Excerpt From *Invisible Cities* (transl. William Weaver) by Italo Calvino, 1974 p.76

Images of Ersilia

Artists produced images of Ersilia. “Transference into another medium may prove the greatness of the original inspiration, as in the illustration of a great poet by a designer” (Fogerty,1937, in Adamson 2010, 367)

Figure 2. Image of Ersilia by Janice. http://drawinginthebackroom.blogspot.com/2011/09/new-print-ersilia.html

‘Inter’ as being with others (Gehl)

As opposed to Calvino’s story of Ersilia, there are situations when interlacing patterns of human relations are thin, underdeveloped and lacking. Then, “string interweaving” of relationships becomes a need, not a burden.

When I arrived alone in Bornholm the whole environment was unfamiliar. I felt really disconnected. After a while tough, I felt more “inter(laced)” with everyone, looking especially in informal situations, which contributed a lot to my wellbeing.

Jan Gehl relates ‘inter’ to “Life between buildings offers an opportunity to be with others in a relaxed and undemanding way” (Gehl, 2011).

This aspect of in-between associated with interlace later influenced my site specific installation.

Meanings of ‘interlacing’

I looked at the word “interlace” for its different meanings in English, as this was the language I used during the semester and communicated to the studio colleagues and instructors.

Synonyms and Antonyms of interlace

Synonyms of interlace
enlace, entwine, implicate [archaic], intertwine, intertwist, interweave, inweave, lace, ply, twist, weave, wreathe, writhe

Words related to interlace
braid, plait, plat, pleach, blend, fuse, join, link, mix

Near Antonyms of interlace
disentangle, uncoil, untangle, untwine, unwind

Synonyms of interlace
intersperse, interweave, lace, salt, thread, weave, wreathe

Words related to interlace
insert, intermingle, mingle, mix, alternate, juxtapose, amalgamate, assimilate, blend, combine, commingle, embody, fuse, incorporate, integrate, merge

Synonyms of interlace
entangle, intertwine, intertwist, interweave, knot, snarl, tangle

Words related to interlace
jumble, scrabble, scramble, braid, enlace, entwine, entwist, inweave, plait, twine, weave, wind, wreathe, writhe

Near Antonyms of interlace
unknot, unravel, unscramble, unweave

Antonyms of interlace
disentangle, unsnarl, untangle, untwine, untwist

Origin

late Middle English: from Old French entrelacier, from entre – ‘between’ + lacier ‘to lace’

Association to Merleau-Ponty

A common English phrase is 'interlaced fingers' which brought to mind Merleau-Ponty's insight about perception, and how the body is always sensing and sensed, but not the same part of the body at the same time. "... the moment I feel my left hand with my right hand, I correspondingly cease touching my right hand with my left hand.." (Merleau Ponty, 1968, 9).

Figure 3. Images of interlaced fingers

This "two sidedness" of the body was associated in my mind with connection between the inside and outside. This aspect of interlace of inside and outside was later a basic aspect of my proposal for a site specific installation, as the final assignment of the studio.

Kiln work and hot blowing work

For interlacing in glass – I adopted two ways of making in parallel: kiln work and hot blowing work.

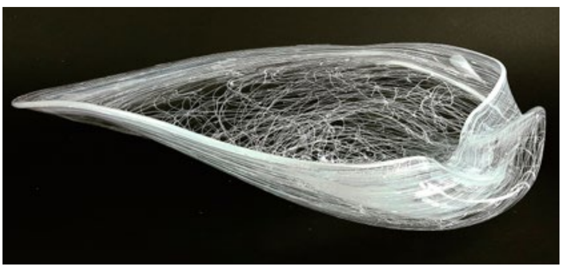
I started by pulling thin canes with white core (Kugler, 2061), slumping them separately over horizontal cylinders both in at right angle and randomly, on 710 °C for 15 minutes. After cooling down, I arranged the slumped canes randomly on a flat kiln shelf and fused them together at 850 °C for 2 hours. The resulting interlace was not satisfactory, mainly because it was lacking the feeling of depth.

Figure 4. Hot blowing work (above) and slumping of thin canes with white core (below)

Learning from a glass master

The glass artist Louis Thompson visited our studio. I had the chance to talk to him. He listened to my ideas and recommended to pull thin Duro white stringers, cutting them to smaller sections, and grabbing them cold on a hot bubble, in layers with transparent glass in between, to get the depth desired.

Figure 5. Interlacing the version taught by Louis Thompson. (above and below)



The site for my site-specific installation

Following a field trip with the studio participants and instructors, I chose Campus Bornholm in Rønne as the site for my specific intervention because in my view it is a place and a social institution that realizes interlacing and interweaving between people, skills and life-worlds.

The proposal of my site specific installation was comprised of the idea of actively involving the users of the place and giving them a symbolic-metaphorical view of the interlacing/s – interweaving/s of the Campus Bornholm Center, its contemporary context and all its user groups .

Figure 6. Campus Bornholm, view of entrance façade. Courtesy of CUBO Architects

The site-specific installation: *Contain*

I named my site-specific installation '*Contain'/ It consisted* of two wide, very shallow bowls with asymmetrical patterns of interlacing threads. When one looks through such a bowl an effect of fisheye lens is experienced, contained within the interlaced layers of white glass threads. One bowl "assembles" the outside – the green open space in front of the building and the more remote landscape of Bornholm. The other bowl "assembles" the interior of the Campus, the Bornholm people that are temporarily interconnected for the purpose of learning and training. A person standing between the two bowls, looking once through the right one, and then through the left one would experience the awareness of the outside and the inside.

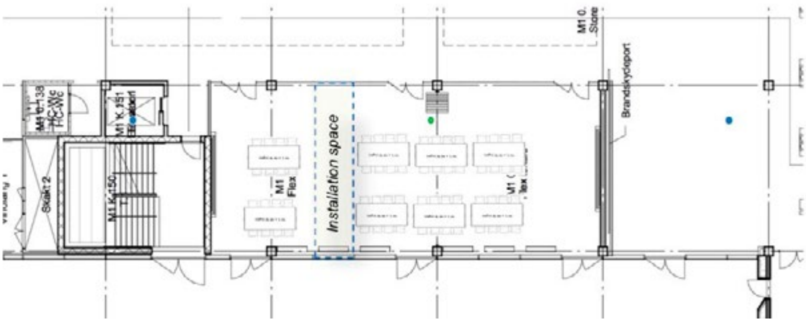


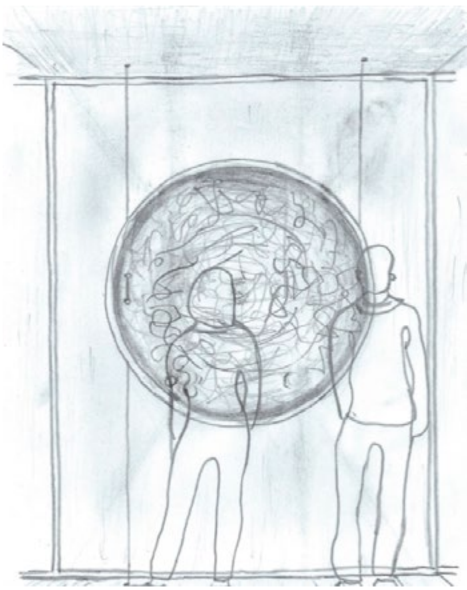
Figure 7. Location of the site-specific installation Contain

The installation was intended to take advantage of the quality of the architecture of the site, and to imply bodily action: “Authentic architectural experience consists then, for instance, ...of looking in or out through a window”. (Pallasmaa, 2005, 63).

Figure 8. The glass bowl with interlacing (above), and the fisheye view through the interlace-pattern bowl (below). (Photos by Ariel Aravot)

Instead of resting horizontally, the shallow bowls open upwards, suspended on two stainless steel cables from the ceiling and fixed to the floor with two other cables. This unusual position and orientation, “will bring to the fore a new structural skeleton, which gives the object a different character” (Arnheim, 1954, 103)

Figure 9. Contain Installation – people looking through the flat bowl.



The name of the installation – *Contain* – expresses the actual physical situation of the bowl as a container, and the idea of human relationships within a safe and friendly emotional space.

Reflection as summary

Reflecting on my experience in this semester I find that my work was influenced by both the academic occurrence in the studio and my personal situation. My conceptual and formal focus on *interlacing* – stemmed in an aesthetically “wandering” observation of the everyday environment. Later, when I was fulfilling the studio assignments, *interlacing* received a thickening and accentuation.

One explanation why I was attracted to *interlace* in the first place, might come from Pallasmaa insight: a photograph of a Finnish Pine forest and a painting of Jackson Pollock – One number 31, 1950. Pallasmaa suggests that *peripheral stimuli* of a natural surrounding or of a work of art (that *are interlaced* – to use my own term) effectively invite us and pull us into the space we face. (Pallasmaa, 2009, 65)

My personal eclectic research led me to various meanings and appearances of interlacing, while the theoretical texts that accompanied the studio provided reinforcements for reflexive experiences and illuminated my self-awareness of the work process.

My focus however remained on the craft side. I encountered problems in interpreting *interlacing* in glass blowing, with challenges ranging from formal search to the very skill and know-how I had to acquire. Moving back and forth from my crafted object to the question of content extended the meaning of my work and posed the challenge for future learning: the question that intrigued me at the end of the semester was how to produce interlacing in the two ways I had experimented with, but at a larger scale, a bowl of about 1m in diameter or more.

Most of all I was attracted to continue experimentations with interlacing of the version I learned from Louis Thompson in the class, and with other versions I found among his works.

In summary of my learning process, I wished there were more opportunities of the kind Pallasmaa describes : ”...the transference of the skill from the muscles of the teacher directly to the muscles of the apprentice through the act of sensory perception and bodily mimesis” (Pallasmaa, 2005, 15).

Figure 10. Peripheral vision and a sense of interiority (Pallasmaa, 2009, 65)

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Marinella Ferrara & Shujun Ban

Women and Maker Cultures – the Relevance of Technological Appropriation from History to Current Phenomena

Introduction

In recent years, consumers and designers' interest in crafting related to *Do-It-Yourself* (DIY) and *maker culture paradigm* (*fabbing, hacking, etc.*) has grown in Europe, USA, and, lastly, in Asia as well. Crafters and makers' exhibitions, fairs, shows, magazines, forums, blogs, image banks, tutorials, and web platforms are echoing the Arts and Crafts movements of the past.

In Europe, as a matter of fact, the interest in craft has never disappeared. Due to different reasons and implications, the culture of craft cyclically returns to be an issue of debate in the design discourse. This is particularly evident in Italy, for example, where design, artisanal skills and industrial manufacture are strongly connected: the debate on craft has been particularly lively in the 70s, together with a new interest for experimental practices. The protagonists of this debate (Alessandro Mendini, Ettore Sottsass, Andrea Branzi and many others) would have subsequently redefined the role of design, marking the passage from design as a tool for the industry to a process of collective and social creativity.

Apart from the numerous and diverse contexts involved in this worldwide phenomenon, one common aspect of the crafting movement is the growing communities of women sharing their creations and activities. This has been regarded as a political act, which can be partly related to a third wave of feminist DIY movement (Carpenter, 2010; Hackney, 2013; Burton, 2015; Salle, 2016).

Another peculiar feature of the current makers' paradigm is the centrality of digital technologies and ICTs: women and ICTs are the harbinger of significant empowerment of our society (Cummings & O'Neil, 2015), as this combination is promising in terms of gender equality, social innovation and sustainability. Women's maker culture can represent a form of opposition to deterministic trends, by rebalancing the way technology is used and by giving voice to a larger part of the society.

Our experience in university teaching has shown us the uncritical adoption of many trends proposed by students and younger colleagues. In particular, from the perspective of digital natives, analogue and manual modes of making may represent a fascinating novelty, regardless of the environments they come from, the material conditions in which they are practiced and what they represented in the past. Ignoring historical processes can lead to falsification or distortion of actual phenomena. To avoid this danger, with this essay, we propose an overview of the worldwide phenomenon of women's making. We aim to contribute to the understanding of the current phenomenon as the result of a gradual women's empowerment in the design field, by regarding it as a part of a century-long process which is still not complete.

We firstly provide a diachronic analysis of the female role in creative practices and technologies appropriation along the history of design from 18th century up to the current time (paragraph 2).

Secondly, we offer a synchronic analysis of the current creativity and design conditions by introducing the reasons and the various characteristics of the craftswomen (who may also be called *crafters* or *craftmakers*) phenomenology. Based on the current literature on the topic (paragraph 3), the critical stances are supported by a number of selected examples drawn from different countries, communities and practices, in order to deepen the understanding of the phenomenon.

Women's Creative and Making Cultures in the Industrial Design History

Throughout the centuries, women have been socially active agents and mediators by combining needs and products, creative practices and technological action. Nevertheless, the relation between women and technology along history has still not been thoroughly investigated[1]. However, by analysing the interconnections between design history, history of women, history of economy and history of labour it is possible to draw insights about women's means of production and their appropriation of technologies. We will start from some of these insights to briefly trace the path of women between creative and technical practices in the Western industrial ages. Without any claim to present a systematic historical study, our aim is to correctly frame a discourse about the contemporary women's maker phenomenon as a part of a historical process. To this aim, we highlight some

1 Much about the women's role in art, craft and design in the Western societies was developed by design & arts since the 70s. Twentieth-century historians and design theorists have put women's role on the sidelines, by nearly ignoring them. In the 80s, a big contribution to the research about women's relationship with technology was given in the frame of 'social construction of technology' (Pinch & Bijker, 1984) with the theory of 'social construction of gender' in feminism and sociology of the 20th century.

particular historical periods and aspects of female making in relationship with the technology appropriation processes.

We use a frame based on the theory of economics' historians, which divides the industrial revolution in three phases, considering a time span which goes from the second half of 18th century to current days. This frame helps to understand and display how the maker culture has been changed and reformulated in each phase depending on different socio-economic and technological conditions. By analysing the evolution phase by phase, it is possible to recognise factors of continuity as well as ruptures with the past through the different creative expression.

The start of an empowering process. The 1st industrial revolution

In the farming economy previous to the industrial revolution, women were confined to their home, where they had to handcraft a variety of goods which were mainly aimed at domestic use (food, soap, candles, yarn, clothes, etc.), and they could interact with each other. Since the second half of 18th century, mechanization traced women's path from home to the industrial factory, starting from Britain. Mechanization, as well as the gradual evolution of consumerism, forced women to face profound changes.

Their work in the factory was structured as an extension of their role at home, although this often ran counter to the rationalization that characterised industrial work (Karamessini & Rubery, 2013, 18). Nonetheless, women's labour in specific sectors like textile, clothing and shoes' field has been appreciated for their ability to manage the manufacturing process, accurate manual skills, attention and patience as well as their low wage (Helmbold & Schofield, 1989).

Some of the most relevant and impacting technologies in women's life were the mechanical loom first and the sewing machine later. These technical innovations had a disruptive impact on the modernization of many areas of the world, by redistributing capital and enhancing social emancipation. Although working in a factory was not considered a desirable job, acquiring a technical competence has led to a growth in the culture of female work. Maker culture and economic independence have been crucial tools for the gradual achievement of a new individualism, and they also paved the way for a modernisation in women's behaviour. This led to the creation of a new social class: the women factory weavers (Helmbold & Schofield, 1989). In 1973, Hannah Wilkinson, an American textile worker and wife of the entrepreneurship Samuel Slater, was the first woman to receive a patent for the two-ply cotton sewing thread (Thorne, 2019).

In the areas where industrial modernization or factory installation were delayed, the productive processes (weaving, embroidering, sewing, etc.) involved women in their homes. Crafting has trained women to deal with complex acts, as craftmakers need to think about what they are doing with each action, with each stitch.

In Britain, bourgeoisie women started to gather in female-led spaces for discussion and education while crafting. In these circles they could share the projects they were working on and express their ideas, as well as their aspiration towards a better society, by conversing and interacting. Starting from 1825, the Female Society for Birmingham, which was born from a small female circle, involved the middle-class women in the first large-scale anti-slavery campaign. Those women handcrafted work bags – a common accessory for women to carry materials for embroidery – and used them as vessels for anti-slavery literature, raising funds and increasing awareness among the population (Midgley, 1995).

During the crucial transition from applied arts to industrial design, women's crafting has echoed the Arts and Crafts movement of the last decades of the nineteenth century: a concerted socio-political stance against the Industrial Revolution, the mechanization of labour, the alienating conditions in the industrial factories and the economic liberalism. Inspired by the Victorian idealism, and the Utopian Socialism of concerted work by Robert Owen (cooperatives), John Ruskin (workers' guilds) and William Morris (craftsmen's workshops), the movement greatly influenced its members' philosophies on the moral of work[2] and spread the idea that the relationship between arts and crafts was a guaranty of the designers' freedom. The movement quickly became an international trend, as it promoted a revival of tradition in the decorative and fine arts, highly valuating the vernacular style.

The creative work, including ceramics, furniture, textiles, jewellery, and metalwork, actually merged into elitist, expensive productions, which were only available for the upper social classes (Dardi & Pasca, 2019, 25). Moreover, the Arts & Craft Society, established in 1887 in London, excluded women from the *guilds* and the best that women could get was the benevolent tolerance from male leaders, helping their artisan father or husband. Women could only contribute to the decoration of the pieces, most of the times by using the name of the male artist (Wolf, 1989). Different was the case of the Arts & Craft Movement in USA (Kaplan, 1991) and in New Zealand (Calhoun, 2000). Here women had the possibility to establish independent small studios and shops where they were free to pursue

2 Owen's work focused on reforming society with the cooperation of school and the pursuit of happiness, Ruskin's work denotes nostalgia for the past as a guide for future reforms, and Morris' work concentrates on the pursuit of beauty as a way to reach social harmony. At first, the movement encouraged amateur practice of both men and women to produce their own furnishings and decorative objects.

their own creative interests in productions as pottery, metalworking and bookbinding: for instance, the ceramists Robineau Perry and Elizabeth Overbeck (Cumming, 1991, 101). In most cases, however, crafts production gathered women in a labour-intensive environment, providing a meager income in exchange for long hours of work. In some contexts, handicrafts were for women a means to increase their income, but only under certain conditions: it could be an economic help for the family, a collaboration with the husband or a diversion for women who didn't need to worry about financial return, since crafts were specialized activities that could only offer limited market opportunities. Women's motivations[3], technical skills[4] of embroidering, weaving, sewing, mixing colours, painting, composing forms, choosing the right materials for each piece, started to be appreciated as a dominant craft sensibility. These factors influenced other categories, especially motivations, cognitive processes and skills. With craft's long-standing roots in women's work, it may not be surprising that women were elevated as tastemakers. Their sophisticated perception of goods has been appreciated also in the service sector during the first development of consumption in the XIX century and then in many other fields during the XX century.

The second phase of industrial revolution. Towards the modernity

Across Europe, the bourgeois families have gradually accepted the possibility for non-married women to study and be engaged in arts and crafts working activities in sectors which have been historically influenced by women making and consumption, like home decoration, textiles and fashion. Crafting was often an opportunity to break free from oppressive domestic roles and experience a creative activity with sensory intensity. Women's maker culture has been appreciated but at the same time underestimated in economic and entrepreneurial terms.

The First World War has acquired a central place in the birth of the *new women*. Wartime posed a challenge to the traditional role of women as homemakers in the private sphere, due to the absence of men: women started to carry out different professions. Invested with a new greater responsibility, they have gained awareness of their ability to manage risks, investments, and business relations. The socio-technical environment triggered dramatic changes in the interaction with other people concerning technical actions and socioemotional support such as the exchange of ideas, the access to sources of information.

3 These include intrinsic factors related to personal interest and inclination.

4 Technical skills are knowledge and expertise in a specific domain and the ability to manage the creative process.

The *Roaring Twenties* represented a cultural discontinuity, and a promising time for the women's emancipation in connection with the renewal of the arts and the industrial expansion. The new ethical function of *Art into Industry for mass production* by Walter Gropius at the Bauhaus renewed the aesthetics and the qualities of the industrial production in relation to manufacturing processes. A rationalist language was developed by the students of the Bauhaus workshops, including the female students at the textile laboratory. Elementary forms, abstract compositions, and references to primitive arts replaced the traditional repertoire of domestic interior.

This cultural renewal which also involved cinema, theatre and ballet, ended up influencing everyday life by proposing new female models. In Paris, where feminism became a political movement since the 1890s, women wore trousers, coloured socks, clothes with soft materials which made body movements easier and more comfortable, overcoming the preconceptions about female sexuality. Among the first women who became role-models for other women, there were artists and designers such as Sonia Delaunay (1885–1979), the American interior designer Elsie de Wolfe (1865–1950), the British Vogue management editor Dorothy Todd and the fashion editor Madge Garland, the Irish architect and furniture designer Eileen Gray (1877–1976), the French fashion designer Coco Chanel (1883–1971), the textile designer Gunta Stölzl (1897–1983), Marianne Liebe Brandt (1893–1983), and Margarete Shütte-Lihotzky (1897–2000) coming from Bauhaus. All of them dedicated their creative and critical energy to the modernist reconfiguration of domestic spaces and to the design of suitable products for the new woman.

In many difficult times and contexts women's production has been marginalized, but in time of war, austerity and autarchy, female work was carried out in the name of the country (Karamessini & Rubery, 2013).

In Italy, during the Fascist Autarchy (1930s–40s), a national policy aimed at the defence of artisanship encouraged female entrepreneurship: many proto-designers in the textile and fashion sector (the so-called *artists of thread)* introduced *avant-garde* trends in the country thanks to their work and experience. The experimentation on local, natural fibres as well as on new synthetic materials was one of the interesting aspects of their modern handcraft. (Lecce & Mazzanti, 2018) Among the many, Fede Cheti (1905–1979) founded her company of artistic fabrics in Milan in 1936: she started to collaborate with the famous architect Gio Ponti and, during World War II, she also patented her own synthetic straw, called Lin-Lan, hand-woven by rural crafters from the city of Cremona. During the 50s, along with the shift towards industrial manufacturing which brought innovation in textiles and design, she patented the *tessuto cinese*: a composition of nylon fibres. She rapidly gained international resonance by exhibiting her work in Paris and New York (Lecce & Mazzanti, 2018).

Both in Italy and in Austria-Hungary (Lees-Maffei, 2008, 11), female professions of interior decoration can be regarded as arenas in which stereotypical gendered roles have been renegotiated.

The sewing machine appropriation between modernization and social resistance

Sewing machine has been a democratic and fundamental technology in women's making culture. This machine played a decisive role in women's experience of the modernity both as producers – in factory or at home – and consumers. Accelerating and decelerating its movement, this machine effectually represents the specifically feminine experience of modernity, i.e. a mediated experience between women's emancipatory progress and social stagnation[5] (Friedrichs, 2018).

The use of this machine in industry has been a drive towards women's social mobility and traced their path into the public sphere by offering them employment and the opportunity of wage earning for subsistence.

As soon as it became affordable, re-designed, *domesticated*, well communicated and promoted as a consumer product, sewing machine entered into women's life. Being previously experienced and used under convenient working conditions, in a context of social interaction[6] sewing machine represented a powerful means for women to enhance their abilities. Manuals and fashion magazines, which provided women with new ideas and prompts like paper patterns for finished garments, contributed to their independence and introduced them to the production and systematization of labour. By sewing clothes for themselves, their family or for sale, women could feel a sense of accomplishment, as they were able to contribute to the family income, or to challenge their role in society as entrepreneurs. As a consequence of this process, it is possible to witness an upheaval of gender-based power hierarchies into the traditional family.

5 The sewing machine has been negatively reviewed by feminist criticism. Most of the critiques are addressed to the promotional claims which declared that sewing machine would make women's life easier by speeding up their work and increasing their free time. On the contrary, the truth was that sewing machines could cause the exploitation of scarcely paid women who worked at home and would end up in actually increasing the amount of housework, reducing women's free time. Compared to manual sewing, which could be done while chatting with other housewives in common spaces, the sewing machine relegated women to their home, favoring isolation, and reducing the possibility of interacting with others.

6 Singer Corporation, the most famous manufacturer of consumer sewing machines, adopted a successful strategy to improve women's appreciation of the machine. They organized courses and other collective events proposing a new experience of interaction among potential users.

The autonomous crafting of clothes allowed women to express their own individuality against a uniformity of appearance. Even after the *pret-a-porter* fashion diffusion, in particular contexts, some women continued to sew thanks to the pleasure that such activity could bring as a creative and technical practice, enabling image control, personal expression and independence from manufacturers (Kramarae, 1988). In more recent times, in developing countries such as Ecuador, Iraq and Pakistan the machine helps to generate economies, and serves as a means of creating and transforming clothes into forms of artistic or political expression, as in the case of the *molas* of the Cuna women from Panama (Berlo, 1992).

As demonstrated by the sewing machine example, when a technology allows autonomy, provides a pleasurable experience and enables personal expression, interacting with it may deploy a huge innovative potential. Any creative process, whether it is handmade or supported by technology, proves to be in principle a source of empowerment. But the appropriation of a technology is unlikely to be effective in this sense if we ignore the wider social environment within which it is designed and used.

The mature industrialization

After World War II, the emancipation of women resulted in a bigger impact of industrial production in their life. In general, middle- and upper-class women's experience of modernity has been related to mass cultural production, the introduction of the department stores, advertisement and consumption of mass-produced goods. The system of mass production boosted women's entrance into the public sphere. Women were involved in industrial production, related professions, and in new department stores. Traditional hierarchies and rules were gradually subverted in working and domestic environments, infusing workers with increased self-confidence and raising awareness of the importance of their work (Porter Benson, 1986).

With the improvement of socio-economic conditions, women became major sellers, consumers and users of mass-consumer goods and technologies. During those times, a general handcraft and low-tech anti-climax emerged. Due to the high level of quality of industrial products, to the promotional activity of brands, and to the enhancing of modern lifestyle, handcraft began to lose its relevance. It was impossible for artisanship to compete with industrial manufacturing. As a result, craft has gradually lost consumers' interest, its cultural capital, perceived value, and legitimacy.

Increasingly complex technologies and products gradually made their way into households and offices, following a path started during the interwar years, firstly in the USA. Home-appliances had a profound impact on women's daily activities and enabled the construction of self-consciousness and the distinction between private and public spaces[7]. Obviously, social class made the difference in terms of accessibility to new technologies, triggering many inequalities between countryside and cities. In the spirit of functionalism, connected to the mechanization and rationalization of work, women professionalised their role as housewives. Many promotional activities contributed to teaching women how to rationalise their work, make it more efficient and raise its quality. Household technology appropriation and the rise of living and working standards have been an important part of the development of the modern industrial society. However, as was noted by Landström (1998), since male engineers and designers developed appliances, these technologies were conservative in their view on what home and women's place in modern society should be[8]. This bias clearly emerged in a study of microwave design in the UK (Cockburn & Ormond, 1993)[9].

A parallel perspective shows that in a consumerist society, which firstly developed in the USA, the home becomes an important market outlet for thousands of products. For the first time in history, women became responsible for the purchase of an ever-growing range of products. As a consequence, enterprises and the distribution sector started paying more attention to women as consumers.

In the same years, the home economist and marketing expert Christine Isobel Frederick (1883–1970) published the popular book *Selling Mrs. Consumer* (1929) which instructed manufacturers and advertisers to take female interest into account. Women were welcome in advertising agencies, industry, and selling fields as the number of agencies increased. Industrial designers added the feminine touch to automotive design suggesting a broad-based demand for women to reach the expanding women's market (Sivulka, 2008).

7 Electricity triggered a systematic change in the mid-class interiors. After the electric iron, the electric sewing machine was the first technology to become widespread, progressively followed by vacuum cleaner, washing machine and refrigerator.

8 For more than two centuries in the design history – as denounced by many feminist scholars – product design has been mainly shaped by the young, white, standard male. Male influence takes over any stage of the social process of shaping technology, (fabrication, marketing, retailing and distribution) starting with the representation of the customer, the construction and control of the consumer up to the user experience.

9 This study demonstrated how the design features were specifically tailored for female or male users, tending to reflect and reinforce gender stereotypes. The microwave was initially designed and marketed as a brown good for single men, who were supposed to only heat pre-cooked meals and to be more interested in hi-fi equipment than cooking. The product was then redesigned as a *white good* and completed with *combi* cooking facilities in order to be sold to family households, assuming that women would take care of the cooking, and that they were both skilled and interested in the topic. The above-mentioned assumptions played a crucial role in the design choices.

Women's role in the job market took several decades to be socially recognised. Women started to create jobs for other women, to organize associations, and created networks to express solidarity and support. After the USA, the focus of marketing on women's consumption patterns moved to Europe. The decrease of women's domestic work as a modern acquisition and their appropriation of technology has provoked the downfall of craftsmanship in many countries.

The 3rd phase of the industrial revolution: the digital revolution

Handcraft revamped as a subversive form of art in the 1970s, serving as a means of feminist expression that criticised patriarchy and the male-dominated society. Textile work by artists such as Judy Chicago and Joyce Wieland attempted to unsettle male expectations of female artists' domesticity and child-rearing (Robertson, 2011, 184). The third phase of the industrial revolution began with the counterculture movement, an anti-establishment cultural phenomenon that widely developed and spread in the western societies between the mid-60s and mid-70s. Within this movement, second-wave feminism helped increase equality for women in the job market. Feminists aimed at improving the private life and the professional skills of women, promoting a greater level of social emancipation and the inclusion of all minorities – an aspect which had its own peculiarities in each area of the world. The social perception of women and the awareness of their role have evolved in most fields and manufacturing sectors.

This phase of the industrial revolution is characterized by the development of digital technologies and ICT, appropriated and used by women. In the digital technology age, the physical power, the command-and-control authority system, as well as traditional hierarchies – including gender-based hierarchy – started to decline, while human capital, information, knowledge, and innovative potential acquired enormous value in the economic competition.

At the beginning, digital technology, advanced electronic products and services – such as mobile phones and social networking – were dominated by men, just like other technologies in the past. As a consequence, all of these innovations did not reflect women's expectations. During the 90s, leading ICT corporations in the USA noted that women were the predominant users of these technologies in the workplace. Their extensive use was related to the benefits that women could obtain: the possibility of increasing social communication and to strengthen interconnections, the chance to have greater flexibility and to balance time between work and family, the opportunity of creating independent networks.

To reach the goal of integrating women's needs in IT, Xerox Corporation started a co-designing process, transforming women from users to designers, and giving shape to new IT-based technical products[10] (Fountain, 2000). They have demonstrated that, compared to men, women tend to have a different point of view on the technological needs of society.

In the following period, digital social media and different application of networking services have consistently increased the number of users interacting, changing the web from an informative solitary activity to a social dimension. Web 2.0, social networking services, open-tools and shared platforms are based on the assumption that people wish to create relationships within the cyberspace. They facilitated relationship building and innovated the way people are involved in collaborative activities. They work as a central mechanism in the design of social systems. We can consider them as new "tools for conviviality" (Illich 1973) because they are flexible to different people's needs, enabling individual freedom in self-expression, and encouraging conversation.

The Expansion of Design and Maker Culture

The third phase of the industrial revolution – in which we live – has clearly marked its discontinuity with the past, since all of the basic conditions of society have changed: one of these is the perception of women's role in the society. "For the first time in history, women have the opportunity to play a major and visible role in a social transformation of potentially monumental proportions. The rich and extensive penetration of information technology into virtually every area of society creates enormous opportunities for women." (Fountain, 2000, 3).

This change, as many others in the field of design, does not come from a radical replacement of the old approach with a new one[11]: design expressions are progressively growing in complexity, and new issues are emerging.

Speaking of design today, we can quote the Italian scholar Vanni Pasca (2020), who claimed that "design has expanded" in three-dimensional axes because of the industry's transformation and globalization. Firstly, design has expanded in quantitative terms all over the world: the number of designers, both female and male, has been growing since the 1990s and is still rising in emerging countries, so is the number of design schools. In addition, new creative practices have been developed by prosumers

10 This obviously led to a strong competitive advantage for the companies.

11 As in each of the past phases of the industrial revolution, the previous model gradually shatters due to new conditions, and new practices and expressions of creativity are formulated. Previous modalities remain as elements of continuity, but new elements of discontinuity become progressively dominant.

(Toffler, 1980) and by individuals engaged in DIY communities such as hobbyists, hackers and *proams* (professional amateurs).

Secondly, design has expanded geographically. A few decades ago, design was practiced only in a few industrialized countries: UK, Germany, Italy, Scandinavian countries, USA, Japan, and few other areas. Today, design is gradually becoming a global activity. Emerging countries, like China or Brazil, regard design as a global competitive edge not only for companies but also for the country itself.

Thirdly, design is expanding in typological terms. In order to compete in the global market, or at least to resist the competition of imported goods, from automobiles to face-masks, from furniture to services, from tangible to intangible goods (as services) all products are invested by design. Design thinking in particular represents the approach to solve all problems and is increasingly called to deal with complex problems such as world hunger.

As a consequence of these design expansions, the ways of practicing design generate a *multiverse*, i.e. a set of coexisting and parallel universes. From industrial design to *design art* (Pasca, 2010), the expanded creative class acts with a combination of practices involving a mix of creative capability, technical ability, aesthetic judgment, community spirit, innovation, and experimentation. This process involves craft, art, design, technology, electronics, informatics, public realm, and science, as well as common users, who are turned into active designers. Made as freelancers, contract micro-entrepreneurship or DIY, design activities can vary over time and result in being more or less flexible labour. This expanded creative class, as those presented by Richard Florida (2004), generates ideas and regards the aesthetics of making as a cultural economy. As a result, it is possible to witness the rise of a new economic phenomenon, in which plenty of independent labours act as cultural production.

In such unprecedented situation, an expanded *maker culture* emerges. It is characterized by "an interconnected play of social, cultural, ethical and political elements." (Nascimento & Polvora, 2016) It seems to shape a new paradigm according to which different manufacturing modes, from industry to DIY, from local to global, can coexist without any conflict: not as opposers but as complementary activities, that influence each other (Nascimento & Polvora, 2016).

Phenomenology of contemporary women's DIY

Much has already been written about the emerging women's craft makers phenomenon. At a global level, these informal creative practices constitute a complex and contradictory arena reflecting the complexities and contradictions of feminine emancipation empowering processes and our societies itself. In each country, the phenomenon shows a different size, peculiar features and *raison d'être* but also common elements. The origins of the phenomenon are connected to a reaction to the global financial crisis of the last decades and the following austerity in the USA and Europe. By retrieving some practices promoted during the past austerity periods, the phenomenon symbolises an "*ideal* response" to the current austerity (Bramall, 2013, 112). This is more evident in the UK where the tradition of sewing circles became a symbol of "political and economic subject-formation". The origins are also linked to the gendered labour inequalities as well as the lack of recognition of women's contribution in the creative work, as it happens in Italy, where the phenomenon is more related to the domain of arts than to the crafts field.

The phenomenon challenges traditional constructions of women's making in the domestic place for money or hobby as purely amateur production. In some cases, it is reminiscent of the ideology that originated the Arts and Crafts Movement, since many of its expressions refer to an ethical attitude towards life, work, and environment, as well as a critique of industrial society and capitalism. But this revamping also includes non-political motivations, such as consumers' demand for unique items as a reaction to perceived impersonality of globalized industrial production. The handmade, unique, customized piece acquires desirability at market level and stimulates a return to lost female craft practices. In this sense, the phenomenon slightly reminds the early-mid-50s USA scene, characterised by the burgeoning consumerism in products sectors such as home craft and interior decoration. There are also similarities with the 1960-70s feminist arts and crafts expressions of counterculture to respect in a society dominated by the white-male.

Sally Fort (2007, 3), who has analysed the scene of British subversive craft, claims that the current phenomenon is "just not craft as we know it [...] but this is a remix". Actually, the DIY trend incorporates many aspects of the past crafting phenomena, but at the same time seems to contradict all of them. It is a remix of intentions, as well as of past techniques and expressive languages. Crafting is often used as a nostalgically ironic tool to recall the presumed role of domestic creativity and it represents a means of expression for crafting women rather than an oppressive task of their domestic role (Fort, 2007). It includes hand-made abilities and "technologies of memory" (Sallee, 2016; Sturken, 1997, 4) – which were traditionally regarded as feminine – such as crochet, embroidery, knitting, weaving, sewing, dressmaking, cooking, etc., however it is not limited to these. The reappropriation of these techniques leads to the creation of cultural products, with tangible value and a strong intangible meaning that send messages. The memory can also be mixed with incorporating new techniques and technologies as in the case of electronic crafts.

One of the biggest international communities of crafters is *Craftivism* (Greer 2003), which was born in the USA thanks to the sociologist and crafter Betsy Greer and has now expanded worldwide. Since the 1990s it is an active movement that focuses on the creative re-use and re-appropriation of making, steeped in elements of anti-capitalism, environmentalism and solidarity. Today it provides a website, a manifesto and a blog that connect craftivists around a globalized digital world, allowing them to share their projects and seek for influences and inspirations. Participants give their contribution to the sharing culture with an open-source mindset, teaming up, and learning from each other. On the Craftivism website, the emphasis is placed on handmaking, as well as on activism, by launching conversations about collectivism, uncomfortable social issues and the will to create a better world.

Activism is also a specific trait of *Knitta Please*[12], a group of artists dedicated to knitting site projects, also named *knit graffiti*, in which the *guerrilla* creativity creates a peculiar resonance through handcrafted pieces of public art such as the *yarnbombing knitting*. To give an example, we can mention the craftivist Maria Molteni and the NCAA Net Works – an international, feminist art collective building on DIY skill-sharing models – which create hoops for basketball courts (Fig.1). Their intervention in the playgrounds includes colourful graphics for the floor and walls, showing that courts are for the use of both boys and girls and to defy gender stereotypes. The NCAA collective revitalizes spaces by launching messages both critical and fun.

As noticed by Luckman (2013), crafter communities are contributing to the repositioning of the craft practice in gender and class as well as in space and domain.

12 Born in Houston, Texas in 2005, the movement is known for wrapping public architecture and street art across the USA and around the world. One of the main exponents is Magda Sayeg interested in the materiality of knit to explore environmental changes to make these more challenging, unconventional, and interesting.

Figure 1. Maria Molteni and NCAA Net Works.

In the craftmakers universe[13], the appropriation of ICTs, and other digital technologies as daily devices is the key driver. ICTs and social networking enable individual expression in a free community by creating a social network that ties other creatives as well as users. This mode of action disrupts the traditional relation between creators and consumers, pursuing a post-industrial economy of mutual aid and co-operation (Fort, 2007). According to Fischer (2011), social computing facilitated a shift from a passive consumer culture to active cultures of participation.

Any individual bricoleur or craftmaker, any *community of interest* and any *community of practices* can share their work, creating videos or other multimedia artefacts, individually managing processes that used to be more complex in the past. With the use of various apps, anyone can

13 Many are the communities of crafters (*One of a Kind, Women Crafting Change, Workshopshed*, etc.) born also with the support of virtual space dedicated to women that want to create their women's creative circle, like *Hearthfire*, or the guide *The Millionth Circle. How to Change Ourselves and the World: The Essential Guide to women's circles* by the psychologist Jean Shinoda Bolen. Many are also the individual makers that use marketplace or their own web sites.

generate cultural contents and products, both tangible and intangible. Any crafter can extend their crafts from an offline individual studio, to a wider online environment where she can quickly, easily and cheaply set up her store, share with their informal network, mediate daily conversations, promote herself, manage and grow her microenterprise (Wallace, 2014). Specialist marketplaces like Etsy, make connection with an audience and sell their creations even easier.

For instance, German craft maker and YouTuber Laura Kampf defines herself as a “self-employed artist/designer/maker and content creator” (Kampf, 2020) who is passionate about her workshop, developing new skills and making objects. She started as metal and woodworker, who repaired, recycles and re-uses all sorts of objects and materials. Every Sunday, she publishes a new video on her making challenge of the week to gather potential clients for commission work (Fig. 2). She has promoted her activity up to the point of selling branded merchandise in her online shop.

Figure 2. Laura Kampf’s video frames.

New digital spaces are not neutral: they are rather made up of agents, social structures, habitus, and practices that operate as a social system and are imbricated with various types of capital, including social and cultural ones, as symbolic modes of power accumulation and class distinction (Wallace, 2014, 101). These digital spaces enable a *pro-am* entrepreneurialism based on creative capabilities, technical ability, aesthetic judgment and community spirit that opens a new flexible work opportunity for women. Being a compromise between paid work and unpaid domestic responsibilities, the phenomenon defines a trajectory in the women’s transition from being traditionally employed to managing a micro-enterprise accessing to international marketing and distribution networks.

The act of crafting is also becoming a fashion trend and a social spectacle (University of Mexico & Sallee, 2016, 3). This process also involves fast-changing China, where craft is growing in popularity among young people who live in over-modernized cities. Some clever entrepreneurial realities such as the KWCW Company by Wang Sujuan, is designed to incorporate the craft on new product and devices for women. The rise of craft desirability in China is a reaction to fast modernization of the megalopolis and to a stressing lifestyle. Craft was for women, and it can still be, a means of well-being, healing both physically and emotionally. Young women's relationship to craft combines the urge to live a quiet and nature-oriented life, and the nostalgia for traditional culture. There are young women who made the choice of eating local food and showing how to wear traditional garments into Vlogs and entered the live broadcast economy as entrepreneurs. For instance, Li Ziqi is one of China's most popular web celebrities with 3.36 million subscribers on YouTube, and more than 20 million views on her most popular video. In her videos she performs the work of a farmer cooking organic food, constructing furniture by hand, or producing her textiles with the grace of a fairy, offering a romantic depiction of China's countryside life. Li Ziqi's huge influence is largely attributable to a sophisticated narrative and visual language, and to people's fascination with a paradise made of forgotten handicrafts, which expresses their desire to return to a closer relationship with Nature. Even if she doesn't truthfully show the reality of living and working in the countryside, Li Ziqi has a big audience made of urban millennials attracted by these appealing rural life fantasies: their interest is giving a big contribution to her territory manufacturing, to the dissemination of traditional crafts culture and to an environmentally sustainable life, consistent with the policy that has been recently started in China[14].

14 Li Ziqi was invited to be ambassador of the China Association of Young Rural Entrepreneurial Leaders.

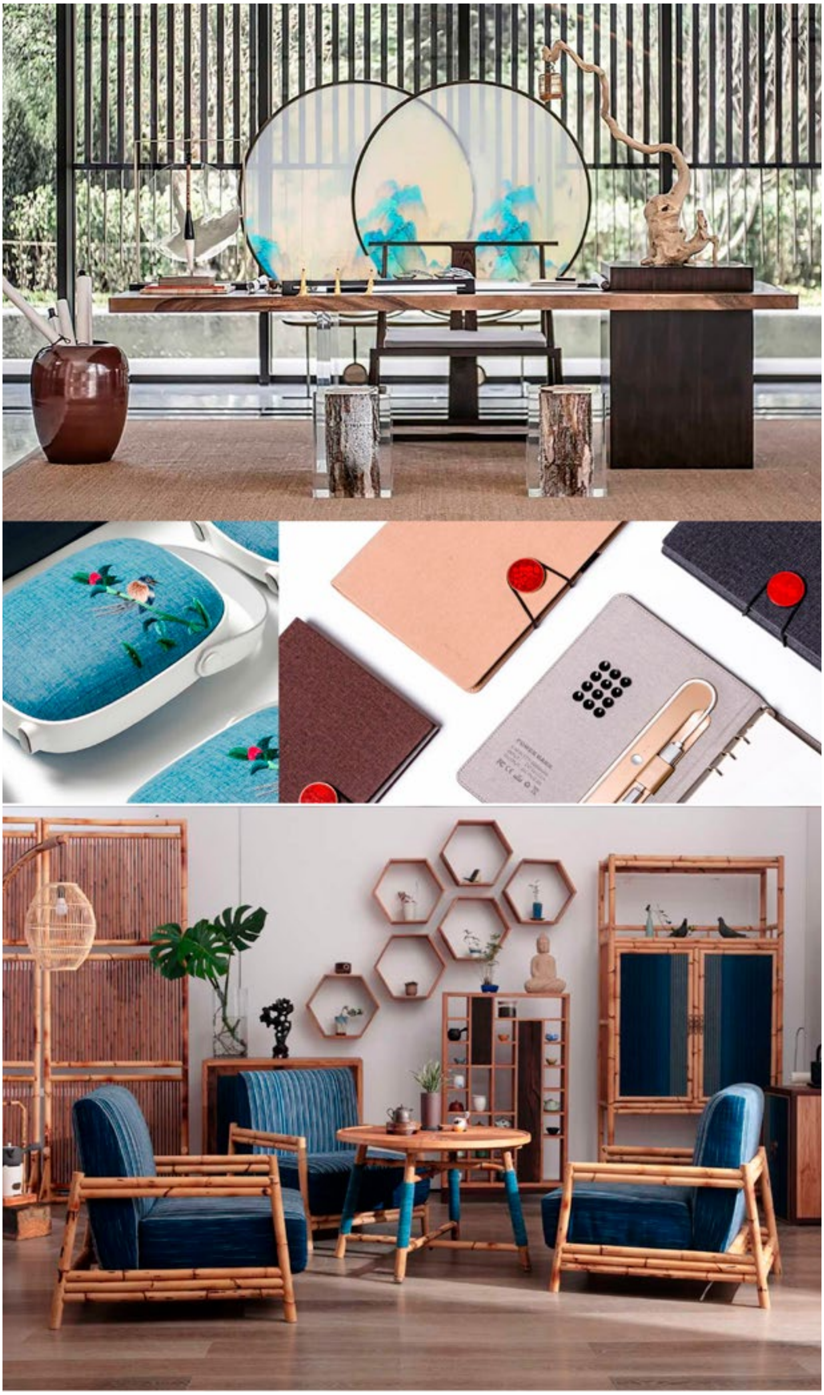

Figure 3. Products by Wang Sujuan and KWCW Company.

Figure 4. Li Ziqi's video frames.

With this paragraph we witnessed how women actively craft a position for themselves and help other women do the same. Creating a new job opportunity in an evolving working environment is not a mere form of resistance to the old system nor just an acritical acceptance of the new, but a continuous interplay between the two. What is crucial in this process is the opportunity for a new domesticity, a new way of working, learning and developing skills, more than just producing and competing. This is a challenge to market processes which can involve all of us as potential producers of things, economies, and knowledge. So, this new kind of products, regardless of their level of quality, carry a much wider range of exchanging values.

The women makers in FabLabs

Moving away from the traditional gendered craft and low-tech DIY, we can delve into the sphere of maker community composed by digital technologies enthusiasts who, regardless of their background, experiment with microelectronics and rapid manufacturing. They shape one of the many facets' phenomenon of the "diffused creativity" (Branzi, 1975) that characterize our times.

In FabLabs (or maker spaces, hackerspaces, innovation laboratories), makers exploit the power of a diversified cheaper set of tools and machines intended for personal manufacturing, as introduced by Neil Gershenfeld (2005). His conception of the FabLab is based on a democratic access to technology, which enables anyone to make (almost) anything[15].

As in the case of ICTs and the web 2.0 for crafters, the FabLabs democratic access to different technologies is the key driver of makers phenomenon. In the past decades, women have been increasingly active in this innovative scene. This first happened in the fashion field, in which women are used to being active entrepreneurs more than in other fields. Protagonists of fashion-tech aesthetic evolutions such as Pauline van Dongen, Lisa Lang, Iris van Herpen and Anouk Wipprecht, infuse their creation with a strong character, exploiting original expressive languages of new technologies.

Following their experiences in fashion and technological visions, young women are encouraged to approach the world of digital manufacturing. For instance, the Italian designer Annalisa Nicola has reconsidered the 3D prototyping potential in the tailoring of female products and created the concept of the XYZBag brand, which offers highly personalized bags.

15 Technologies in FabLab are digital fabrication devices (CNC machines, 3D printers, laser cutters, etc.), open-source and low-cost hardware (Arduino, Raspberry Pi, etc.), and all the multiple digital and analog add-ons from the newest ambient sensors to the oldest materials.

Her start-up adapts the products to differences between individuals, by involving consumers in self-design and self-expression creative processes. Once interviewed, she said: “The result of advances in 3D printing production is going to reset the lines between prototype and product, by revisiting the tradition of hand-made craft as digital craft where hand-made is replaced by a code. The bags are custom designed as per the individual’s personality, mood, or the occasion. Each bag is produced one at a time. Twelve hours of production, layer by layer. A few hours of rest not to stress the piece inside the powder block and finally a hand-made post-treatment finishing.” (Toure, 2016)

Figure 5. XYZbag, a line of highly personalized bags 3d printing manufactured.

The makers community[16] is seen as the vanguard agent in creating a new society, as well as the leader in generating disruptive innovations that

16 The community is composed of fabricators, artists, designers, scientists, engineers, educators, students, amateurs, professionals of various ages. Associated through the Fab Foundation, a global network of Fablabs, this movement has spread to more than 80 countries and counts more than 1,000 labs worldwide.

largely affect scientific, economic, educational as well as social structures (Deloitte, Hagel, Brown & Kulasooriya, 2014). It has the potential to break down past deterministic hierarchies by using technology, moving from centralized production to decentralized distributed manufacturing, from consolidated processes to a more sustainable and inclusive way of innovation. For this reason, the many fields of research focus their attention on these communities and spaces, with the aim to increase the participation of women and to develop the potential of makers community's innovation. The enhancement of diversity increases the spectrum of ideas and perspectives considered to identify opportunities, opening the range of new products and services. Women's presence is needed for a better understanding of users' behaviours and customer needs, and also gives enterprises the chance to meet those needs (Hillman, Cannella & Harris, 2002; Miller & Del Carmen Triana, 2009; Galia & Zenou, 2013). This is confirmed by what women from FabLabs are proposing. For instance, in the food system innovation research, Engeli Kummeling, a co-founder of FarmHack, uses data and technology to empower smart farming and achieve a more sustainable and diversified food production, in order to change a productive system that is mainly focused on efficiency. Chiara Cecchini, the co-founder of Future Food USA, carries out her research to enhance the reduction, the recovery and the recycling of waste from the agri-food industry. For a big brewery in the USA, she has developed a method for obtaining flour from the large quantities of barley malt waste that remain at the end of beer production. Involving an Italian gastronomic team, they found recipes in which these flours could be used for pasta, bread and sweets. In the field of recycled material innovation, which is currently developing in Italy thanks to many women engaged in sustainability, circular economy and eco-design research, Alice Zantedeschi and Francesca Pievani are transforming the waste of the stone districts into the fabric coating Marm More, with the open innovation project Fili Pari.

A study on makers, related to the EU MAKE-IT project, shows the results of female leaders in term of difference with male. Although both males and females use the same technologies to a similar extent, women tend to have a more sustainable impact than their male counterparts (Millard et al., 2018). This study also shows a difference in hard skills acquisition: males are slightly more likely to be involved in modeling, software development, robotics and Internet of Things (IoT), while females tend to use a wider range of technologies and to be less specialized in their technology use. Major difference between male and female soft skills: learning is more important for males, whilst interaction is a crucial skill for females. Men are also slightly more likely to use the technology for commercial purposes than females, and again females tend to be more generalist in their use of technology.

Unfortunately, despite women-in-tech being a rapidly growing phenomenon, it still remains a minority. In fact, women's participation in FabLab is low if compared to men. In the 3D printing field, women only represent 12% of the people involved, as reported by Sculpteo and Women in 3D printing in 2019.[17]

The issue of women's underrepresentation in maker culture represents a contemporary challenge to achieve gender equality in the twenty-first century[18] (Cooper, 2006).

Final Considerations

With the aim of understanding the current phenomenon of women makers, we have been proposing a historical excursus of women's creative and technical practices during the industrial ages in the context of Western societies.

As noticed by Jill Seddon (2000), we can confirm that the pseudo-inclusion of women in the design profession is a recent conquest of the first half of the twentieth century. For this reason, we framed the excursus in very blurred boundaries between crafting, design, making, and user practices. We highlighted the various ways in which women have been active agents of making in different cultures, sectors of activity, techniques, labour situations, times and environments. Examples include areas that have traditionally been seen as women's domains, i.e. individually crafted houseware in the domestic settings as well as collective work in spaces like circles, studios, agencies, or factories designed and created for others. Women have also been regarded as tastemakers in public spaces as consumers. Women's creative practices were, and still are, linked to self-realization, self-expression, resolving economic or family problems, pleasure, positive emotions and interplay of emotions, identities and relations with other people. These practices empower women, link them to other people, allow them to build products with a subjective or social value. From all these

17 The under-representation of women-in-tech is mainly caused by some anachronistic preconceptions that prevent women from undertaking technical or technological studies, especially during high school, resulting in a decrease of their job opportunities. Other causes have been identified in the interplay of socio-cultural barriers such as gender stereotypes, male dominance within the co-working space, and a lack of female role models.

18 The search of solution to this problem may concerns initiatives aimed not only at democratising digital technology by making it more approachable to a wider audience of people who may be reluctant to work in the field, but also to foster a transformation of traditional school systems and provide pathways to achieve social and environmental sustainability goals. FabLabs should work to overcome cultural stereotypes (Maric, 2018). A number of FabLabs (such as FabLab London, FabLab Trójmiasto and Solidarity Fablabs) have been working on this. US-based organizations such as Code/Art, CODeLLA, Girl Scout, MakeGirl, and other maker initiatives such as Double Union, Mothership, Hacker Moms or Seattle Attic are some examples of co-working spaces established and run by women with the aim of actively transforming the male-dominated image of maker culture (Maric 2018).

practices, women's *everyday creativity*[19] strongly emerges by embodying the interaction between *individual processes* as well as *social processes* of creativity. The latter is a particularly suited and relevant concept in the contemporary discourse of empowering society through cultures of diffuse, collective and social creativity (Branzi, 1975; Fischer, 2013; Amabile, 2017).

Moreover, the nuanced path of women has been characterized by times of acceleration as well as times of deceleration towards modernity. Women's participation in the public sphere as makers or consumers is considered as an acceleration[20]. On the contrary, the segregation of the making in private space is seen as a deceleration, often connected to ideological movements against modernity and its effects[21]. The social complexity of this path has profoundly shaped women's behaviour. Women have introjected specific creative modalities linked to an *artistic approach*, and got a *soft mastery* characterized by soft skills of negotiation, compromise and give-and-take as psychological virtues (Turkle, 1984). Women's creative modalities create a space for mutual support and trace a path towards an inclusive society, which is more democratic and respectful of diversity, founded on diverse perspectives by making all voices heard. The *creative approach* and *soft mastery* are fundamental to complement hard skills in order to manage complex projects (Azim, Gale, Lawlor-Wright, Kirkham, Khan & Alam, 2010).

The democratization of digital technologies has opened new opportunities for anyone to engage in creative acts and to contribute to an increasingly diffused phenomenon of *social creativity*, characterized by *the culture of participation* in which digital technologies are an integral part. Like a *multiverse*, it is a complex system, unitary and manifold at the same time, which cannot be understood in its intrinsic unity. It is constituted by different and parallel communities of prosumers, amateurs, bricoleurs, crafters, makers, and professionals that grow around different types of creative

19 Many researches recognize the peculiarities of women's creative processes in everyday life, among which there are the complex mechanisms of integration of creative activities and tasks related to care, upbringing and household responsibilities. Day-by-day creativity and production are significantly influenced by experiences, emotions, perceptions, and motivations. It "brings together tradition, imagination and innovation." (UNESCO, 2014 p. 74)

20 For instance, the sewing machine appropriation shows gender-based boundaries of public and private sphere in modernity. The oscillation between these two different spheres, the domestic and the public one, gives evidence to the fragility of modern feminine gender identity.

21 Such movements have accompanied more or less every new step of modernity, making a stand, but so far, all forms of resistance have turned out to be rather short-lived and unsuccessful, like in the case of the Arts & Crafts movement.

processes, cultures and meaning of their practices, that follow different rhythms, patterns, aims and horizons, and bring different visions and identities. This multiverse is relevant as a potential sphere of opposition to deterministic trends and also promising in the perspective of moving away from a world in which a small number of people defines rules, creates artifacts, and makes decisions for many consumers. It has the potential to shape a reality in which everyone can have the interest, motivation, and possibility to actively take part in building the future (Fischer, 2013).

We have shown that many crafters remain as hobbyist at an amateur level, others create nostalgic products, gadgets and playful experimentation, some others become entrepreneurs and launch start-up companies or produce value in the maker community, but only a small number of makers design for disruptive innovation of strategic importance.

This happens because their production remains in a significant social gap and sustainable innovations require stronger connections with communities that have been active – commonly for decades – in the improvement of the living conditions of marginalized people, by protecting the environment or caring for older generations.

As suggested by Fischer (2013, 26), we believe that today's challenge is to reduce the gap between making and sustainable social innovation. Maker culture should stimulate social creativity further, not by reducing its heterogeneity and its specialization, but by building bridges between different communities, and exploiting conceptual collisions as sources of real innovation. Canalising participatory design processes (Manzini, 2015) towards the resolution of complex social issues, such as environmental sustainability, is one of the greatest challenges of our time to achieve meaningful large-scale innovation.

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III
DESIGNER'S KNOWLEDGE AND THE PHILOSOPHY OF ARTIFACTS

Huopalahti housing in Helsinki (1986–) contains mixed signs of handwork, concrete technology and digital design (Photo: Tarkko Oksala)

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Arto Mutanen, Tarkko Oksala & Mervi Friman

On Visual Reasoning

Introduction

Visuality and reasoning are not generally integrated into one concept. A reason might be that visuality is principally connected to human senses and experiences, whereas reasoning is an intellectual act that is connected to human reason which should be formalized. Visuality is studied through aesthetics and reasoning through logic. So, it might seem that these two are mutually exclusive conceptually. However, the situation is not so simple. Human reasoning is a practical activity which includes different kinds of activities. Moreover, visuality is much more than mere aesthetics and reasoning is much more than logic.

Currently communicating with memes, sharing photos and videos are an essential part of our lives. Even if the pictorial communication is strikingly present in our societies, the phenomenon is as old as human societies (Neurath, 1936). Pictorial information has shown its strength in education, and present-day computers, via computation, BigData, and CAD, open new possibilities of dealing visual information. So, it is necessary to explore visual reasoning deeper. In this article we want to illuminate the connections between visuality and reasoning from the perspectives of pictorialism, design science and architecture. Inspiration to this study rises from the relationship between theory and practice and the possibilities of non-linguistic communication.

To start with, let us take a look at what Lewis (1976) says. Lewis (1976, 133) says that "Everyone who speaks English is familiar with two meanings for the word *sense*: (a) ordinary intelligence or 'gumption', and (b) perception by sight, hearing, taste, smell or touch, which we shall call *aesthesis*. In our individual linguistic histories gumption is undoubtedly the earlier meaning." So, Lewis shows us that the word 'sense' is polysemic. Moreover, the meanings lead to directions we are interested in. As the starting point of his study, Lewis (1976, 134) takes the meaning of sense which is "something like 'to experience, learn by experience, undergo, know at first hand'" which is closely connected to reasoning.

The notion of aesthesis "descends from the concept of taste" (Shelley, 2017). It is connected to "fine art" in which it is tied to "subjective effects, which were the central concern of" (Gage, 1999, 135) artists. However, the artistic experience and even scientific knowledge have some common ground which can be seen, for example, in our understanding of colors (Gage 1999). For example, we can find in both multitalented groups working together in order to create something new. The working groups are creative but systematic like experimental laboratories, trade unions, or industrial organizations (Jaeggi, 2009). Moreover, Beyme (2009, 352) writes about the close connection between science and art, but emphasizes that "art has more possibilities at its disposal, because it is able to influence the human psyche directly".

Jaeggi (2009) and Beyme (2009) explain the idea of Bauhaus, an avantgardist institution which integrated art and design. In fact, Neurath and Carmap gave some lectures at Bauhaus. Their formal, logical and pragmatic philosophical attitude was the connecting link to Bauhaus philosophy. (Cat, 2019b.) The notion of design integrates planning, engineering, and science, which was expressed by Simon (1969) as design science or as science of the artificial. Design science is an important example of how visualization and (scientific) reasoning go together. Moreover, it is possible to understand works of art as part of a more general design science.

Artifact can be defined as "an object that has been intentionally made or produced for a certain purpose" (Hilpinen, 2010). However, such a definition does not specify artifacts very precisely. Still, as the definition specifies, an artefact has some properties arising from the intention of the designer. They characterize the "intended character of the object" (Hilpinen, 2010). Even more deeply, one can formulate a dependence condition which says that the existence and some properties of the artifact are dependent on the designer (and maker) of it. Galle and Kroes (2014, 204) characterizes an artifact by its function, physical structure and social aspects. Moreover, they discuss how extensive the class of artefacts should be.

In planning artefacts, the planner or designer might use different kinds of notation, for example, linguistic, symbolic, pictorial, or cinematic. The distinction between these types is intended to be neither exhaustive nor exclusive. So, design science might be a good example to show how visuality and reasoning go together. In fact, Priest, de Toffoli and Findlen (2018) show how diagrams from logic and mathematics can be used in engineering and architecture and how they can be understood as proper reasoning in a logical sense.

Visuality and Visual Language

Visuality is something that is present everywhere, but, at the same, it is difficult to specify. In science, perception, or more generally observation, plays a central methodological role. Perception gives visual information to the perceiver. What kind of information perception gives or may give is a question that has been studied in the philosophy of science. A natural method of expressing perceptual information is pictorial (Neurath, 1936; Priest, de Toffoli & Findlen, 2018). The logic of perceptual information provides a lot of indication on how the perceiver might attain some information via perception. However, the basic idea is that the information is linguistic in character. (Hintikka, 1968; Niiniluoto, 1982.) The idea of visual information as linguistic information is also supported by Husserl. He thought that phenomenal information can be, in principle, expressed via linguistic means. Carnap (1969, 307) says that "the cognition of processes of consciousness of another person is 'based upon' the perception of his motions and linguistic utterances; that cognition of a physical object 'goes back' to perceptions; that a given experience 'consists of' the visual perception of a bell; the auditory perception of a sound "consists of" individual perceptions of such and such tones". He still agrees with the philosophical orientation of the book: the very method of his Aufbau says that the concepts of different fields of sciences "refer to the immediately given" (Carnap, 1969, v).

The role of visuality in semantics is emphasized by Wittgenstein in his "picture theory of language". The very idea is that language "pictures" the reality. This picturing character is present also in colloquial language, where we use pictorial and metaphorical phrases. Moreover, the pictorial character is present also in logical and mathematical language, which is noticed by Wittgenstein and by Peirce in expressions like "We make to ourselves pictures of facts" (Wittgenstein 1922, 2.1). This observation is a fundamental semantical fact. Even if there cannot be a semantical theory, sentences show their meaning. This is expressed by Wittgenstein in Tractatus (6.127) as follows: "Every tautology itself *shows* that it is a tautology." So, in the strict sense there cannot be any picture theory in the Wittgensteinian sense.

Pictures might convey linguistic information and they might act as the semantical medium of language. Then, it seems that a language might be wholly pictorial. This was the idea driving Neurath (1936; 1939; 2010) while he was developing his pictorial language. The very idea of pictorial language is extremely important. Neurath (1936, 10) starts with simple examples of pictures that "are very small and in black and white and red only". The idea is to show how to construct the language and to manage the syntax (and semantics) of the language. Neurath (1936, 17) explains why and how pictorial language in fact works. His example is of a traveler arriving in "a strange country" and getting all the information they need via pictorial instructions. These instructions are still in use in such places as railway stations, metro stations, and airports. In fact, these pictorial instructions are very informative and their information content can be managed, as the present discussion about the traffic signs shows. These pictorial instructions show the idea that Neurath had in mind of pictures in a pictorial language being simple, which also means that they do not have perspective. (Cat, 2019b.)

To develop proper pictorial language supposes that pictures should be combinable. Without this property there cannot be a proper pictorial language at all. However, there are limits to how much they can be combined. In particular, pictures and pictorial combinations cannot be compositional (Pietarinen, 2011; Mutanen, 2016). However, Neurath (1936, 54–56) shows that his pictorial language has several properties that a proper language needs to have, in particular he gives examples which show that it is possible to formulate statements in a pictorial language.

The applications of Neurath's pictorial language are intricately connected to design science, such as picture design and typography (Pietarinen, 2011), which has also inspired artists (Holter & Höller). The other direction of application has been in urban planning and design (Pietarinen, 2011) which deepens the understanding of the close relationship between Neurath and Bauhaus (Cat, 2019b). So, we will consider more closely design science, but before it, let us consider briefly pictorial thinking in mathematics and logic.

Pictorial Thinking

Pictorial thinking can be utilized and applied widely in mathematics. In geometry it is usual to use pictures and figures to express the problems to be solved. The solution includes some more drawings and analysis of the pictures and figures such that searched solution or proof can be constructed. The method of analysis and synthesis follows such a procedure. The method originates from ancient geometry. However, the method is not restricted to geometry but can be applied to all fields of mathematics. Moreover, according to Aristotle, the method of analysis and synthesis explicates general human deliberation which is expressed by Niiniluoto (2018, 22) as follows: "In *Nicomachean Ethics* (1112b15-29), Aristotle compares it [the method of analysis and synthesis] to the structure of deliberation: in the process of planning, a decision-maker searches for the means to obtain a given ends, and further means to obtain intermediate means, etc. until this reasoning 'backwards' comes to something that can be done or is impossible."

In the quotation, the double directedness of the method is explicated. The decision-maker starts form the intended goal and goes backwards until he or she finds out something from which he or she can construct the intended goal or, should they be unlucky, he or she recognizes that the goal is impossible to achieve. The analysis from the intended goal to the foundation of the task maps a road from the present to the intended goal. The task of designer is, obviously, structurally similar.

Pictorial thinking in mathematics is not restricted only to geometry, but it can be utilized more generally in mathematics. In geometry, pictures and figures explicate, i.e., make visible, the problem situation. In the algebraic context similar pictures are not possible. However, as analytic geometry (which was developed by Descartes) shows, there is a close connection between geometrical figures and algebraic equations where numbers correspond to geometrical entities and equations explicate the relationships between them. So, the pictorial model can be applied also to algebraic mathematics (Hintikka & Remes, 1974; Hintikka, 1973).

In mathematical reasoning more concrete pictures, such as graphs and knots, are used (de Toffoli, 2017; de Toffoli & Giardino, 2014). These pictorial modes of thinking have also some "transformation rules" which direct the pictorial reasoning. More generally, visual reasoning in mathematics has been studied extensively (Zimmerman & Gunningham, 1991; Giaquinto, 2016). In fact, model theory offers a well formulated mathematico-logical approach to the visual thinking in mathematics and logic, as Gödel's completeness theorem shows (Hodges, 1993).

Mathematical reasoning is part and parcel of scientific reasoning which is demonstrated by the use of the method of analyses and synthesis in several fields of sciences. So, pictorial reasoning has remarkable role in scientific reasoning. Pictorial thinking is meaningful in the context of applied research, especially design science and engineering science need knowledge which give instrumental information about the connection between the present situation and the intended aim.

Design Science

Scientific research aims at new knowledge. The target of basic research is new knowledge "for knowledge's own sake". Instead, applied research aims at new knowledge "because of some practical utility". However, both basic research and applied research aim at new knowledge. Basically, basic research aims to acquire descriptive knowledge about the reality. This entails that epistemic utilities are the primary utilities in basic research. Applied science, like engineering science or practical social science, aims to acquire "new knowledge which is intended to be useful for the specific purpose of increasing the effectiveness of some human activity" (Niiniluoto, 1993, 5). Because of the intention of applied science, the acquired knowledge is meant to be useful for some practical purpose, which entails that besides epistemic utilities, also practical utilities are present in their planning and use.

The notions of techniques and technology refer to several different but interrelated things. Niiniluoto (1984, 258) characterizes these notions by saying that they "are used in many different senses" and he divides the different senses into six categories: (i) They refer to concrete or abstract manmade tools and artefacts. There are several different kinds of characterizations of what kind of entities these might be. (ii) Besides the tools and artefacts, the notions refer also to the use of such tools and artefacts which open several interrelated areas of study, like (iii) the knowledge and skills needed in the use of the tools and artefacts. Technical tools might be extremely complicated to use. Moreover, (iv) the design of such tools and artefacts supposes special skills and knowledge, like mechanical engineering and product design. However, it is not good enough to have a plan or a prototype of a tool or an artefact, but one also needs to produce these tools and artefacts. The (vi) knowledge to design and produce these tools and artefacts is a special area of practical knowledge, namely design science and engineering science.

The technological science or design science refered to above needs to be specified more closely. Simon (1969) specified the notion of sciences of the artificial or design science. In his book, there are chapters that focus on the distinction between "the natural and the artificial worlds" (Ch. one), the special characteristics of "the science of design" (Ch. five), to "social planning" (Ch. six) and to "the architecture of complexity" (Ch. seven). The structure of the book shows that the scope of the science of the artificial is extremely wide. However, there is still something common behind the whole approach: humans plan and produce artifacts and the artificial environment systematically – at best this might be science based. However, it is not obvious what kind of scientific foundation there can, or should, be behind the design and production.

According to Niiniluoto (1993), basic research as descriptive research is searching truthful lawlike results, like

(1) "X causes A in situation B" (or its probabilistic variants).

These results describe how the reality (or some aspect of it) is or behaves. They can be used in descriptions, but also in predictions: we know that if we are in situation B and we observe X we can predict that A takes place.

In design science, descriptive results of the form (1) play a central role. However, in prediction the results of the form (1) are useful independently of the character of the factor X. In design science, the factor X must be human manipulatable to be useful. So, prediction and design (and planning) share a similar structure but still have an essential difference. In design, the result of the form (1) explicates an intended goal (A) and means (X) to get the goal from the present situation (B). The result (1) explicates beliefs needed to make design rational. If the belief is used in the design, then it can be called science-based design which is the topic of design science which is closely connected to the practical syllogism which originates in the philosophy of Aristotle.

It is not easy to specify what kind of knowledge is needed in design. The basic idea is that the knowledge should give instrumental information about the connection between the present situation and the intended aim. Von Wright (1983) characterizes this instrumental information (knowledge) as a technical norm: "If you want A, and you believe that you are in a situation B, then you ought to do X" (Niiniluoto, 1993, 12). Of course, this might be formulated in probabilistic mood. The basic idea is that effectivity (truthfulness) of the technical norm is based on descriptive knowledge characterized above by formula (1).

As we recognized, a remarkable difference between the prediction and design is that the factor that causes the effect must be human manipulatable. So, because we cannot manipulate the factors that cause sunshine we cannot, in a proper sense, design sunshine for the forthcoming garden party. That is, the scientific laws of the form "X causes A in situation B" are behind predictions and design. But we can speak about design only if the factor "X" is human manipulatable.

The notion of human manipulatable is technology dependent. The essential aim of technology is to make our living more pleasant and good, as already Bacon recognized. In this task, scientific knowledge has played central role, but there has been and still is a lot of technology which needs no scientific knowledge. Technology makes some acts and activities possible that were not possible before the corresponding technical invention. An example is the airplane which made it possible for humans to fly. In general, technological development opens new possibilities for humans. However, technological tools are not mere tools. They give some new skills and possibilities, but, at the same time, they change several other things. Airplanes made it possible for humans to fly, but they also generated a new way of life that we have nowadays. Marx was one of the first who studied systematically how new technology changes social structure of the societies. (Niiniluoto, 1993)

A good example is architecture, the art and practice/science of designing and constructing buildings and cities. Architecture is not the mere planning of artefacts. While used for designing buildings and environments, at the same time it re-orientates humans to others and to the environment. Moreover, in architectonic planning, pictorial thinking plays a central role. So, let us take a closer look at the logic of design in architecture.

Architecture

Architecture is multi-sensory, but visual sensations dominate in it. One explanation is that visual sense transmits most effectively environmental information (Hintikka, 1986). Architecture is action which participates in the production of environmental artefacts, but also more abstract cultural objects. In this work it needs planning and design languages. In fact, the language view is extended into architecture itself (Perret, 1948; Oksala, 1981).

The revolutionary development of design languages coincides with the adoption of digital computation into daily life, starting from the syntactic level. The idea to apply semantic information theory into design (Oksala, 1981; Niiniluoto, 1990 a; b) opened the doors to the interpretation of design patterns with real design works. This also gives tools to discuss practical design questions in an exact frame like that of practical conduct (compare above Oksala, 1981). The connection of architecture with artefacts is fundamental (Simon, 1969/1981; Hilpinen, 1984/1986, Mänty, 1984; Coyne, 1987) for design theory. This idea can be developed under the notions of planning science and design science. The latter has been developed using the notion of designology (Gasparski & Orel, 2014). In the area of more general planning we may mention the exact development around planning preliminaries in engineering ontology and "Towntology" (Teller, Billen & Cutting-Decelle, 2008). These kinds of sciencelike activities can be summed under the notion of knowledge-based planning and design (Gero & Oksala, 1989; Linn, 1998).

In a changing world we need new viewpoints, and even the classical definition of architecture (Vitruv, 1991; Mänty, 1984; Eskola, 2005) needs parallels. Architecture is the skill and art to plan, design and build (realize) prototypes (of environmental artefacts or institutions). In this sense the basic work of an architect can be distributed to teams and corporations in advance. Then we have products of environmental care, which citizens see as concrete actual architecture. The work of an architect contains a lot of decisions in social decision networks connected to visual reasoning. This is all supported with reasoning around practical conduct (Oksala, 1981).

Architectural Languages and Reasoning

Visual grammars

August Perret expressed the idea of architectural languages in the 1948 promotion of the predecessor of Aalto University by saying:

> *Structures are an architect's (mother) language. An architect is a poet who thinks and speaks with structures.* (Oksala, 1974/1978)

This idea may be understood to lead to the application of poetics (Ingarden/Oksala, 1976) in which realizations are derived in standard steps from an idea. Then we are working toward classical art studies. The need for exactness in recent digital architecture was solved by using grammars as pre-poetic (syntactic) devices. This may happen at the level of formal languages (Oksala, 1974/ 1978) or using languages of logic as a frame. The final goal is evidently to use natural language in the design of natural (human) architecture (Perret, 1948; Aalto, 1972) under some design-scientific analysis. Then the big problem still is that architecture is synthetic. One solution to this problem is to use the method of analysis and synthesis with the appropriate interpretation.

Logic of Architecture (Oksala, 2014) is the doctrine of right thinking (involved) and gives conditions for that at the syntactic, semantic and pragmatic levels. In this sense it is reasonable to start from grammars which have as their goal the correct usage of language. Grammars are also key tools in structuralism.

In the use of grammars, the notion of idea is replaced by a start symbol. Intermediate poetic forms are called non-terminals and final ones as terminals. To act we need some meta-rules, production rules and rules to terminate the process. The notion of meta-rule is added here because architecture is generated in complex social situations and thus related to ethics.

Grammars serving architectural production may have real content like buildings (Wright, 1954), graphic content like in design and symbolic content like in planning. The notion of grammars can then be extended to concern right action as regards skills (Kotila, Mutanen & Volanen, 2007) and arts. They offer a toolkit to formally produce the needed product. These are known as prototypes.

Visual languages and information

The problem involved in architectural generation stays open, even if we have formal grammars. Creation and poetry are replaced at this formal level by production. Semantics can be introduced into the formal game (Hintikka, see Oksala, 1981) using semantic information theory, whose semantic analysis is done by the "Possible World Semantics" – preceded by the necessity semantics of R. Carnap (Malatesta, 2014).

In design language it is possible to refer by one abstract sign to the derivatives of it (Wittkower, 1973; Oksala, 1981; Mänty, 1984). Such professional, often "tacit knowledge" (Polanyi, see Wåhlsröm 1986/1988) can be expressed exactly in quantitative information theory. At the same time, qualitative information theory has also its value, especially in complexity and order aesthetics (Oksala, 1976; Smith, 1979), and there we have a key connection to the level of quality and value discussions (i.e. pragmatics).

Formal languages of architecture simulate composition or construction of building blocks, etc. This corresponds to the idea of formal picture languages in CAD based on configuration or formal symbol languages in computation based on concatenation. Now we have, however, the problem of dimensions. In “time-space-action” meta-space (Oksala, 1972) we have a lot of parameters. Symbols can be concatenated in time, but in the case of notations and pictures 2D becomes a problem and in architecture we need at least to think in 3D. In this sense architectural composition is similar to that of music. If we have spatial or action related additional needs then notations should be enriched accordingly. There are of course evident compositions like laying out bricks in a row or making grid layouts, etc. In principle there are also challenges like free-form composition (see also elastic standardization) (Aalto, 1972; Oksala, 1986).

Meaning in visual language usages

The syntactic innovations, as regards visual languages, in the 1960s were important, but one-eyed. The problem was the lack of automated semantic skills needed in pattern recognition (Zusne, 1970). In comparison to these achievements it is interesting to note that the pictorial language of O. Neurath (1936) was from the beginning semantically oriented. The simple reason for that was the pragmatic intent to guide human action, for example in the case of passenger arrival. (Cf. Majurinen & Oksala, 2009)

When we use language ideology in architecture, real semantic problems start in using two languages. This is based on the idea of mixing the role of certain languages and reality. (Hintikka, in discussion 1969) Languages form thus realities of their own and architecture (even as language) may act as “model” of requirement language. (Oksala, 1981) Chained interpretations are then also natural, like those between plan, design and building.

In semantics we differentiate between extension and intension. Then the notification of qualities becomes important. In standard architectural practice we may differentiate quality types, like (Niukkanen & Oksala, 1986):

Technical, experienced, usability (quality)

Ideal, formal optimal (quality)

Technical quality is roughly the same as satisfaction of intent in the same sense as in sport-critique. This idea is closely related to the notion of practical conduct. In experienced quality we note enjoyment or suffering connotations / person by person. In usability the satisfaction interpretation is by nature of collective origin.

In working with quality problems, we have ideals to adapt with formal requirements. In multi-optimization these are noted together. A good example of architectural success is Pareto optimality, the idea of which is visible already in the theory of beauty by L. B. Alberti. According to it, nothing can be added or taken away from a masterpiece without worsening it.

Qualitative criteria can be roughly used in quality or value analysis in systematic planning and design, but the clarity of master-intuition is of course difficult to achieve. The situation is analogous to the problem of axiomatic and intuitionist work in mathematics. The ideas of Gödel in particular (Linn, 1998) show how limited the logic approach is, but it is the start of rationality in any case. In more complex decision making we know the paradox of Arrow. This shows how difficult it is to run teamwork or notice politics in prototype creation. The same problem concerns user participation in housing design and city planning, for example. This means that the method of trial and error has its role in human craftwork and bodily made design (Ylinen, 1968) like architecture.

Visual style as print of hand and way of thought

Computation, ICT and AI promise computation power up to the limits of Big Data. In this sense it is possible to make classical slave work nearly limitless. The need for computer power is, however, so big, that trial and error methods become costly. There is also the dream that AI assistants in design will become cleverer than their "masters", which is called technological singularity. This may concern the problem at some collective and average level, but in human architecture we are interested in the development of personal styles of masters even with "mistakes" (i.e. point of beauty).

Style means the way we use our hand in writing, drafting and building in prototyping. It can be studied to a certain extent as related to probability (Hintikka in discussion 1968) and as concretized in information aesthetics (Smith, 1979; Oksala, 1981; Niiniluoto, 1990 a; b). It is well known how it is possible to detect, for example, the style of P. Mondrian or that of Bauhaus (see Bruton & Radford, 2012, 79). In this sense computational art is working on the border of robbery and innovation. All is fair in love and war or art, but in a wiser form. Artists use loans, but in a prudent, honest and useful (Cicero, 1813) sense. It is possible to see the inspiration between the Maison du Peuple of V. Horta (Bruxelles) and the House of Culture of A. Aalto (Helsinki), but the relation is as remote as possible from a responseless copy. So far as devices have no body, neither emotions nor will (Niiniluoto, 1984b), they cannot make deeply interesting aesthetico-ethical choices in comparison to man-made, body-made and hand-made mastery (Wåhlström, 1986/1988).

From the language point of picture or picture point of language architecture is the expression in which the role of the hand (as style) may influence planning, design and building up to action-style and lifestyle. Besides such processes, skills grew up to be arts. They are technical skills like in architecture or "arts of the possible" like we know from politics. Then the idea contains the dimension of care and therapy (Oksala, 1986) of common affairs and common environment up to the dimensions of our globe and up to cosmos.

In solving such problems, we need reasoning and among it visual reasoning consisting of:

- Visual analysis, synthesis, practical conduct (i.e. recommendation)
- Visual in- vs. deduction, ab- vs. adduction, trans- vs. production

This totality supports as preliminary skills visual thinking consisting of:

- Visual ordination, planning, design
- Visual comparison and interpretation, evaluation, conduct and decision making

In this sense visual and other thinking coincide in statu nascendi of the human mind. What we need is the theory opening the potentials of interaction. This is maybe the reason why Aristotle considered architecture as the "Mother of all Arts".

Closing Words

We have seen that visuality and visual language have several important properties. Even if there are challenges in developing visual languages, there are both theoretical (conceptual) and practical examples which show the power and interest of visual languages. In philosophy there is a long tradition of dealing with visuality which gives a lot of philosophical knowledge about different aspects of visuality, visual language and visual reasoning. This plays a central role in developing the use of visuality in science and in practice.

Architecture is an excellent example of an area in which visuality is a familiar phenomenon. In architecture visuality plays several different roles. In architecture the intention is to plan and build buildings and environment. Hence in planning, several different kinds of visualization methods have been used, but in "practice" a concrete object has been constructed in reality. So, architecture builds bridges over the gap between theory (design) and practice (building). The result is not mere buildings but a human environment in which humans and human communities live their lives.

Architecture is intricately connected to technology. The planned buildings have to be built by materials and techniques that are available. This connects architecture to the technology. Moreover, buildings and environment have to be pleasant for humans. This connects architecture to aesthetics and art. However, the connection of visuality to art is not a special property of architecture but all visual languages have aesthetic aspects as Neurath's example shows.

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Carina Söderlund & Pete Evans

Co-design in Immersive VR

Something Old, Something New, Something Else…

Introduction

In the following text we will cover the areas of participatory and collaborative design (co-design) in immersive collaborative virtual environments (CVEs), as well as the experiences of the body and mind while designing together in virtual reality (VR). The aim is to explore immersive VR as a media for co-design, with anticipation of the potential use of this media for participatory design and co-design. The purpose is to investigate if and how immersive VR can facilitate co-design experiences and the collaborative making process, in order to establish a basis for future co-design studies in immersive VR including potential users and other relevant participants. The present study is delimited to exhibit design, more specifically, the design of museum exhibits and low fidelity prototyping (lo-fi prototyping), with focus on the initial phases of the design process, as well as the ideation and the design of low-fidelity (lo-fi) prototypes.

We'll begin with an introduction to contemporary design approaches, or more specifically, human centered design and participatory design as a co-design approach. This will be followed by a note on the development of VR-technology where we'll look at some of the examples of current research that are close to the theme, besides, there is an reflection on the core concepts real, virtual, and actual. Then we'll continue with a presentation of prototyping as a co-design method, including contemporary cognitive psychology theories which highlight the body, mind, space, and interactions that take place with a diversity of tools as part of our thinking process during prototyping. Next, we'll describe the method in further detail, namely, through sharing an introspective study conducted by two co-designers (the authors of this text). In the final section, we'll present a reflection and analysis of the introspections regarding the actions, thoughts, feelings, emotions, and sensations (sensory and bodily perceptual experiences) that take place while co-designing in an immersive CVE. In order to analyze the key moments and experiences when co-designing, the empirical data have been illuminated by theories on direct perception and design fixations, for instance, which emerged during the study and analysis of the findings. Finally, we will conclude by offering proposals for future research and tentative suggestions regarding co-designing in immersive CVEs, i.e., their metaphorical qualities and how they may affect the designed artifact, and how immersive VR technology supports a design relationship among co-designers, which may open up a sincere and genuine dialog when co-designing remotely.

Participatory Design and Co-design in Immersive VR

Historically, before the Second World War, design referred to decorative art and architecture (Dilnot, 1948). Some argue that design can be traced back to the industrial revolution (Bayazit, 2004). Nevertheless, notions of design have evolved over time in relation to vital movements and changes in society. Over the last decades, the concepts of *user*- and *human-centered design* have advanced alongside the progress of the personal computer. Today, there are ISO standards for human centered design (ISO 13407:1999; ISO 9241-210:2010) and how to design usable products based on users' needs, as well as prerequisites related to contextual conditions.

However, Buchanan (2001) argues that human centered design goes beyond usability, and brings attention to other values besides the need to operate and interact with a product, since human centered design relates to "human rights" and the "affirmation of human dignity" (p. 37). In that sense, a designer supports people in being active and acting as agents in their own lives. These ideas relate to the foundations and values behind the approach called participatory design, which is a collaborative (co-design) approach based on Scandinavian traditions and democratic values, which advocate that impacted people should have a voice in the design process (e.g., Ehn, 1992; Björgvinsson, Ehn & Hillgren, 2010). Unlike observing or interviewing users regarding their actions and the context of use, participatory design is about designing and creating together (Salvo, 2001). In that sense it is possible to say that co-design deals with notions such as empathy, diversity, influence, and inclusion.

Nevertheless, there is no unified definition of the concept "co-design". Sanders and Stappers (2008) discuss this conceptual confusion and multiple definitions of co-creation and co-design as these concepts are related, and they suggest that co-design deals with group creativity throughout the design process. According to Ehn (1992), co-designing from a participatory point of view focuses on learning, as users and designers learn from each other and share their unique knowledge and experiences. It situates the designer and the user in new positions and relationships.

Examples of VR-technology and previous research in co-design and exhibit design

Simply put, VR is a computer-generated simulation. It is easy to associate VR with entertainment and gaming used by the younger generations. However, VR is also applied to areas such as psychology and medicine (Slater & Sanchez-Vives, 2016), as well as engineering, product development, and architecture. Today's VR experiences can be accessed with easy-to-use headsets, such as Oculus Rift and HTC Vive. Such VR technology has advanced from principle examples such as the Sensorama (1962), the Sword of Damocles (1968), and the CAVE in the early 1990s.

Historically, VR has been limited when it comes to resolution and movement synchronization (Slater, 2000). Only the highly technical CAVE achieved the potential for active collaboration, at a very high cost. Such VR technology has been the privilege of few professionals and researchers. Immersive VR technology has only recently become affordable and an easy-to-use commercial and consumer product. With that in mind, professional designers and design students are now able to use VR technology in a mediated and embodied making process and, for instance, prototype ideas and co-design with colleagues, clients and consultants via immersive CVEs.

Research on VR began to evolve in the 1990s. During this period, with respect to immersive CVEs and co-design, the definition of VR was broad and covered web-based 3D chats (e.g., Active Worlds and Second Life), CAVEs, and lab-based experimental head-mounted displays and hand tools. Over the last decades, the computer technology has rapidly expanded. Mel Slater (in Pan 2020) recently pointed in one of his presentations the important synchrony of the visio-tactile and visio-motor information, which offers the user a multi-sensory experience, a strong feeling of immersion, and a sense of presence, particularly relevant in the making and co-design process.

Recent research does not give much attention to co-design in VR and immersive CVEs in relation to spatial design, exhibit design, and museum exhibit design. Examples of current research on co-design in VR and virtual environments include a study on co-design and design ideation by Boletsis, Karahasanovic and Fjuk (2017). The study by Koutsabasis, Vosinakis, Malisova and Paparounas (2012) elaborates on situational awareness when co-designing architecture (built spaces). Flint, Hall, Stewart and Hagan (2018) present a study on designing a virtual museum in collaboration with children. However, the co-designing was not performed within a CVE. The case study on virtual design studios in education, by Vosinakis and Koutsabasis (2013), discusses benefits and limitations with designing in VR and the development of digital prototypes. For instance, the virtual environment provides simple shapes and tools that are easy to prototype with, however, the prototyping process is considered to be time-consuming.

Real, actual and virtual in the making process

Now, we will discuss if and how immersive VR can facilitate the co-design experience and collaborative making process in immersive CVEs. The design process takes place in a virtual space. In the dictionaries, the word virtual is defined as almost and not exactly, which could explain the cases where immersive VR and CVE are considered to be less authentic medias.

Nevertheless, the co-design experience and collaborative making process in an immersive CVE do not have to be considered as less realistic or authentic compared to when they take place in a design studio. Pierre Lévy (1998) discusses how that which is virtual is considered to be less true and authentic, and that we may fear that the virtual will destroy the personal. However, Lévy redefines the relationship of "real and virtual" to "actual and virtual." This semantic shift allows for "virtual" to act more as complementary to "actual," which is considered to be in situ and complete. Put another way, prototypes and models can be considered to be virtual, as they are representations and potentials of a designed artifact. It can also go the other way, where shapes of thoughts or actual design ideas can be considered to be virtual, and when the design process is complete the prototype becomes an actual historical artifact. This represents a constant movement, a transformation, between the virtual and the actual.

Thus, it is important to critically consider whether a designer who is prototyping in immersive VR may perceive prototyping as virtual, intangible, and the co-design process as delusory. As Kälviäinen (2005) states, the process of making is multi-sensory with a relationship between body and artifact, which relates to an emotional experience such as empathy and passion, and to qualities such as materiality and meaning. However, in immersive VR, our corporal body is not in physical contact with tools, materials, and the designed artifact, which affects the multi-sensory process that relies on the bodily senses. Malcolm McCullough recognized the importance of the mind-body relationship in using computer technology to, for instance, make a painting. The computer technology supports visual and spatial thinking and a multi-sensory participatory engagement, and McCullough argues that the hand, the eye, and the tool (e.g., an interactive pen display) interact just as in any making process (McCullough, 1998). Nevertheless, multi-sensory impressions while designing are multimodal. It can be compared to the development of photos in a dark room: the scent of the chemicals, the feeling of the photo paper, and the sound of the rippling water are all sensory inputs in the making process. Computer technology used in today's businesses and institutes of higher education rarely deals with all the senses and such sensory input (not yet, anyway).

Spatial, distributed and extended cognition and lo-fi prototyping

At the start of a co-design process, several methods can be applied. In this case, lo-fi prototyping was used. When co-designing and developing lo-fi prototypes in the early phase of a design process taking place in an immersive CVE, it is relevant to reflect upon the cognitive aspects that are related to such a process. In the initial stage of a design process, a designer may use pens and paper to create sketches or develop paper prototypes and mock-ups. Prototypes consist of visual, tactile, and sometimes verbal and auditory information. Nevertheless, prototypes give, for instance, shape to ideas and/or thoughts to be communicated and reviewed.

Traditionally, prototype has been an artifact on paper or in material representation. Lo-fi prototyping on paper has potential when it comes to identifying problems or possibilities with a design idea in an early stage of the design process (Retting, 1994). Digital prototyping first emerged with the introduction of computer technology and provided a digital representation of thoughts and ideas on a screen. It is possible to prototype in VR (Evans, 2018). Immersive VR provides an embodied context, where body, space, and artifact can interact, creating new opportunities for the virtual extension of the body during prototyping. This refers to contemporary theories in cognition psychology.

The perception and cognition can be explained as two-folded, i.e., based on pre-experiences and knowledge, as well as on our sensory input when interacting with and in the world. Today, human perception and cognition do not only consider information processes within the brain. There is a relationship between the inner world (the body), the outer world, and our thinking. Barbara Tversky argues that thinking is embodied and spatial. The thinking is part of the bodily experience and reactions (the inner space) relate to the nearby surrounding, and a geographical space (Tversky, Morrison, Franklin & Bryant, 1999). Another theory from the 1990s considers our thinking to be distributed and part of a larger system which includes tools, the surrounding environment, people, and their interactions (Hutchins, 1995).

Theories of distributed cognition are related to design thinking. A designer uses tools and methods to design or "distribute" their ideas to the outer world, making them visible and tangible to themselves and others. These prototypes, models or sketches give access to previous and present ideas, as an external memory, stimulating our memory (van der Lugt, 2005; Purcell & Gero, 1998). Pertinent to this, Andy Clark's theories discuss our thinking as an interaction with tools. Cognition is considered to be an open system, which could be part of a technical system (such as a CVE), then the cognition is extended (Clark, 2001/2003). In VR, the designer is forced to use VR equipment, for instance the headset and hand controls. This experience is explained by Andy Clark (2001/2003), who discusses how cyborgs are a part of humanity, as we interact with a diversity of technology in our everyday lives, such as pens (to write text or draw pictures) and typewriters. There is no clear demarcation between our corporal body and the technology (ibid.). A contemporary example of VR technology becoming an extension of the corporal body and our vision is the FlyVIZ (Ardouin, Lécuyer, Marchal, Riant & Marchand, 2012). It had a setup that allowed the user to see all around themselves like a fly and, for instance, when catching a ball thrown from behind.

An Introspective Study

We conducted an introspective study to investigate if and how immersive VR facilitates the co-design experience. Focus was placed on the ideation and the co-designing of lo-fi prototypes representing museum exhibits in an early phase of the design process that takes place in an immersive CVE. The nature of the introspection was a first-person study. In this case, we as authors observed and reflected upon our actions, thoughts, emotions, and sensations (sensory and bodily perceptual experiences) while co-designing.

More deeply, introspection is more than just observing a phenomenon in the world. Rather, it is a subjective observation of body and mind, based on how we experience the world (Gallagher & Brøsted Sørensen, 2006). This introspective study was based on a reflection that took place during and after the design process. Such a reflection concerns a vast amount of phenomena. In this study, we reflected upon the bodily sensations, as well as feelings, emotions, and design activities that occurred both during and after the co-design process.

To prepare for the introspection study, two commercial immersive CVEs, their software, were tested; Rumii (est. 2016) and Glue (est. 2017). Rumii is like a lo-fi prototype environment with the capabilities of collaborative white boarding, document presentation (2D/3D), sketching (2D/3D), and 3D platonic form making. Rumii was used in this study since it provides 3D platonic form making, while Glue did not at that time.

As a pre-study (pre-test), and to prepare for the introspection and to prepare for some eventual technical challenges, the immersive VR technology and Rumii were integrated into an advanced CAD curriculum at a US midwestern university. To flesh out ideas for co-designing in immersive CVEs, we supervised sixteen industrial design students when they were trying to design, develop, and present ideas and prototypes in Rumii.

Preparing and executing the introspection

Following this orientation with the students, we proceeded to conduct three pilot tests (pre-tests) in the very same CVE in order to advance the technique, explore tools offered by the virtual environment, test recording techniques, and plan a design brief.

In preparation for co-designing in an early phase of the design process, including ideation and early lo-fi prototypes, we (the authors) formulated a design brief based on our design skills in co-design and spatial design with a specific focus on exhibit design and architecture. Both of us (the authors) are educated in spatial design and architecture. One of us has moderate experience in using immersive VR technology, and the other has over ten years of experience. The design brief was a shared premise, dealing with ideation, early prototyping and design of exhibit stands as well as furniture and other artifacts as parts of a larger museum exhibit. The purpose of the brief was to display historical artifacts, such as jewelry and coins, for young children to interact with and learn about history while visiting a museum. Focus was placed on the shapes and colors of stands, furniture, and other artifacts. No details regarding texture and specific materials, for instance, were included. Instead of using traditional tools and methods (such as sketches or cardboard models), platonic building blocks were used, offered by the collaborative virtual environment Rumii, with twenty three (23) virtual geometrical shapes, and combinations of them, including a color palette of twenty two (22) basic colors.

Wireless Oculus Quest headsets and hand controls were used during the design session. The work was done remotely, with one designer in Sweden and the other in midwestern USA.

Figure 1. This picture shows one of the authors with a VR headset and hand controls comparable to the one used while co-designing in an immersive CVE. The bodily movements and actions are mediated with the VR equipment and reflected by avatars in the CVE.

The co-design session continued for one hour (including 5-10 minutes spent dealing with technical problems). The reflection during and after the design session was inspired by the theories of Schön (1983). Through talking out loud during the session, we reflected upon our individual thinking, actions and contributions, as well as on our collective making process. When the session ended, the reflections continued individually, captured by field notes. In addition, the reflections continued during two online meetings, face-to-face, allowing us to compare notes and further reflect upon the design activities that took place, as well as the thoughts, sensations, feelings, and emotions that came up while co-designing within an immersive CVE.

The recordings and field notes were analyzed by highlighting key moments and experiences when co-designing. Keywords were noted, and screenshots from recordings and quotations from the notes were categorized into themes. The themes were as follows: *Visioning the design possibilities*, *Interaction with objects (including the sub-themes Choice of color and shape, Scale of objects, and Moving and changing objects), Interactions between designers and Hearing*, and *3D-audio*.

Reflective Analysis and Discussion

The actions, thoughts, feelings, emotions, and sensory and bodily perceptual experiences that occurred while co-designing early prototypes in an immersive CVE were analyzed through a diversity of theories that emerged while planning the study and analyzing the empirical data. Some of the theories have been applied in previous studies and the theories are common in, for instance, design studies and pedagogy, and concern direct perception and affordance, socio-semiotic, remediation, design fixations, and theories on existentialism and human relations. These theories were applied to reflect upon the key moments and experiences during the co-design session and, to some extent, describe and explain them.

Figure 2. The picture visualises the mediated authors when co-designing on a display box. In the background platonic forms (cube, circles, etcetera) are listed on a white board, beside are colors which can be used to give colour to the platonic forms.

Design fixations

The immersive CVE used in this study provides a menu, which offers an overview of the available 3D platonic forms, i.e., geometrical shapes (materials), and color possibilities. Such platonic forms can be compared to the more abstract forms used during lo-fi paper prototyping.

When entering the CVE, qualities are represented (functions and a visual appearance) that support interactions with and within it, relating to concepts such as familiarity and remediation. The metaphorical likeness with previous media may affect how new media are interpreted and used. For instance, the CVE has avatars and visual similarities which we recognized from previous games and online 3D chats, such as Active Worlds or Second life used in the late 1990s. Moreover, the CVE provides a menu of possible functions, which is comparable to basic modeling software programs. By adding a socio-semiotic viewpoint by Kress and van Leeuwen (2006), it is worth mentioning that the programmer and developer of such a virtual environment bring along their own values, culture, and experiences when inventing such an immersive CVE. In addition, they are influenced by conventions, which can be related to interactive games that are available today, or were previously available since the advent of the 3D gaming industry. The CVE in this study was approached as an "actual" and cultural place due to previous experiences and memories of using other places, such as design studios, similar virtual environments and our previous digital games experiences.

The co-design session started with a dialog around the possible functions offered by the CVE and its design possibilities: "*…all shapes, forms and colors of modeling ideas are discussed togethe*r" (Fieldnotes).

Figure 3. The initial geometrical figure (building block) in the immersive CVE which is in focus of the investigation, at the start of co-designing a lo-fi and digital prototype, representing parts in a museum exhibit.

One of us initiated the co-design process by explaining the menu in closer detail, and choosing a geometrical figure called a "Cube Corner," which was orally and collectively signified as a chair (Figure 3). A blue color was selected, then a symbol (a star) was added to signify the chair as a throne (Figure 4). This can be perceived as a semiotic act, derived from the users' similar cultural context, past experiences of games, and pre-experiences of museum exhibits and exhibit design, among other things. Through this act, this meaning making process, the geometric figures gain meaning for the users and the design makes sense.

Figure 4. The digital prototype in the initial phase of the co-design session. A flat and circular shape was used to express a dais to a throne.

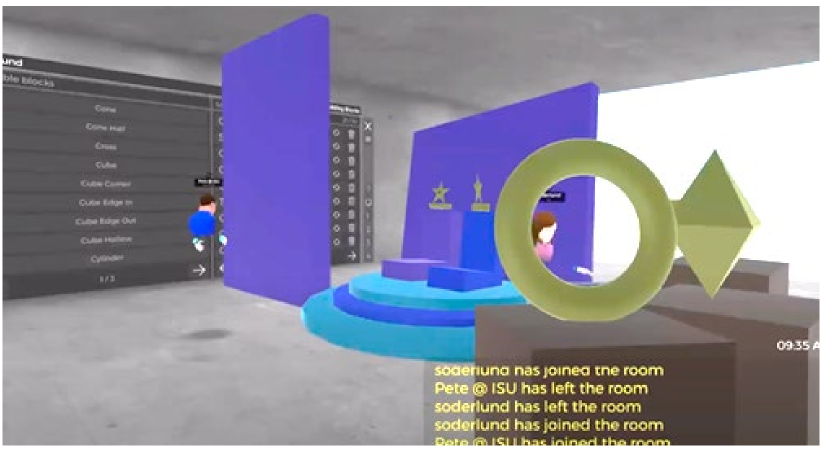

Figure 5. The prototype, at the end of the co-design session.

The co-design session continued with creating a place, a part of an exhibit at a museum that is, and architecturally defining the place by marking the location with circular and flat shapes placed above one another to indicate differences in height and depth. These shapes were expressed and interpreted as a dais to a throne (Figures 4 and 5). As the co-design session continued, the more limited the shapes became in their meanings, which constrained the design options. The findings indicate that the first shape limited the meaning of the subsequent shapes and the manner they could be combined, and ultimately limited the design of the digital lo-fi prototype and outcome of the design session. This phenomenon can be related to the concept of design fixation.

Previous studies indicate that novel ideas are based on old ones. Thinking while designing is not a free or standalone action but, on the contrary, can be fixated on our previous experiences and knowledge of previous forms, shapes, and concepts (Ward, 1995; Purcell & Gero, 1996). There are studies demonstrating that VR may support collaborative creativity, such as the study by Alahuhta, Sivunen & Surakka (2016). However, the co-design process in this study did not necessarily lead to collaborative creativity in the sense that the co-design session generated creative, novel and unique design ideas. Thus, it is relevant to reflect upon whether immersive VR supports collaborative creativity per se, or if it may depend on how knowledgeable a designer is with, for instance, the co-design process, in using immersive VR technology and tools while designing.

Affordance and remediation

Squares, rectangles, spheres and cones were the most dominant choice of shapes during the co-design session. The shapes were moved, placed separately, beside or above each other and squeezed together. The shapes were combined into forms with a given meaning. The initial scale was 1:1, in relation to the size of the avatars (Figures 2-5). When the shapes were enlarged (beyond the 1:1 scale), they were no longer easy to view. To describe these experiences, the concept of affordance may be of interest.

The concept of affordance, in its original definition, has, in many cases, expanded and been applied in several areas, for instance, in interaction design (Norman, 2013) and co-design in VR when for instance Alahuhta, Sivunen & Surakka (2016) highlight seven affordance possibilities (e.g., avatars, co-presence, and multimodal communication) when collaborating in VR. However, it was Gibson (1977) who invented the concept of affordance, based on the ideas of direct perception, referring to perception in action without higher levels of cognitive processing. Originally, affordance designates how an object (fluid or firm) invites a human (an animal) to interact, depending on the relationship between the properties of the body, object, and surrounding environment. Groome (2010) discusses the concept of affordance in relation to the bottom-up processes and the function of the motor cortex, as we interact with the world by grabbing and pulling things. According to Greeno (1994), the concept of affordance may be confusing, whether it refers to properties of an object or to the properties of the one interacting with the object. Nevertheless, if we approach the concept of affordance as originally described, as the interrelation between the body, object and surrounding environment, such an interrelation can be considered to be a prerequisite for interaction.

When it comes to co-designing in immersive CVEs, it is worth discussing if and when the concept of affordance is relevant to use, and if there are other suitable concepts. This introspective study indicates that a direct perception may be a problem, since co-designing in VR indicates a semiotic act, performed in a cultural space. It is likely that the interactions with the 3D platonic forms are based on learned behavior and activities. Besides, the combinations of the platonic forms were based on conventions and pre-experiences and pre-knowledge.

To reuse McCullough's expression digital medium from 1996, co-designing in this immersive CVE was a virtual, yet actual, making-process. The digital materials in this case were geometrical figures preselected by the programmers and developers of the immersive CVE software program. These 3D platonic shapes constrain the design possibilities, i.e., what to design and how to do it. These digital materials are carriers of design qualities since they, for instance, resemble Legos, the familiar interlocking plastic construction toys. Furthermore, the appearance of the CVE in this study resembles previous computer games and online 3D chats from the 1990s. It is worth considering whether this similarity raises ideas (opportunities and obstacles) while co-designing within the virtual environment, or ideas about the functions of the shapes, the design (how to combine the shapes), and how to collaborate (e.g., waiting for your turn to act/interact). This aligns with the theories on immediacy, hypermediacy, and remediation by Bolter and Grusin (2000), and similar theories by Manovich (2001); namely, that previous visual media and technology are used metaphorically when interacting with new media, and conventions are recycled from one media to another, based on pre-experiences and pre-knowledge of similar situations, shapes, and environments. It refers to a cognitive top-down process, opposite to direct perception, and the concept of affordance.

Nevertheless, during the co-design session the perception was split between the virtual and mediated body, and the corporal body and its physical location. For instance, one of the co-designers was physically kneeling on the floor when modifying the floor-level shapes in the virtual environment. The kneeling was confirmed by a sensory input (a pressure on the knees), from the actual oak floor in the room where the corporal body was situated. In such a situation, when the actual and virtual are interrelated, the concept of affordance may be relevant to the exploration of the co-designers' situational awareness, and the interaction between physical space, virtual space, and actual place.

Co-design Interactions

The co-design interactions took place through avatars, mediating the corporal body and its movement via hand-controls, and through 3D audio that mediated speech. The interactions were supported by the facial expressions of the avatars. Initially, in the session, their mouths didn't move, signaling a technical problem with the audio. The interactions consciously stopped due to these technical problems, until they were resolved, and the avatars' mouths started moving with the audio again, supporting the interactions and the co-design session.

Throughout the design session there was, on one hand, a focus on the same aspect of the design during collective testing, evaluation, and negotiation and, on the other hand, a focus on individual creation and evaluation of individual ideas, which then became visible to both parties. As previously mentioned, when co-designing, shapes were pointed at, moved, and shared. Shapes were grabbed by the virtual and mediated hands, and these shapes could be shared between hands to support each other in replacing or resizing a figure or shape. There was a synchronization between the actual hand and the virtual, apart from the fine motor skills.

The perception of this bodily experience via mediated bodies differed. On one hand, there was a sense of a solid body: *"I was conscious of my co-designer, his presence. It does not feel okay to stand above him or inside him."* On the other hand, this experience was also a non-material experience: *"There was fun interchange physically where we moved through each other where the realness wasn't a limitation…"* In this case, the immersive CVE violates Cartesian dualism, with the body of material and the mind of non-material.

However, the corporal body is represented by an avatar. To refer to the ideas of Magritte, such a representation can be explained as an act of a visual thought (Guerlac, 2007), since the avatar is the thought of the designer who made it, as well as the thought of the person who uses it. In that sense, the avatar can be perceived as a part of someone's mind, which may undermine or bypass the corporal resistance to step over, stand above or "move through" each other (or the avatars) while co-designing.

Figure 6. Sharing shapes when co-designing in the immersive virtual environment.

Design relations

A sense of presence in virtual reality has multiple definitions. One definition refers to being at a real place (being there), a place illusion (Slater, 2009). Somebody that is very used to the VR technology may interact within an immersive CVE and not perceive that they are beyond the world instead of at a place, such as being at home or school (Slater & Sanchez-Vives, 2016). In this study, the CVE was perceived as an empty, less real place when being alone within it. Such an experience can be interlinked to a user's moderate experience of using immersive VR technology. However, when co-designing, the experience of the place was different: "*It becomes a different sense of presence when you hold one object in your hand and give it to the other, and you hold it at the same time*" (Field notes).

Such a contact reflects the relationship between oneself and the other, which is discussed by Merleau-Ponty, for instance. In VR and immersive CVEs, this phenomenon can be related with the concept of *co-presence*, as you become aware of the presence of the other, e.g., a team member, while collaborating. The VR technology can support such a co-presence, and facilitate it (Schroeder et al., 2001; Wiederhold, 2003).

Figure 7. At the end of the co-design session. The lo-fi prototypes represent parts of an exhibit design, to display historical artifacts for young children to interact with and learn about history while visiting a city museum.

Here, ideas of existentialism and the theories of Martin Buber (1923/1937) can be relevant, since they highlight the relationships between people. These theories are applied in several disciplines touching on humanities, such as pedagogy. The theories can be applied without regard for religious belief, which is done in this text. Referring to Buber's ideas, the world can be experienced through a filter as we describe, identify, and categorize (objects, people, and the world we act in) based on e.g., previous understanding and knowledge. This is a matter of the so-called "I-and-it relationship", which is a common relationship. In contrast, the "I-and-thou relationship" refers to encountering each other beyond our previous experiences, knowledge, and prejudices, in the space between us. In this case, "I" starts to exist in the presence of "You" (Buber 1923/1937). Such a relationship is not based on confirmations of the previous experiences of the world but, instead, can be compared to an exploration of the same. According to Salvo (2001), an I-and-thou relationship may open up a dialog between collaborators in a co-design process. However, Salvo does not elaborate on how such a relationship may occur, neither when co-designing in "reality" or in VR.

In this study, objects and shapes were shared when giving and receiving 3D platonic forms, such as cubes and spheres, by switching hands virtually: "*Co-creating/designing ... was enjoyable and felt very real in terms of you were there with tangible stuff including fun episodes of taking materials and constructions from me and back and forth in a humored fun way.*" (Field notes). This co-exploration and sharing opened up a dialog regarding the design options and possibilities. Furthermore, the spatial audio in this immersive CVE was directional and followed acoustic principles, and automatically lowered the volume of the voice when the avatars were further away from each other and raised the volume when they were nearby: "*Like just hearing an immediate, familiar voice and turning my head and the voice was right by my shoulder* …". (Field notes). During the design session, the spatial audio gave support when it came to understanding how to orientate and navigate in the virtual environment in relation to each other's bodily positions. The sound quality, the volume, and the location of the sound affected how the voices were perceived and, consequently, the identification of a co-designer. "*His voice sounds different compared to the phone. Is it really him? It is softer and maybe fuller (fuller base) than normal.*" (Field notes). The spatial audio affected the sense of embodiment and co-presence in that we could maintain focused attention individually while still sharing the same audio space in the immersive CVE, comparable to acting in a physical design studio working on a project together.

In that sense, spatial audio, co-exploration, and the exchange and sharing of objects between virtual and mediated bodies reinforced an I-and-thou relationship in this immersive CVE since "I" began to exist in the co-design relation to "You."

Final Thoughts and Future Studies

Through an introspective study, this text presents a reflection and analysis of actions, thoughts, emotions, and sensations when generating design ideas and co-designing lo-fi prototypes in an immersive collaborative virtual environment (immersive CVE), in an early phase of a design process. The purpose was to investigate if and how virtual reality (VR) and immersive CVEs can facilitate the co-design experiences and the co-making process. Theories related to direct perception and affordance, socio-semiotic, remediation, design fixations, and existentialism and human relations emerged during the study and analysis of the findings, and were applied to reflect upon the key moments and experiences during the co-design session. The study illustrates possible areas for further studies on co-designing with immersive VR and within immersive CVEs.

Based on the findings, it can be tentatively suggested that the immersive CVE in this study was approached as an "actual" and cultural place due to the co-design inter-activities within it and the designers' previous experiences and knowledge, as well as the resemblance to previous games, virtual environments, or 3D chats. Moreover, it is tentatively suggested that the digital tools, digital materials (platonic 3D shapes), and the place where the co-design activities are taking place in an immersive CVE have metaphorical qualities, which influence the interpretation of shapes, choice of shapes, the combination of shapes, the result of the co-making process (the prototype) and the co-designing experience as a whole. Futhermore, when co-designing virtual lo-fi prototypes in an immersive CVE, the sharing of objects and shapes, such as when they shift hands, as well as the spatial audio, may facilitate the experience of a design relation, an I-and-thou design relationship, when co-designers collaborate from remote places.

Spatial audio, the synchronization with avatars' facial expressions and the audio's possibilities of simulating space, appears to be relevant when co-designing in immersive CVEs. However, avatars and their functionalities and feasibility are not covered in this study, and we suggest that future studies examine these aspects further. Future technology developments might influence the co-design experience in immersive VR, which is also yet to be explored. The study presented in this text is an introspection, small in scope, and further investigations with multiple methods and users are recommended.

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Ontological Premises of Technology and design: a Critical Analysis

Annotation

The article aims to analyse the ontological premises of technology and design. The main problem, expressed as a question, is as follows – are man's technical projects arbitrary constructions of his consciousness (thinking), as Günter Ropohl supposed, for example, or 1) *are they predetermined*, as believed Paves Florensky and Martin Heidegger (strong thesis); 2) *are they limited*, as Friedrich Dessauer suggested (weak thesis).

To answer this question, the concept of "ontological Propis" is introduced, with the help of which any objects that are consistent (CO) are designated. Correspondingly, contradictory or non-consistent objects (NCO) are located "outside" the ontological Prescription and are imaginary objects. Most COs exist in the realm of the possible world, and a smaller part exists in the real (empirically given) world. Ignoring the difference between these worlds gives rise to the main temptation of design: the human mind is autonomous and free, and, therefore, "everything can be designed!" The inaplicability of this claim is shown in the form of three limitations of technology and design:

The first limitation: human consciousness (thinking) can design *consistent and only consistent objects*. "Consistency" is the general requirement of the ontological Propis for all possible and real objects.

The second limitation: human consciousness (thinking) can design *those and only those objects that are law-conforming* (Dessauer). Law-conformity is a requirement of the ontological Prescription for real objects.

Third limitation: human consciousness (thinking) can design only those objects that are *human-proportional*. Human proportion is a requirement of the ontological Propis for real objects.

Conclusion: the activity of the designer is not arbitrary but is significantly limited by the ontological Propis.

Introduction

One could, however, rather tentatively say that the era of "design" was initiated by Rene Descartes, whose maxim Cogito ergo sum[1] (Descartes, 1989), became a kind of slogan of the entire Enlightenment. It was Descartes who formulated his worldview in such a way that now the *"existence of human"* (and the world in general) was made dependent on *"human thinking"*. Both components are important here: firstly, "thinking", and this means that the whole philosophical world that comes after Descartes *will be based on this very thinking* and everything derived from it, up to modern computer programming and modelling; and secondly, "human", and this already means that *all other rational forms – the "realm of ideas"*, *God's intentions, theology (literally "words of (for) God"), and suchlike – are left out of the discussion as "non-human"*. In fact, Descartes proposed not just the "project" of the New Man, but, if you will, the *"project of all projects"*. In a sense, Descartes is the *First Designer* in the European culture of the New Age. He gave an impetus to what later will serve as the basis for the division of all researchers – of course, also, very arbitrary – into two clearly distinguishable groups: the first, which *directly followed Descartes* in this matter and put the works (products, artifacts) of a person in dependence of his "thinking"; and the second, which, *contrary to Descartes*, tried to discover the origins of human projects in the world itself (sometimes in nature itself). To understand why this was so, let us take a step aside and consider some concepts that we will need to elaborate on the matter.

Concept of the "Ontological Propis"

In order to describe these two groups and the premises that became the foundations of their views, as well as to adequately describe the nature of "technology" and "design" and explain their essential features, we need to introduce a new concept. Such a concept would be "ontological propis". By "ontological propis" (hereinafter referred to as "Propis") I will mean a *set of consistent and only consistent objects, both possible (given in theoretical knowledge) and real ones – given in sensory (empirical) knowledge*. To mark the Prescription, I introduce special symbol "". Now let's denote some properties and features of the Propis. To do this, I introduce the corresponding notation. For a better understanding I will compare it with the corresponding symbols and operators in the von Wright model of time (von Wright, 1983), which also employs a "logic of events" rather than a "logic of utterances".

1 Descartes writes about this in the treatise "Discourse on the Method". A critical analysis of this statement can be found in the works of J. Hintikka (1962; 1988), as well as in Pavlenko (2012).

1) The Symbol $\mathbf{S}_f$ denotes complete (**f**ull) space of states of the world. It appears, at a new level, the only analogue of von Wright's operator «p T p» (the event exists and continues to exist) (von Wright, 1983), that characterizes such space of sensuously observable physical events of the world, *when the "sequence of events" is, but there is no meaningful change in events!* The variable "p" in the von Wright's model means "some event in time". Broadly speaking, von Wright allows construction of such model, assuming that we can take the entire set of events, length of *m*, and receive the "number of possible worlds", equal to 2^m (von Wright,1983) insted of (Chalmers,2002).

Disjunction of such "possible worlds" Wright calls "T-tautology" (von Wright 1983). However, regarding this description von Wright makes a disappointing verdict: "... T-tautology does not say anything about the history of the world. It is trivial and therefore logically true" (von Wright, 1983). We see that the expression «~ p T ~ p» ("event does not exist and does not come into existence") does not fit into von Wright's model again. We see that von Wright didn't *know what to do with the phenomenon of the lack of change*. After all, if the world is given entirely and there are no changes in it, therefore, there is no time. I think, here he doesn't notice that his own model readily admits this scenario: : p T p; p T p; p T p ... p_n T p_{n+1} .

2) The Symbol $\boldsymbol{S}_e$ denotes "**e**mpty space of states of the world". It only is the analogue of von Wright's operator ~ p T ~ p, so it characterizes such a "state of the world" events, when *there is no event in the physical world and it doesn't occur*. I call it "empty" and I take the term "space of states of the world" in quotes in order to emphasize the specificity of this expression, because it – by the way, von Wright himself does not indicate to such a feature it somehow – strictly speaking, describes not a real sensuously observed *physical event*, but only some of the possible events, which *is not given* in the space of the actual state of the physical world in the present. For me, it is strange that von Wright did not pay attention on this. After all, he had, in fact, built *a model of temporal physical events (observed) of the world*. The operator ~ p T ~ p simply *falls out* of the sense-perceived physical reality, speaking *only about the possible events*. After all, the variable for the event (~ p) *denotes anything, but not sensuously observable physical event (p).*

3) The Symbol $\mathbf{S}_{h/f}$ denotes "half (partially) complete (**h**emi**f**ull) *space of states of the world".* It is an analogue of von Wright's operator p T ~ p, namely characterizes such state of spaces of the world, when *there is a real event, but it starts to move from the real world to possible one*. Let us note again that von Wright did not share his world events in real and possible.

4) The Symbol $\mathbf{S}_{h/e}$ denotes “half (partially) empty (**h**emi**e**mpty) *space of states of the world*”. It is a distant analogue of von Wright’s operator ~ p T p, videlicet characterizes such a state of the world, when *a possible event starts to become real.*

Operator’s specificity $\boxtimes$ is that it denotes the space of all changes *as the set of changes which have been given*, that is to say, “the space of sequences of events” (in Wright’s terminology - “space changes”).

Further, I will outline the main properties of the Propis, which were already described in the previous work Pavlenko (2012), but which I will need again, in connection with the description of the nature of technology and design.

Let’s try to characterize the prescription of world events. I will signify this phenomenon by means of Russian word “Propis”, expressed by the symbol $\boxtimes$:

1) The Propis *is the world of consistent and only consistent objects and events.*

$$\text{(I)} \quad \boxtimes \quad \leftrightarrow S_f \wedge S_e \,,$$

$$\text{moreover, } (p \,\&\, {\sim} p) \notin S_e \vdash (p \,\&\, {\sim} p) \notin S_f$$

2) Consistent objects (events) *can be* implemented in a sensually observable (physical) world.

$$\text{(II)} \quad S_f \subset S_e$$

(3) *Propis* is the sum of all the conjunctions of events observed in sensually observable and possible worlds.

$$\text{(III)} \quad \boxtimes = \sum \left(S_f \wedge S_{H/f} \wedge S_{H/e} \wedge S_e\right))$$

(4) Be implemented in the observable world can that and only that, what is consistent:

$$\text{(IV)} \quad S_f \in S_e \,,$$

$$\text{Moreover, } (p \,\&\, {\sim} p) \notin S_f$$

(5) All events in the S_f are elements (lines) of prescribing the sequence of events of this "Propis":

$$\text{(V)} \quad S_f \in \text{※}$$

(6) In S_f there is no real event which does not belong to ※.

(7) In S_e there is no possible event which does not belong to ※.

(8) Accident – is a characteristic of the human knowledge and description of "Propis", but not the "Propis" as itself.

(9) Changes in the world of events S_f – are *hand-written-samples.*

(10) The line of Propis – is a strict sequence of events in the real or possible world of this recipe.

(11) The Propis, from the temporal point of view, is a set of qualities, united by sequence of events.

From "Ontological Propis to "Technology" and "Design" (The First Limitation of Technology and Design).

Now let's try to bridge the gap between such an abstract philosophical concept as "ontological Propis" and the concepts of "technology" and "design". It is reasonable to ask: what can the concept of "Propis" give us in explaining the nature of technology and design? In fact – a lot. As we could see, according to formal expressions (I) and (II), *consistent and only consistent objects can be realized in the world*. Therefore, if we assume that: 1) *the plan always precedes the execution*, and that 2) *the plan is a project (design)*, then we have the right to assert that since *"human design" is a process (product) produced by human thinking*, then, accordingly, the design should also have such a quality as "consistency". This is the first consequence from the Propis. Having established this, we can now formulate the first problem, which we express explicitly as a question:

> *Are man's projects just arbitrary constructions of his consciousness (thinking) or are they something more (than just constructions of his consciousness)?*

In a slightly more concise form:

> *Are human projects products of only and only human thinking?*

To answer it, let us draw attention to the fact that thinking is connected, first of all, with the world of "possible objects", and the latter are most directly connected with ontology. Therefore, both "technology" and "design", as long as they discuss the *construction of possible technical objects*, are also related to ontology.

The world of the sensually observable "technical sphere" of human life, turns out to be not the only "world of technology" from this point of view. Meanwhile, many researchers are inclined to see only the positivistic - "materialized" – sphere of technology, which is empirically given. "Opportunity of technology", on the contrary, allows us to talk about "technology" even before "it" – at the stage of a technical project – gets a "materialized" expression, gaining empirical observable forms of a particular technical product – an artifact. In other words, technology (technical artifact) exists in two ways:

1) at the stage of the project (design) as a *possible object*; (fixed in expression (I));

2) at the stage of implementation of a possible object into an *empirically given object* (if we are talking about physical objects). (It is fixed in the expression (II)).

If a technical artifact is impossible in principle, then there are not any reasonable grounds for its implementation in actual reality. This follows directly from expression (IV).

Having understood *the first* – the most general – *restriction* in the field of engineering and design, let us now consider the prerequisites that still give rise to hopes of "unlimited possibilities" of human design.

Anthropocentrism – the Premise of the Main Temptation of Design

From my point of view, as the most representative figure expressing the position of "anthropocentrism" in the philosophy of technology, Günter Ropohl and his explanation of the nature of technology can be considered: "I would like to make it clear to the reader," writes Ropohl, "that for my part I consider invention as a primary, counter-natural product of human consciousness" (Ropohl, 1989, 216). Such an invention is achieved, according to Ropohl, due to "planning, intellectually controlled and future-oriented activities, as well as due to the human ability, in the imagination, to move in space and time, to combine any feature of the available" (Ropohl, 1989, 216).

Polemizing with the representative of the ontological approach (to be discussed below), Dessauer, Ropohl asks a question that he thinks is crucial on the topic under discussion:

"I hardly resist the temptation to refute Dessauer's train of thought with examples from technical practice: perhaps here I would directly fall into a satirical manner of controversy if I would consider, for example, the question of whether front-wheel and rear-wheel drives pre-exist in the Platonic realm of ideas" (Ropohl, 1989, 211.)

According to Ropohl, it is human consciousness that is the source of technical inventions: "Technology is nothing more than overcoming nature through human consciousness" (Ropohl, 1989, 217). Ropohl's position is frank and that is good.

So, asserting that the new is a product of human consciousness, Ropohl, gives an answer to the question: "*where* does the technically new come from?" Claiming that the new arises from the "planning, managing, directing and combining activities of the human mind," Ropohl also answers one very important question: "*How* does the technically new come about?" Ropohl's broad answer to this question can be presented in a laconic form: *technically new is a combination of the available!*

From my point of view, the basis of Ropohl's and his associates' position – unbeknownst to them – is built on the premise according to which there are two realities: the first reality is "nature"; the second reality is "human". If there are no technical devices in nature, then they should be in a person, in his mind. It seems to me that this position is erroneous. And here's why. The basis of this argument is the wrong syllogism:

A) All that does not exist in nature is a human invention

B) "A car drive" is not what exists in nature

C) "A car drive" – is a human invention

Obviously, the conclusion is not true from logic's point of view, due to the violation of the rule of the first figure – "the smaller premise should be an affirmative judgment." Indeed, from the fact that the "car drive" does not exist in nature it does not follow with logical necessity that it is precisely a human invention.

It is this view of the nature of human abilities that gives rise to the main temptation of technology and design: *the conviction of its unrestricted power – the human mind is autonomous and free, so "everything can be designed!"*.

Let us show the unimplementability of these claims, due to the objectively existing limitations of technology and design, not in the possible, but in the real (empirically given) world.

The Main Intrigue in Explaining the Nature of Technology and Design

A discussion of the world of "possible objects" may also take a different and very unexpected, ontological perspective. So, for example, should one understand "possibility" as a kind of "special world of the possible" that exists outside of a person who is aware of this "possibility", or is the sphere of the "possible" limited only by human thinking and consciousness? The two most likely answers to this question have given rise to two most authoritative areas in the philosophy of technology, to which, to one degree or another, most researchers gravitate.

Among the supporters of understanding the "possibility of technology" as a *special world* (be it the world of "ideas", "possible world" as a world of consistent, but still unrealized technical projects, "being" or something like that) are Pavel Florensky, Martin Heidegger, Friedrich Dessauer and some others.

Another answer, according to which the "possibility of technology" is limited by the bounds of human thinking and consciousness, is, on the contrary, the most influential. As a representative of this trend, I have already cited the point of view of Gunther Ropohl. According to this school of thought, the *"source" and, therefore, the "possibility" of technology is human consciousness and only human consciousness*. Any other ways of reconstructing the occurrence of technical artifacts are considered by them as "metaphysical" and devoid of any basis.

In fairness, it should be noted that other approaches than two mentioned above are not completely absent. Not at all, they exist. Moreover, some of them aim to go beyond the narrow framework of described dichotomy and propose different basis for typology. For example, Carl Mitcham in his work "What is the philosophy of technology?" (1995) proposed to classify approaches in the study of the phenomenon of "technology" on the basis of "engineering – humanitarian". The choice of strategy proposed by Mitcham is quite explainable: first, the word is given to professionals, and then – everyone who wants to state "their opinion on the philosophy of technology" are welcome to do so. Indeed, who, if not professionals, knows the subject of discussion – "technology per se"?! However, despite this approach being natural from the point of view of common sense and professional pragmatism, it is also not free from shortcomings and provokes perplexity.

Heidegger in one of his works on the philosophy of technology (Heidegger, 1962, 5) shrewdly observes that the “essence of technology” in itself is not something “technical”. In fact, if this is true, then specialists can speak out professionally about the “technology” itself, but the “essence of technology” will remain outside the scope of their professional knowledge and skills. In this case and hereinafter, by the “essence” of any object we mean simply the *totality of inalienable attributes, without which the given object cannot be thought of in a complete way*. “Essences”, in our understanding, are not metaphysical or religious “substances”, but “inalienable attributes” of the objects in question.

The ontological approach, according to materialistically and positivist-inclined philosophers of technology, can provoke only bewilderment and healthy sarcasm. However, Mitcham’s approach, brought to its logical conclusion, can itself lead to obvious absurdities. So, for example, one can pose a fully justified question: who is competent in deciding on the need for cloning of human being by means of bioengineering (and discussing this topic in general)? The answer prompted by the position stated above (Mitcham and his supporters) is unequivocal: first of all, bioengineers (after all, they know there is “bioengineering”), and then everyone else inclined so! But does a bioengineer know “what human is”? The reason for the emerging concerns, it seems, is that the essences of the things of the world contain some “additive” not reducible to their “spatio-temporal” explication as objects of our scientific and technical representation in the present period of time. This “additive” does not have to have a religious or metaphysical nature. It can be purely natural – physical, chemical, biological, etc. – but always remain in the realm of not fully known in the present period of time[2]. Having understood this, let us now try to briefly consider the main provisions of the ontological approach in explaining the nature of technology and design.

Ontological Turn in Understanding Technology and Design

One of the first attempts to understand the place of technology in the life of a new European person belongs to J-J. Rousseau (1961). Technical person was also criticized by F. Nietzsche, O. Spengler (1931) etc. However, in addition to general “reflections on technology” in the last quarter of the 19th century and the first quarter of the 20th there is a real boom of analytical research on this issue. A significant proportion of this boom comes from Germany. The most significant works of this period belong to Ernst Kapp (1877), Theodor Bäuerle (1917), Friedrich Dessauer (1928; 1959), Manfred

2 For example, today in physics there is no unambiguous explanation (somewhat harsher – there are no clear explanations at all) of the nature of “dark energy” and “dark matter”.

Schröter (1934) and some others. Researchers are beginning to reflect on the fact that technology cannot be simply reduced to just “material-technical products” – the products of human activity.

But the question – where does a person get knowledge about technical objects, which, in fact, do not exist in empirically given reality? – becomes the main nerve of interest.

Philosophers and engineers began to understand that in order to clarify the nature of technology, it is necessary to establish the ontological basis of its nature. Thus, the philosophers faced the task of answering the question, “how is technology possible”? If they found the answer to this question, then they would penetrate the essence of technology. Historically, the first attempt at such penetration was made by Pavel Florensky in 1917–24, with the analysis of which we will begin our study.

Ontological origins of technology by P. Florensky

In one of his works, Florensky literally says the following: “The whole culture can be interpreted as an activity of the organization of space. In one case, this is the space of our life relations, and then the corresponding activity is called *technology* (italics mine - A.P.). In other cases, this space is a conceivable space, a mental model of reality, and the reality of its organization is called science and philosophy. Finally, the third category of cases lies between the first two. Its space or spaces are visual, like the spaces of technology, and do not allow life interference – like the space of science and philosophy. The organization of such spaces is called art” (Florensky, 2000, 112).

The technology “changes reality to rebuild space”. But how can technology rebuild space? We are well accustomed to believing that “technology” can rebuild “house”, “bridge”, “road”, but “space”? It looks incomprehensible and almost mysterious. We also confidently know from school that all the things of the world are “placed” in space: houses, people, air, the ocean. From the largest, Cosmos, to the smallest, particles: everything is “in space”! This self-evident belief, in fact, rests on one single non-obvious cornerstone – the Newtonian understanding of the nature of space: “space is a container” (Newton, 1954, 280–281). Pavel Florensky offers a completely different understanding of space, according to which it is not a container, like a Universe-sized barn in which God places utensils of the Universe. In the understanding of Florensky space is a *force field of activity*. He says that technology – just like science, philosophy and art – forms a “force field” (Florensky, 2000), which distorts space. So how and in what sense can technology – any artifact of it – distort space?

To answer this question satisfactorily, a radical rejection of the self-evidence of Newtonian ideas of space is necessary. In order to switch to another understanding and perception of space, it is necessary to consider an example – some "action in space". Florensky proposes to consider the "gesture", an ordinary gesture made, for example, by the human hand. He says: "A gesture forms a space, causing tension in it and thereby distorting it" (Florensky, 2000, 113). That is, the "gesture" as such is the source and cause of the distortion of space. But another approach is also possible, says Florensky: "When the tension in the space *is marked* by the tensions from the gesture in this place (italics mine - A.P.). It was already here, preceding the gesture with its force field. But this distortion of space, invisible and unavailable to sensory experience, became visible to us when it showed itself via force field, assuming in its turn a gesture" (Florensky, 2000, 113). In this case, the "gesture" is no longer the "source" of the distortion of space, but its "consequence". It is this latter approach that is more "appropriate," according to Florensky, to explain the essence of technology. We can say that the "technology", as well as the "gesture" only causes, develops, I would say–- *reveals the distortion of space*. Indeed, the "technical" curvature of space, "was already here, preceding the gesture with its force field" (Florensky, 2000, 113).

Using the concept of "ontological Propis" introduced above, I will say: being is already total and complete, according to Florensky, contains all the Propises of all "gestures". Human only follows these ontological Propises with more or less precision. Such, in general terms, is the view of Florensky on the ontological basis of technology.

Another, no less interesting, supporter of the ontological explanation of the nature of technology is Martin Heidegger. Consider his approach.

Ontological origins of technology by M. Heidegger

Technology as Machenschaft. Heidegger begins his analysis of the ontological basis of technology in one of his early works, *Beiträge zur Philosophie (Vom Ereignis)* (1925/1989), by analyzing the concept of Machenschaft. The meaning of Machenschaft should not be associated, according to Heidegger, with its common understanding as "trick", "bad" art or with the concept described by the word "fraud". That would be oversimplification. According to Heidegger, in relation to the question of being, Machenschaft should be understood as "the way of being" (*eine Art der Wesung des Seins*) (Heidegger, 1989, 126). Machenschaft is not just the work of human hands, it is rather how it is done. Machenschaft, Heidegger says, lets us name something that "something creates from itself" (Sich etwas von selbst macht) and is thus suitable for emerging needs. This Sich-von-selbst-macht came from τέχνη and its semantic field, which, in turn, came from a certain interpretation of φύσις. Today, Sich-von-selbst-macht is itself coming to power domination (Heidegger, 1989, 126). According to Heidegger, Machenschaft was already present in antiquity. But there, while remaining hidden, it never revealed in its entirety its essence, for antiquity was under the influence of ἐντελέχεια. For the first time, Machenschaft, as they say, “comes out of the shadows” in the Middle Ages. The medieval concept of actus obscures the original Greek understanding of the dis-closure of being. Now Machenschaft, according to Heidegger, is more clearly revealed due to the role of the Jewish-Christian understanding of creation and the corresponding idea of God, which contributed to the transformation of understanding of God as “being” (ens) to his understanding as “being creator” (ens creatum) (Heidegger, 1989, 126). And also due to the fact that God, and then the world, were reduced to a causal understanding (Hösle, 1991, 146), according to which God began to be interpreted as “the cause of oneself” – causa sui (Heidegger, 1989, 127). So, Machenschaft, from an ontological point of view, is Sich-von-selbst-macht. The latter concept could be interpreted as “building oneself out of oneself” or, leaving German aside, with the appropriate Russian word, “samosozidanie” (self-creation). Consequently, the Heidegger’s Machenschaft is “the self-creation of human”. Until the era of the New Time it had never come to domination – *self-conscious self-creation*. Having come to such a state, Machenschaft takes a special form – the subordination of everything to this domination – the form of Gestell. Therefore, Gestell is just a specific manifestation of the Machenschaft!

Technology as Gestell. If Heidegger was interested in the source of technical, technology as a way of being-in-the-world (Dasein) as early as 1925 – and now this can hardly be argued – nevertheless the essence of modern technology, its “global nature”, Heidegger, in fact, analyzes in detail only in his work *Die Technik und die Kehre* (Heidegger, 1962), which is based on the report “Gestell”, read in 1949, as well as in a number of other post-war works. Heidegger begins his explanation of the essence of modern technology with the question of how does technology relate to its own essence. Indeed, for example, the essence of a tree is not something “wooden”, Heidegger notes, therefore, “... neither the essence of technology is something technical”. (Heidegger, 1962, 5) At the same time, technology is not something neutral, as many believe, linking its understanding either with technical means or with human activity using these means. This is an instrumental and anthropological definition of technology (Heidegger, 1962, 6). Of course, both of these aspects are present in technology, and such a definition of technology would be correct. However, “correctness”, according to Heidegger, should be considered justified only when it leads to the essence and method of its discovery – the truth (Heidegger, 1961, 7). But instrumental definition does not lead us to it. Why? Because, Heidegger answers, we are in the grip of instrumental definition. To free ourselves from its power, we should understand what is “instrumental” in and of itself. After all, any instrument, in essence, is something adapted to achieve a specific goal, for the sake of which something is processed. Here, it is found that an action performed for some purpose is called the cause (Heidegger 1962, 7). This is the "active reason", previously called the *causa efficiens*. It is this type of causality, according to Heidegger, that underlies the instrumental explanation of technology. Turning to the Aristotelian classification of causes, Heidegger says that neither an active reason, nor three others, have ever been understood by Aristotle himself or his contemporaries in the sense that consciousness of the New Time endowed causality with. For Greek consciousness, the reason is not "what is being done with something." The Greeks understood "reason" as – ἀιτίον. But ἀιτία cannot be translated as "causa" or German "Ursache". It should be translated as "ver-an-lassen", which would be close to the Russian "order". And any such *order* is "Her-vor-bringen", that is, "pro-knowledge" or in Greek ποίησις (creativity). But this is how φύσις opens. "Φύσις," says Heidegger, "is also ποίησις in the highest sense" (Heidegger, 1962, 11). Pro-knowledge leads something from concealment to non-concealment. Therefore, "pro-knowledge" is at the same time Ent-bergen – "disclosure", that is, just what the Greeks called ἀλήθεια, and we call it "truth". Therefore, Heidegger concludes, technology is not just an instrument, technology *is a way of disclosing* (Heidegger, 1962, 12). Antique τέχνη, therefore, was associated with the cognition and method of revealing the truth, and not "making something for the sake of some purpose".

However, the ancient understanding of technology is significantly different from its modern "machine" understanding – Kraftmaschinentechnik. Its difference is that the latter type of technology is based on natural sciences. Although the process of alienation of man from nature was lengthy, nonetheless, from Heidegger's point of view, a decisive event was the emergence of the philosophy of Descartes. Descartes identifies the "extension" as the geometric image of space and the "real space", that is, reduces the latter to the former. This gives him the opportunity to consider the whole "nature", "placed in space", simply as an "extended thing" – res extensa. "Behind such a characteristic of natural objectivity," says Heidegger, "is the position expressed in the *cogito sum* formula: being is representation". (Heidegger, 1988, 285) It was this reduction of nature to the "extended thing", which can be mathematically calculated and presented, that was the premise and basis that "made new European machine technology metaphysically possible and with it the new world and its humanity" (Heidegger, 1988, 285).

It should, of course, be noted that even Heidegger paid attention to the connection between the essence of technology and natural science. For example, Ortega y Gasset spoke about this connection in his lectures in 1933 (Ortega y Gasset, 1957, 93). However, no one like Heidegger considered it from ontological point of view. What type of non-covertness do we now see? What kind of technology is this from the point of view of its essence?

Everything in the surrounding world is brought into the state of availability by this technology (Bestand) as something intended for delivery for the sake of something. The main feature of modern technology is that this "available state" is not something external to a person as an object opposing him (Gegenstand). Bestand is a way of becoming material of both technology and the person himself, therefore, Bestand as such is invisible. Heidegger asks: who carries out this delivered-ness, making it non-covert? Obviously, a human! (Heidegger, 1962, 17). However, Heidegger observes that as Plato did not create "ideas" in the form of which the essence of being was revealed to a man in antiquity, and likewise[3], modern man does not create "technology" in which something non-covert is revealed. Modern technology is least of all "the work of human hands" (Heidegger, 1962, 18). Each challenge facing a person prepares him for delivered-ness. This preparation sets up a person to bring all reality into available state. It is precisely this verdict (Ausspruch) of being, which instructs a person to focus on self-revealing in bringing everything to the available state that Heidegger uses the term Gestell for (Heidegger, 1962, 19). Everything is delivered that falls into the circle of dissolved space of being: nature, bowels of the earth, space, and finally, human himself. Gestell is not, therefore, neither human activity, nor a simple tool serving such activity. And in these conditions of Gestell's domination, human imagines himself to be the "protagonist" and "creator" of technical civilization. This is where the danger awaits. Indeed, at the "moment" of awareness of one's dominance over the world, a person, in reality, turns out not to see himself in himself, for he himself is in the power of Gestell.

Having considered the ontological approach by explaining the nature of technology by M. Heidegger, let us now turn to the consideration of another, no less interesting, ontological approach proposed by Frederick Dessauer.

Ontological origins of technology by F. Dessauer

In his first work on the philosophy of technology "Technical Culture" Dessauer introduces the concept of "The law of the development of technology" (Entwicklungsgesetz der Technik). The meaning of this concept is reduced by Dessauer to the fact: "that the progress of mankind is generated by the progress of technology, acquiring, thanks to the latter, the quality of striving forward... proportionality – is the greatest, most powerful, fundamental law that characterizes the development of human spiritual culture as a whole[4]". In this work, by the term technology Dessauer means

3 Ortega and Gasset draws attention here to the connection of "technology" and "theory" in the 16th century. (Ortega y Gasset, 1957).

4 Since, unfortunately, I don't have Dessauer's original work "Technishe Kultur" at my disposal, I'm giving a definition of the "law of the development of technology"

not "machine technology", but all human activity that is performed and is being carried out, which is aimed at the outside world. In this case, technology becomes a kind of art. But what then characterizes the law mentioned above? According to Dessauer, technology is the way in which a particular nation asserts its power and rule over the world. Here the question should be asked emphatically: is there a goal for the development of mankind subordinate to this law? But, before one gets the answer to the question about Dessauer's understanding of technology, one should start by answering the "first" question: where does the source of technology come from and what is its essence.

The Socratic Source of Technical (Socrates and Technology). According to Dessauer, technology – as something "technical" – is first discovered in Socrates' speeches. Why, then, was Socrates chosen as the founder of the "technical" by Dessauer? The reasons are as follows. Socrates, by his origin – his mother was a midwife, his father was a stonecutter – and in the manner of his thoughts, was a "born technician." *Almost all of the examples that Socrates uses to express his own views are borrowed from craft activities, or, simply, from technology.* Here is how Dessauer describes the "genesis" of Socratic technology: "Socrates introduces two serious topics into the discussion: the topic of truth (knowledge) and the topic of good (value). These two functional questions of philosophy form the center of attention of philosophers at all times, as, for example, in the era of I. Kant, two millennia later, in the form of the *famous four questions* (in his "logic") (my italics - AP)" (Dessauer, 1959, 60). So, Dessauer shows that Socrates does not just talk about the "truth" and "good", but tries to bind them into something united. How does Socrates manage to unite truth (knowledge) and Good (values)? According to Dessauer, Socratic philosophy created a "model of technology" in which he combined "virtue with knowledge". In fact, as a technician, Socrates knew very well that any technological product is preceded by "knowledge of a thing" (Dessauer, 1959, 63).

This first condition is necessary, because without its feasibility "the emergence of technology from pre-scientific – primitive knowledge of nature is impossible" (Dessauer, 1959, 63).

The second thing Socrates was sure of was that all technical objects (products) *are determined by human goals.*

From this, in turn*, the third* follows: before the inception of the image of the product, its eidos, its design should be seen in the soul of a person. *In other words, a certain "idea" of this product must pre-exist for all this.*

based on the work by Dessauer's researcher Klaus Tüchel (1964, 12), in which it is given without abbreviations.

The fourth step involves the very process of implementing the "technical product", due to the combination of concept and action, "guided by the goal". Here, the "work" (das Ergon) becomes the "product" (Organon). The work corresponds to the "goal" (das Ziel), and the instrument corresponds to the "purpose" (der Zweck).

Fifth step. Thanks to the already existing conditions, *the concept* (Phronesis) is carried out not arbitrarily, not by chance, *but in accordance with the already conceived.* And this means, in the language of my work, that the design (technical construction) precedes the manufacturing.

And finally, at *the sixth step*, the purpose (der Zweck) is fulfilled, which in the eyes of the technician acted as a goal, which, in turn, simultaneously is the good for this purpose, which has value, due to which Socrates's teachings entered the world of values and good. *In fact, that is good that achieves the goal!*

Indeed, the above *six steps* of understanding of technical remain valid to this day in explaining the nature of technology. Of course, Socrates could not have imagined the whole variety of forms of manifestation of technology that are revealed to the man of our time. However, his strategy – to connect the idea (as well as the design) with its implementation, the "goal" of the product with its "purpose" was, in Dessauer's opinion, extremely productive.

Among the existing and most common interpretations of technology, Dessauer identifies Ernst Kapp's (1877) concept of "organoprojection" as an example of the wrong move in explaining its nature. According to Kapp, a person "copies in the 'technology' things he saw 'in nature', in biological organisms". According to this approach, the "technical" already exists in the material nature and man only copies it. According to Dessauer, this is the influence of biologism.

So, to consider technology as a technologically oriented design, which asserts itself in a product, means to explain, in Dessauer's opinion, its essence. Here we come to the distinction between understanding "the goal" (das Ziel) and "the purpose" (der Zweck), which is of great importance in explaining the nature of technology in Dessauer's conception.

The difference between der Zweck and das Ziel. Even the most superficial approach to the history of mankind indicates that man has always been a creator, inventor, designer (die Gestalter) and in this sense has always been a "technician". In fact, a person, first of all, studies his subject. In this, he acts as a Homo Investigator. By exploring, a person offers new solutions to problems. "A man," says Dessauer, "is also Homo inventor, the constructing creature." But Homo faber is also a making or producing man. He transfers his forms from the inner world to the outer. *The soul projects* *its formed representations and images onto nature*. These mental forms of representations have a threefold character:1) they are extracted from nature; 2) they are brought from non-availability to availability; 3) they are connected in patterns.

Indeed, any technical thing – for example, a "medical pill", indicates its demand by society. What is requested by society has its purpose. So, what is the difference between "purpose" (der Zweck) and "goal" (das Ziel)? Understanding the differences between them will bring us even closer to understanding the essence of technology. The very first difference, that literally springs to mind, is that a person is able to consciously set goals and strive for a goal. But the device (das Gerät) cannot! *The device is capable, being unconscious, of only fulfilling its purpose*. Dessauer gives a very revealing argument in favor of this. For example, a microscope fulfills its purpose when it makes very small objects visible in good resolution. However, before the microscope and its purpose were realized, the goal of the inventor, designer and manufacturer of the microscope should already exist. "The goal precedes the purpose!" – this is the main thesis of Dessauer in his discussion of the question of the temporal sequence of the relationship "purpose and goal". So, Dessauer captures a significant result for him - there is a temporary asymmetry between the "goal" and the "purpose": first the "goal" arises, which leads to the birth of what has the "purpose". Here, in this temporary gap, the most inexplicable point in the appearance of technology arises: how are ideas implemented in things? According to Dessauer, psychology (constructive imagination) alone, as suggested by G. Ropohl (1989, 216) later, is not enough and neither is anthropology alone. Here, according to Dessauer, a metaphysical basis is necessary.

And here we come to the most innermost in Dessauer's philosophy of technology – to the question of the "origin of technology". What no researcher can disagree with is the fact that prior to the act of invention technical objects *were non-existent*. They simply did not exist in the available world. For example, in the world there was no "microscope" before its invention. There was no "rear and front-weel drive", which G. Ropohl (1989, 211) speaks of. What follows from this? Does the emergence of these devices (contraptions) - their invention – mean there was some "successful" play of the human imagination? If we answer this question affirmative, then we will find ourselves in the realm of consciousness, which is the realm of the psyche. Therefore, the source of technology, ultimately, is psychology!? Is it so? Dessauer takes, from my point of view, an original step that overcomes the "psychological reduction" of the nature of technology. He finds in a technical product feature that does not depend on the psyche, or anything human in general. Dessauer (1959, 63) discovers that: "... the quality of an object existing as a microscope was already in space, otherwise it could not have been invented". What does "the quality of an existing object already existed in space" mean? This means that the *being of the world* in which the microscope arose *was already originally arranged in such* *a way* that it contained - even before any act of invention - "the ability to increase (decrease) the optical size of the objects contained in it" (Dessauer, 1959, 63).

If we use the concept of Propis proposed above (Pavlenko 2003; 2003b), then we are obviously forced to admit that Dessauer has come close to a similar understanding of the structure of being: "microscope", as the quality of the being of the world described above, was already contained in being, was literally pre-scribed in it.

However, the following point turns out to be extremely important here: what in existence itself allows the existence of a certain kind of qualities and what prohibits them? Neither Florensky nor Heidegger find such a formulation of the question. So, what allows technology in the present world?

"Consistency" alone, which was stated in expressions (IV) and (V) in the first section of this article, is no longer enough, because we are dealing not only with the world of possible (theoretical), but also with real (physical) objects. And for the feasibility of real (physical) objects, physical limitations are actually required, which Dessauer will talk about in other context.

In the context of the topic under discussion – the connection between technology and design – this means that any design projects *are predetermined,* as Florensky and Heidegger believed. The predetermination of the possible and real worlds of technology can be considered as a "strong thesis": *any technical artifact is predetermined in the world of the possible, and, therefore, in the real world.*

Dessauer makes it possible to soften the "strong thesis", giving this imperative the form of a "weak thesis": *technical design and technical artifacts are limited.*

The Second Limitation of Technology and Design

Law-conformity of technology

As early as his first work "Philosophy of Technology" Dessauer brings up the "justification of technology" by emphasizing its "nature-conformity": "technology has never been in conflict with the laws of nature, on the contrary, it always conformed to them... the human spirit always resonated with the laws of nature and yet it is not technology itself" (Dessauer, 1928, 4). So, we see that technology complies with the laws of nature both as a product, since it does not contain contradictions, and also as an idea, since human thinking "contains" the same laws as nature itself.

Indeed, by doing this Dessauer addresses one of the most serious issues related to the foundations of technology, which has not lost its depth to the present: *Why is technology complementary to the laws of nature?* The same question can be expressed in other words: *Why does such a technology turn out to be consistent with precisely such laws of nature?*

To answer this question, Dessauer clearly formulates his ontological position:

> *… all technical objects that were invented "did not exist" before, they were not available before that. There was no microscope prior to its invention. But the quality of an object existing in this precise way as a microscope, was already in space – otherwise it could not have been invented. (Dessauer, 1959, 71)*

This thesis of Dessauer's is easily read by the consciousness brought up in anthropic argumentation. In both the first and second cases, we find a correlation. In the second case (in the case with the anthropic principle), the correlation of the properties and qualities of the observer with the properties and qualities of the physical Universe, and in the first case (in the case of technology's law-conformity) of the properties and qualities of technical objects with the laws and characteristics of nature: "There are no technical objects (creatures) contradicting natural laws or external to them" (Dessauer, 1959, 71).

At first glance, both the anthropic correlation in cosmology (physics) and the correlation of technical objects to the laws of nature look like a banal tautology. Indeed, what other devices (technical products) are possible apart from those consistent with nature? However, following the logic of the latest multi-world theory in cosmology (Linde, 1990), we could argue as follows: in our world, where we are observers and creators of technology, it cannot be different, but in those worlds without us and where laws are different – perhaps there are other observers with other technical products. Dessauer, in his author's version, gives a philosophical explanation of this conformity of technology to the laws of nature: "This causal nature-conforming process is directed towards the realization of the goal, it is determined by completion or teleologically." (Dessauer, 1959, 71–72).

At the same time, Dessauer admits that in the inorganic sciences (physics, chemistry) the final outcome is not obvious. On the contrary, in the organic sciences a final outcome (Zug) is found, which is aimed at the integrity of living organisms. Technical products have the same integrity. The first or main characteristic of a technical object is its "strict integrity" (in der strengen Bindung) since it serves its purpose (Zweck), in accordance with the laws of nature (Dessauer, 1959, 71). We see that both living objects and technical objects – unlike inorganic nature – have one common universal feature – their existence is subordinate to the goal. It is no coincidence that Dessauer finds support from Kant, who allowed for the "Technica-naturalis" of living beings, thanks to the goal-setting. Speaking about the law-conformity of technology, Dessauer notes another significant feature of this correlation: a technical invention is more than just "applied natural science". Every invention gives, in relation to a simple sum of knowledge – even known laws of nature – *an excess increment*. So, for example, a watch is "something more than a flat combination, than just a sum of hands, pendulums, wheels, springs". The fact is that watches, possessing the integrity of watches, fulfill their purpose (Zweck) – *to show time*, which serves some goal (Ziel). But! Each watch detail cannot do this individually. Here we are dealing with a non-additive sum of parts. "The measurement of time," says Dessauer, "is the excess Mehr-als-Summe of the parts". A holistic structure, a finally ordered unity is first embodied in a watch". (Dessauer, 1959, 86.)

Law-abidance of technology

The connection of technology with the laws of nature is manifested not only by the fact that technology, "by definition", is consistent with the laws of nature, "observes" them and is determined by them in its forms. The simplest example is the whole technical field of "material resistance". However, not only because of this technology is associated with the laws of nature. Technology, at its source – *at the stage of the birth of a technical product* (device, tool, contraption) – is subject to the laws of nature. And here's exactly how. Let's take, for example, the invention of the wheel, which does not exist in nature as just the "wheel" created by human. According to Dessauer, the very way the wheel acts is strictly determined by the laws of nature, which means that "the laws of nature are always given in their availability" (Dessauer, 1959, 78). This means that any technical inventions of a person cannot be "arbitrary", that "exuberance of human imagination" is by no means infinite, but is necessarily subject to these laws! *All these findings are directly related to design.*

Law-possibility of technology

From the fixed nature of the subordination of technology to the laws of nature, essentially one more important consequence follows: in nature that is not filled with technical inventions of a human, *the possibility of strictly law-conforming technical inventions initially exists*:

"This unambiguity of the clearly rounded shape of the wheel is the solution to its realized essence, as allowing (Lösung) to exist as 'this precise being' (Sosein) or as the former philosophers said, its Quidditas, its 'substance', was also given, it 'expected', so to speak, its inventor" (Dessauer, 1959, 79).

From the words of Dessauer it can be seen that the "substance" of the wheel, consistent with the laws of nature, was contained in being itself as an "opportunity". The "Sosein" of the wheel, its "definite form", was predetermined. Not being valid, this "substance" was already here, however, without existence in the available (empirical) world.

Ontological status of technology

Dessauer then asks the question: can we say that since something does not manifest itself, then it does not exist? If we recognize the "existence" of the unmanifested, then where does it exist? According to Dessauer, in this case *the "technical" does not exist in the realm of the real, but in the realm of the possible!* But this is half a step. The possibility differs from the reality exactly by this – it is not real[5]. How does Dessauer address this problem? He says that in this area it (the invention – Lösungsform) was "not some indefinite, arbitrarily given, but fixed in its existential certainty and qualitative givenness" (Dessauer, 1959, 79). That is why it is possible to discover an invention (inventive idea). Essentially, Dessauer recognizes the existence of pre-given forms that do not contradict laws and are abiding them. He calls this type of "pre-given forms" "predetermined objects" (prästabilierte Objecte). Moreover, after the discovery of the "predetermined object", *each technician creates his own approach* to the "ideal form" (Lösungsform), which is revealed to him in the process of invention. The concept of "predetermined invention" was considered for the first time by Dessauer in his work "Philosophy of Technology" in 1927, and before Dessauer, A. Du Bois-Reymond discussed the existence of this form, as mentioned by Dessauer himself, in *Erfindung und Erfinder* (1910). However, even with such an argument, the question remains open: is "invention" – "discovery"? For de Bois-Reymond, yes. Dessauer is less categorical in answer to this question. For example, the discovery of America, cosmic rays and the like is the discovery of what already existed in the given world – reality until the very moment of discovery. The invention is more complicated. According to Dessauer, de Bois-Reymond is wrong. And here's why. Yes, invention is also a discovery, but, says Dessauer, "not in the space of the real, but in the space of the possible" (Dessauer 1959, p. 82). In order to untangle this problem of the "real – possible", Dessauer introduces the idea of several worlds.

First of all, *Dessauer indicates the world which determines the ways and forms of decisions*. This world establishes and limits the technology, which, hence, is defined according to the principle: "unthinkable, therefore, impossible." That is why the "perpetum mobile" is ontologically impossible. Dessauer also calls it the "vast supramundane realm" – this is a world of

5 Plato, after all, had a realm of true existence. Dessauer does not recognize the existence of this realm.

hidden, not yet realized images, which acquire real existence only via human activity. It is a world that can become born.

We see that Dessauer admits something completely unthinkable for the philosopher of the 20th century – the existence of an implicit area, which at the same time *coexists* with the explicit one, which is given to us in sensations and thinking. In this case, it turns out that the *inventing human in almost a photographic sense develops "images" of the implicit world in the explicit* (Dessauer, 1959, 84). In fact, Dessauer here describes what I refer to as the "ontological Propis". But in order to bring forms and images from the "nonexistence of the available world" into the "existence of the available world", "human innate formative abilities, which are the basis of what is happening technically in history", are necessary. This is a world of human abilities and actions. In fact, according to Dessauer: "...the hidden state of the 'fourth world' of pre-existing and realized forms is a possible basis of technology" (Dessauer, 1959, 84–85.)

But here again an unpleasant question may arise: why does what a human needs – in the sense of technical necessity – have to have an appropriate form in this "special supramundane realm" of forms and images? Indeed, "perpetual mobile" or physicochemical devices with an efficiency of 90–95% or more – for space exploration or for energy supply of its needs – would come in extremely handy today. Dessauer gives a negative answer to this question: technology is possible only as a "compositional symmetry" of these two worlds. "It is possible, perhaps, only as a structural similarity. The dictionary of the language of human needs and desires should ideally correspond to the dictionary of feasible forms, with possibly underlying this – one-to-one correspondence of words" (Dessauer, 1959, 85). The conclusion is astounding: *a technical person perfectly matches the natural world in which he lives!* But, in this case, we see that the anthropic cosmological principle (ACP) is also involved in technology. This is essentially the philosophical discovery of Dessauer.

Third Limitation of Technology and Design

When a human imagines, invents, comes up with something, he almost never reflects on the fact that it is "he" who imagines, invents, comes up with. "Thinking", "imagination" and "invention" are perceived by man as a *natural process*. Aristotle would say, as that which is "inherent to human". In this case, we will agree to mean "human" as generic creature, and not specific individual.

And here we come close to the question of the relationship of "human proportion" of human technical inventions and design. Design by its very nature – *the ability to construct something suitable (human-sized) for a human* – is focused on such results, which, ultimately, should be *used by* *human (convenient for human).* Although for objectivity it should be noted that design can also be understood in two ways.

In a *broad sense* – like any (including genetically programmed) *construction* aimed at meeting the needs *of any living creature* (we can talk about the "design" of the anthill, the "design" of a bee hive, the "design" of a bird's nest, etc.).

In the *narrow sense* – as a human design, as a *conscious design and engineering* aimed at meeting the needs of a human as a *generic creature*. Since design, like any human projection, is closely related to his consciousness (thinking)[6], new problems arise in explaining the nature of design (in general, human projective ability).

Challenges in Explaining Engineering and Design

If, hypothetically, we accept the point of view of Ropohl and his associates that "the creation of technological projects and design are products of human and only human thinking and consciousness", we will be forced to state, even within this approach, several insurmountable difficulties that also appear in the form of restrictions imposed on the design of technology, but not from the "outside" – from the ontology side – but from the "inside" of the anthropocentric approach itself. We express these limitations in the form of the following problems:

The first problem. *Human information (information given to a human as a generic creature) may turn out to be "finite information"*. What do I mean by this? The following:

"Finite Information" $_{Df.}$ – is a set of *data* that is *detected and recorded by human and only by human*, based on the analysis of the observed Universe.

It follows that there may be information that goes beyond the "finite information" – it is contained in the Universe itself, but is inaccessible for human (for example, at the moment, in a given time period). It turns out that human engineering design is limited by the presence of "finite information".

The second problem. Human consciousness may turn out to be *"finite consciousness"*. (FC). Let's define FC:

"Finite Consciousness" $_{Df.}$ - *this is the totality of knowledge that is generated by human and only by human, based on the analysis of only and*

6 On the design of thinking itself, see Kees (2011).

only data that has already arrived in consciousness from the surrounding Universe.

It follows that there may be knowledge that goes beyond the "finite consciousness" – it is "contained" in the Universe itself (generated by data contained in the Universe), but inaccessible to human, has not been revealed to human (for example, at the moment or at this period of time). It turns out that human design is limited by the very fact of the existence of a "finite consciousness".

Conclusions

In this article I demonstrated that the activities of a technical designer *are not arbitrary* but, at least depend on the three limitations described above.

It was found that human *consciousness (thinking) can design those and only those objects that are human-proportioned*. However, "human proportion" is such a given that it itself cannot 1) be either arbitrarily chosen by a person, nor 2) be arbitrarily constructed. Figuratively speaking: human can be a "designer of objects" in the world he designs, but he cannot be a *"designer of design itself"* (the very ability to design and construct). And this means that the technology constructed by human and the very ability of such construction (design) are *given to human*. They are *prescribed* both in the most general form (consistency) and in special cases (law-conformity, limits of human consciousness and available information, etc.) in our Universe. Therefore, the original scheme of evolution of the design subject proposed in Ceschin and Gaziulusoy (2016, 143) naturally needs to be continued – the establishment of "sustainability" not only in relation to human and the technosphere, but also in relation to human and the Cosmos (Universe)[7] – the cosmosphere.

If we allow the validity of the already cited multi-world interpretation in the model of the chaotic Universe by Andrei Linde (1990), then we can say: in our world, where we are observers and creators of technology, technology (design) cannot be different, but in the worlds where we do not exist, and the laws differ from those in our world – maybe, there exist other observers with different technical products and different design.

In other words, we cannot, at least hypothetically, deny the possibility of the existence of "technology" and "design", which are not anthropomorphic and therefore not human-proportioned. In this case, *we could*, so far,

7 The simplest example of the demand and necessity of such a "space design" is pollution of near-Earth space by the waste of human "conquest" of space. This problem is already becoming very acute Drolshagen, Kaschny, Drolshagen, Kretschmer & Poppe 2017.

however, purely hypothetically, *talk about the possibility of a multi-world understanding of technology and design*.

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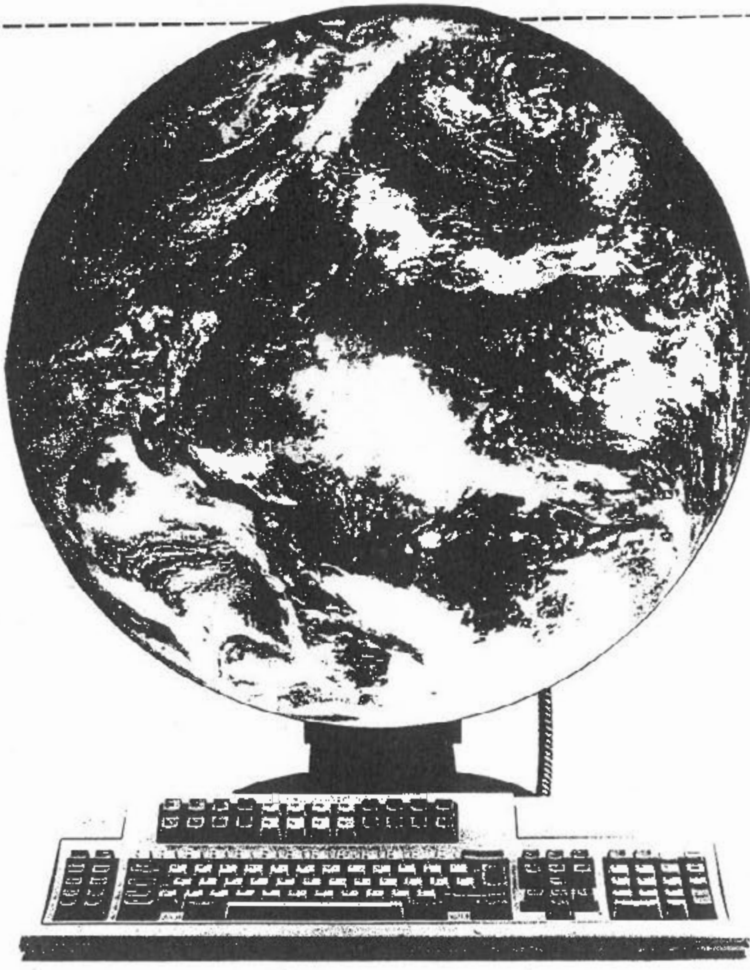

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IV
EPILOGUE:
THE PERPETUAL TECHNO-LOGICAL CHANGE

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Greg Andonian

The CAVES of Global Identity: From Critical to Creative Thinking

Introduction

The Global Identity evolved around *"CAVE"* encounters of acquiring knowledge that eventually shaped the condition of the universal mind. It related firstly to reflective and critical thinking, secondly to imaginative and projective spirituality, thirdly to innovative and creative vision, and fourthly to artificial intelligence and systems thinking. The art of reasoning, the pursuit of passion, the craft of technology, and the cybernetic control embodied the mythology, the mystery, the magic, and the message and meaning of human inventiveness. Universal values, divine purpose, ethical means, and freedoms and responsibilities were sought in the quest for a sensible destiny for entire humanity.

The philosophical discourses on existence and essence advanced various realms of human reasoning: among them were idealism, moralism, and realism – to name a few. The challenge has been to determine how to harmonize novel ideas avoiding conflicts, devise honorable plans embodying society's aspirations and appropriate creative minds respecting everything living. The inalienable human rights for shelter, nutrition, and productive work are juxtaposed against the responsibilities of authorities regarding how to exercise control in order to achieve a balance between human need, social aspiration and professional duty.

The "Caves"

Existentialism was the modus operandi of Pre-tech society on the Aegean shores until the 5th century BC. The absence of choice negated decision-making and, hence, tradition dictated logical reasoning. This paralleled the rhythm of social, cultural, and professional life. Mythology glorified itself as the imaginative realm of human endeavor. And science in abstraction resorted to reductive thinking; its attempt to understand nature was zeroing in on the atomic structure of matter. However, the essence of life and its surrounding ethical and political issues were deemed irrelevant.

Then, Greek philosophy changed the focus of humanity. It did provoke debate on human logic. From analysis to synthesis, it adopted deductive and inductive reasoning. The concept of the mind was challenged regarding thought provoking and thoughtful making of art, architecture and city planning. It questioned man's ideas about himself regarding his belief system, social order and political agenda. Human logic impacted on society's ways of critical thinking and means of creative dwelling; it attempted to define the realm of being.

From critical reflection and imaginative spirituality to creative vision, the human condition evolved in "cave" experiences that characterized the global identity. These experiences questioned the humanity's value judgment, revealed man's innate aspiration for immortality, and exposed humanity's most cherished dreams for infinite creativity. Thus, ***the first "cave"*** – defined by Plato and which embodied his idealism– aspired to invent a new code of conduct. It challenged humanity to construct universal links with the cosmos. It attempted to establish an ideal social relationship by enacting the rule of law for the common good. And it pursued to appropriate ethical means for desired ends. It debated the schism between human perception and reality, form and matter, and image and representation, also defying pre-Socratic existentialism. It sought freedom of choice and eternal values. This "cave" was a fictional invention – a reflection on mind, a product of reason, and an abstract notion critical to prevailing ideas – favoring mind over body and man over nature.

The Platonic view of the cosmos was indeed manifested in the "cave." It narrated a scenario where a shared world-view – an "ideal" human community, with common values and understanding – was presumed established among the chained prisoners of the "cave" who faced the wall as the immutable board of knowledge. (The wall reflected images of visitors, projected by a distinct light source coming from the entry door behind.) Their vision was limited to the wall screen and blurred because of proximity. For them, shadows were the only "reality" to debate in a valiant attempt to comprehend the larger whole outside. Indeed, the prisoners made "sense" among themselves; they offered critical commentary on the ghostly presence of the visitors and linked the audible whispers to shadow movements. They engaged in interpretation. Then, when a prisoner was released on a limited time pass to see the wonderful, to experience the glorious and to witness the brave world outside, upon his return to his former chained status, he felt as if transformed into an outcast. He could no longer make "sense" with the rest of his comrade prisoners. Their shared worldview had vanished. Now he knew about the real world outside, and the rest knew only its shadows; hence, they no longer measured up. This Platonic pursuit of universal truth has aspired many to view the cosmos as the ultimate destiny of humankind. Higher order, cosmic beauty and divine harmony were what man had to seek in this "cave" beyond human desires and value systems. Accordingly, even though man had to aspire for a meaningful role in society, find his own individual place in the state setting and pursue fulfillment of his dreams with the help of the city establishment – he should never abandon the search for the universal truth. Indeed, man had to seek asymmetrical solution in design, in a subdued form, to enhance freedom of self-expression in art, architecture and urban planning. Plato's idealism attempted to prevent the corruption of the human soul. The eternal future with its values and relationships was deemed more important for humanity than earthly achievements.

If Socratic moralism had to prevail in these "cave" experiences, then individual goals, objectives and aspirations had to become suspect. Consequently, the pursuit of happiness through earthy possessions had to be ultimately questioned. The end state of mind had to be challenged in advance since man always aspired to seek power to subjugate the weak for personal gains, tended to accumulate wealth to control minds for political advantage, and attempted to build fame to dictate his terms of reference. The Socratic moralism was built upon the notion that every human end-goal was eventually attainable, but argued about human sacrifice, resources commitment, and environmental cost. In advance, the end value had to be critically tested against its perceived worthiness. Indeed, if the past had any message to humankind, it did reveal the fact that man never knew how to govern himself – man neither understood how to satisfy his desires without inflicting suffering, nor was he able to control his instincts without causing pain. In addition, man's tools and inventions were always used inhumanely, causing demise of individual rights, decline of moral responsibilities and decay of professional respects.

If Aristotelian realism had to exercise its reasoning in the "cave", then man's present situation regarding possibility thinking had to prevail. It had to advance tasks for the establishment to provide health care, education and employment for the citizens, and maintain law and order in the country. The state had a "god given" mandate to protect itself against the various named "enemies" within and without, and the responsibility to enhance safety for all. Eventually, the state needed its citizens for her "defense" – hence city-plans and architectural solutions had adopted symmetry in design for ease of access and control. Buildings thus embodied monumental scales in form and expression to command authority and ultimate control.

Indeed, the trials and tribulations of the dwellers of this "cave" embodied, first of all, the Platonic vision of universal truths and ideal relationships; secondly, they advanced Socratic reflection upon human intentions and moral aspirations; and, thirdly, they articulated the Aristotelian ethical mission for the realism of goals and objectives. The ideal, moral and ethical values were defined through abductive, inductive and deductive reasoning – a prescription for the "perfect man" to carry responsible tasks for the citizenship, with genuine authority and sincere commitment. This "cave" was the final manifesting triumph of mind over mythology. Man aspired to be in control of his situation.

The second "cave" is defined by Holy Sepulcher and articulated in early Christian existential narratives pertaining to eternity. It enhanced individual spirituality and advanced metaphysical aspirations, dictating its own code of conduct where reason was suspended to absolute authority. It filled the gap between wonder and doubt – advanced a surreal spiritual entity devoid of human critical thought and self-awareness. Paradoxically, submission of the self to the will of God-almighty brought man to the centerfold of divine interest, ignoring the existence of nature and the world outside. God-man-earth cosmology was emulating a mystery from this "cave", where spirit triumphed over body. This "cave" was real, not fictional, but inaccessible to human inquiry and incomprehensible to the human mind. Man could not offer critical commentary on this divine "transfiguration." Hence, the schism between mind and belief evolved, expanding into the realm of existence and experience. Man became numb – senseless and emotionless. He was gazing at the skies with imaginative spirituality for connection, but the messages were yet to come.

When the gate of the last Platonic School of antiquity was closed in Athens by a decree of Byzantine Emperor Justinian, the Christ "cave" then was the only option available for the pursuit of knowledge. From 5th to 15th century, this "cave" was the ultimate challenge for academic curiosity. To dwell in God's mind was the purpose of "visiting" there. Many attempted to reflect upon and project through this "mystery box" without success. Deciphering the puzzle that God could enter the "cave" physically "dead" and leave spiritually "alive" defied human imagination of the era. Could man not use the model for himself? Man was faced with an unprecedented dilemma: to believe in what "happened" in the Christ "cave" – as a manifestation of divine intervention – or to reject it as untrue. Was there any recourse for the "may be" interpretation regarding the mystery inside?

Amongst the notable "visitors" of the "cave" of this millennium were St. Augustine, St. Gregory of Narek and Dante. Indeed, in the City of God, St. Augustine distinguishes man's divine aspirations as the forum for spiritual dwelling, as opposed to in the City of Man mind-body inhabiting man's consciousness. This advanced a duality between man's existential experience and essence. The philosophical question stipulated was not why mind-body should be enduring finite suffering on earth for the "promise" of eternal spiritual existence in the "heaven", but how the mind-body could endure suffering. In contrast to the Buddhist manifesto that life is suffering on earth and man's desires are the prime cause for it, in the Christian belief, there existed possibilities of eternal suffering in the "hell" yet to come if man pursued worldly aspirations here and now. This debate on "hell" and "heaven", now and then – referring to earth and cosmos – led nowhere. St. Gregory of Narek, a 10th century Armenian Church philosopher, in his Conversations with God asks for an audience with divine wisdom and attempts to engage in a dialogue. Upfront, he accepts man's imperfection, but argues whether it was man's making. If the divine code of conduct for man after 10 centuries of preaching couldn't be put in practice, then what's the point? Maybe God's expectations were too high for man to deliver. Man needed help but not hurt, guide but not guilt, and lead but not let. Christ, the Son of God, couldn't dwell in this "cave" for more than three days, but man feels trapped in it for a millennium and can't find a way out.

Humanity's ongoing conflict with divinity originally stemmed from the description of the latter regarding the "perfect man" as God's agent, defined by the metaphor of this "cave." It requested man's conscious denial of his worldly experiences during his temporary existence on earth. In lieu, through the fellowship with the Sacred Book, pretentious spiritual "training" was mandated for his "immortal" mission to cosmos. This conflict, regarding the character instruction of man on earth for a cosmic thereafter endeavor, is the very theme that Dante entertains in his Divine Comedy. His visionary visits to "heaven" and "hell" aspire to reconcile the differences among the dwellers of both extremes and, in doing so, attempt to establish a "genuine" understanding between universe and earth, including God and man.

In the 15th century, it was Martin Luther's translation of the Bible from Latin and, subsequently, Gutenberg's spread through the invention of his printing machine that the truth about divinity was revealed at last. Man's "immortality" was assured through God's grace alone, but not by good deeds as stipulated before. Now man was free to read and individually interpret the holy texts, work for himself and reclaim the knowledge that was left off at the close of antiquity about a millennium ago. This heralded the opening of ***the third "cave"*** and the beginning of a new time and space for man to rethink his position on issues pertaining to the physical world around, experience reality independent of preconceived ideas, and question the very essence of being. Science and technology, rekindled by works of Leonardo da Vinci, Raphael and Michelangelo, once again promoted great trust in self-knowledge. Newton advanced the foundation of mechanics from cogs and clocks to steam machines. The industrial revolution reshaped the global landscape from countryside to city-ports. Maxwell's theories on electromagnetism were utilized in the design of the dynamo and the electric light bulb; they transformed night inhabitation and work ethics. From Einstein's imaginative theories on space, time, light and gravity to studies of sub-atomic particles, man evolved to tab nuclear power. Indeed, now man was thinking holistically. From unity of cosmos to the structure of matter, man was articulating the theory of everything. Matter transforming into wave-motion was under intense study. Chaos theory was unfolding into predictable order. And man was able to fly and land on the moon; space settlements were in the works.

Man's reasoning has evolved, too. Cartesian space devised by Descartes became the technical space for measurement. Within this concept, everything had a relative value, as opposed to an absolute one. His analytical problem-solving methods, in particular, his "divide and sub-divide until one understands" rule, became one of the bases of scientific reasoning. Copernicus and Galileo redefined the earth's relative position regarding the sun and cosmos. Darwin placed man in nature relative to other species. And Freud redefined the human psyche as being instinctive and irrational. Marx envisioned a classless society, Nietzsche declared that "God was dead" and hence man was in charge, and Peirce formulated American ideals in pragmatism. The concept of the world was being drastically redefined…

Architecture, as an important embodiment of human aspirations, transformed itself from the medieval, mystical and introverted spatial experiences to more open, utilitarian and life-sustaining narratives. Man, now was building for himself, expanding for progress and appropriating new technologies. Architecture negated ornamentation and styles of the past and became in tune with human social and basic needs. Functional determinism, pattern language and spatial behavior were the metaphors for these initial designers. Reinforced concrete, steel and glass, and plastics brought new sensibilities to the experiential dimension and the expressive essence of architecture. New building typologies and city morphologies evolved that shaped the scope of modern built environments. New government buildings and transportation structures, education and health institutions, sports and arts centers, shopping malls and theater complexes, office towers and production plants and, lastly, housing units – defined the modern life-space.

The 20th century "civilized" man brought upon himself terrible calamities. World Wars I and II devastated Europe, staging the forum for genocide and holocaust. Science and technology as tools of design and construction became means of destruction and ethnic cleansing. Displacement and dislocation, loss of history and memory, and distorted culture and obfuscated facts resulted in significant upheavals in social structures and great discontinuities in man's life. People in governments had yet to learn how to become human in restoring global justice by not resorting to sovereignty as an inappropriate shield for hiding crimes against humanity. Forced inaction on the disoriented prolonged the memory of suffering and the agony of injustice that haunted many.

Cybernetic control, artificial intelligence and systems thinking presently define the realm of ***the fourth "cave"*** at the threshold of the new millennium. Indeed, this "cave" is evolving to become everybody's place. It has incorporated the global, universal and omnipresent. Here, man is the creator of his virtual reality and the inventor of his cyberspace. In it, novel ideas not only exist, but they are in action. And man appears to be in control of his situation. In this "cave" man has created a new illusive reality outside his existence. So far, this reality is experiential – what you feel is what you get. There, the "self" is a relative thing, which is in the domain of flux – constantly transforming itself from being to novel becoming. It embodies man's creative vision to connect with all, at will and at all times, in order to make sense. This aspect of the "cave" is advancing to project itself as the magical realm of infinite possibilities. This open dwelling is considered fundamental to the notion of human rights, respects and responsibilities, as it will continue to shape the future human condition.

Using the millennium life cycle of the former two "cave" models, man at this point could assume that he is exactly halfway through in the latter two "caves" of dwelling experiences. Accordingly, there remains indeed another full five centuries of life span to evolve, during which man will have many survival challenges to confront. Global man will have to raise serious questions about his mode of innovative thinking, ways of intelligent planning, and means of creative making. Will man eventually devise a global economic union whose government will advance global education, bring social justice and mediate amongst nations to cooperate on issues of pollution and waste, natural environment and industrial development, management of renewable and non-renewable resources, preservation of agricultural land, and controlling ever-present overpopulation? Will man be in control of the earth to enhance his survival? Will he be able to bring order, harmony and balance to his mind, spirit and body? Will man play a crucial role in the healing of nature and healthy environment building? What will his value system be regarding priorities? If man's history will continue to be a history of selfish competition, inflicting suffering and cruelty on masses, then social, economic and ethnic conflicts will propagate further global tension. Humanity will lose even more of its scarce dignity. Man's tools of advancement will become tools of utter disintegration, subjugation and manipulation. Controlled misery will prevail globally. Eventually, earth will become a dumping site for the ones who could flee this cesspool and settle in outer space. The rest will falter around, in cyclical disarray, and eventually perish. Then, man will question, in his final moments of reflection, whether he has learned anything from these "caves" experiences.

Reflections on the Future of Architecture

The Global condition of mind, embodied in four distinct "cave" scenarios, posits criticality on experiences and exposures of contemporary hi-tech in constructing a plausible global civilizational identity. Attempts of **first "cave"** visionaries to devise a politically astute, socially cohesive and individually competent **"perfect intellectual man"** – on grounds of idealism, moralism and realism – did not materialize. Democracy lost its essence to the Roman Imperial Court as an oppressive model for human condition. Even the highly developed human mind failed humanity, as man could not solve his challenges intellectually. In the **second "cave"**, God revealed his code of conduct for the salvation of the **"perfect spiritual man"** reserved for the heavens. Divinity lost its essence to dogma as the corrupt model for human condition, as religious strife failed humanity, and man could no longer handle his earthy miseries spiritually. Functional determinism became the modus operandi for theoretically testing the endurance of the **"perfect social man"** in challenging social-cultural, economic-political, and psychological-environmental experiments that humanity interfaced in the **"third cave"** scenario, where the means always justified the ends regardless of the untenable human sacrifice. And, lastly, in the **transitional fourth "cave"**, advances in science and technology hold the promise of defining the **"perfect hi-tech man"** as the product of prosthetics; it attempts to prepare human beings for future productive work, social interaction and creative entertainment. If instrumental reasoning will dictate the condition of mind as it relates to being and becoming, then man will seek technological solutions for his genetic defects, spiritual emptiness and intellectual ineptness. Where the mind's reason and God's passion "failed" humanity, and defunct social experiments yielded ultimate misery, will hi-technology succeed in assuring a sensible destiny for entire humankind?

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The testimony of the persistence of craft heritage in some cultures, in design practices and in recent craft sensibility of consumers, can help us better understand today's design reality. Meanwhile, it also sheds light on the choice of this special theme – craft, technology, design – for this book. What is more, this theme has brought together a group of scholars, researchers, designers and artisans, allowing them to exchange their points of view and their expertise, and hence find new solutions for the major design challenges of today.

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