SUSTAINABLE DESIGN 4.0: METHODS AND TECHNIQUES OF THE CONTEMPORARY DESIGNER IN THE KNOWLEDGE SOCIETY

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ABSTRACT

When confronted with the problems of contemporaneity, designers often tend to use their own creativity as an answer to a specific need, maintaining divided design fields and methods, this leads to a lack of attention to actual society problems and goals, which have already been defined and highlighted from UN – with the 17 Sustainable Development Goals – and from the theoreticians of the industry 4.0.

The research method proposes the convergence between innovative production technology – such as open technologies – and different design approach, the parametric one and the participatory one, because their hybridization could lead to the design of artifacts through a unique system and, as well, customized on the need of each user emerged through the participation of the same.

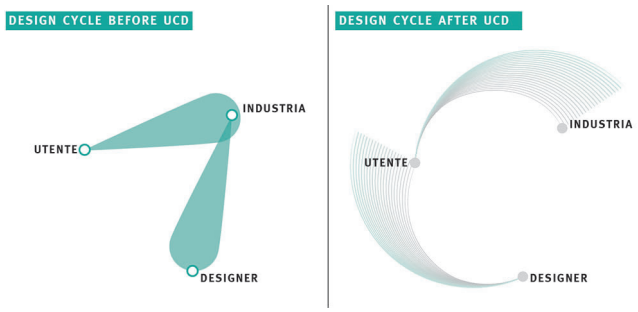
It is clear that a convergence like this will have an important impact on the society, thanks to the attention on sustainability, inclusivity and iterability, of the process and products.

Key Words: Industry 4.0, Parametric Design, Participatory Design, Specialized Processes

1. INTRODUCTION

The evolution of the design dimension, which has been witnessed in the last years, thanks to the innovation of tools and technologies of the industry for the production of goods and services more and more *user friendly*, has been gradually defining an increasingly heterogeneous scenario, in which the standard product, at the time defined by industrial design, is no longer sufficient to satisfy the diversified needs that characterize the vast landscape of users.

As Maldonado said, the task of industrial design had become that of coordinating, integrating and articulating all the factors related to the production of artifacts, related to their consumption, both on an individual and social level: in fact, often design is understood as a link between the production system and the consumption system. But since the 90s, this idea of design begins to become obsolete, especially if we think that the effort of the designers is dedicated to the definition of functions and morphologies more and more shaped by the needs expressed by users - User Centered Design, UCD – Figure 1.



[Figure 1] The design cycle before and after the introduction of User Centered Design method.

Design oriented to building human scenarios consistent with technological advancement, today faces the challenge of defining products and services that are increasingly in line with users' expectations: the digital skills that the industry is getting richer, open the road to dynamics on-demand interaction in which the user becomes a sort of co-worker, an active part of the network of stakeholders involved in the creation, management and distribution of goods. In a scenario of this kind, the designer has the role of director, becoming a figure of mediation between idea, materials, production and realization. To understand the motivations of what has been stated, it is important to carry out an analysis of the different actors in the design cycle, understanding how industry, designers and consumers interact with each other, projected towards the definition of a network in which each part sees its specific boundaries dilate and its own roles hybridize with the others.

2. INDUSTRY

Industrial dynamics and manufacturing systems lose in this modernity the obsolete definition of place of mechanical production that destroys man and his efforts, in an anachronistic vision of the factory as the protagonist of Chaplin's masterpiece – Modern Times, to become instead spaces in which new relationships are defined, which introduce the user in the process of defining the value of the consumer good, in terms of active participation in the configuration of tangible and intangible contents. Driven by digitalisation and automation, industry is overwhelmed by technological transformation, evolving itself into Industry 4.0, the fundamental objective of this phenomenon is to make innovations converge towards a widespread and permanent improvement of the quality of life.

Among these technologies, we want to mention the most relevant compared to the research presented:

- *Big Data*: represent nowadays the richest source from which to draw in order to define, elaborate, transmit and store huge masses of data, whose basic technology is the storage of data on immaterial storage archives and no longer on hard disks. Data can come from two large source families: the first includes databases, files and document archives, social networks and messaging systems. In a system like this, users insert the information, more or less structured, into different applications. The second family concerns data coming from devices that automatically acquire them, by using specific sensors, surveillance cameras or computer edge of vehicles, and transmit them in system, network, etc. As a tool, data becomes elements for the explanation of dynamics of everyday life, creating knowledge in *real time*, generating relationship and developing systems fed by continuous connections to networks.
- *Industrial Internet of Things:* with millions of devices daily connected online, we are seeing a deep change that is happening in different levels and fields of design, what is achieved are expressions of product design, services design, communication design, etc., which communicate in real time with other items. Everything is potentially connected and interactive, constantly changing, allowing a continuous updating of the operating routines of the single objects in the system that communicate in real time with other objects. At the base of such technologies there is the annulment, absolute and / or partial, of the time factor, no longer calibrated with respect to space, but to software and to the computing and interconnection capacity of digital systems (Bauman, 2002).
- *Additive Manufacturing*: the term identifies a series of techniques and production technologies in which the finished product is created without the need to melt the material into molds or using the classic techniques

of subtractive production. The additive production - AP - allows great freedom in the design and realization of the artifact, indefinitely extending the range of geometries and complexities achievable, breaking down the constraints and obstacles of design and processing, offering the possibility of obtaining easily and quickly the realization of prototypes and small series. The techniques of additive production consist in the stratification of material that is, in fact, added by levels: it is from this that derives the now popular meaning of "3D Printing", emblem technology of additive manufacturing - AM -, which has radically changed the perspective of how engineers design the production process: no more molds and assembly of different pieces, the 3D printed object is made in one piece starting from the virtual model turned into files for printing: as stated by Marinella Levi, engineer at the Politecnico di Milano, "3D printing is the closest case to teleportation. 3D printing is used to do what you need when you need it".

The digital dynamics of manufacturing systems, allows us to offer customized products, a feature that has always been recognized as an added value to the manufacturing system itself: customization requires the definition of an intelligent factory whose versatility and flexibility makes it possible to find "specific solutions for variable requirements: product families, individualization of needs to be met, variable segmentations of demand" (Lombardi, 2017). The intelligent and performative dynamics of the production system, offers the possibility of arriving at the conception of a new class of artifacts, equipped with technological equipment, which connects the end-user with tangible and intangible products and services, through new forms of interaction and experience. An example of application can be represented by the *Sound Shirt* – Figure 2, a wearable technology designed to allow deaf people to enjoy listening to music: it was possible to carry out a project of this kind thanks to the constant involvement of end users - a group of deaf people - who for the six months of prototype testing have constantly oriented the outcome of the final product, commissioned to a company producing hi-tech clothing (CuteCircuit) from the Jugen Symphoniker in Hamburg.

[Figure 2] Sound Shirt: CuteCircuit. 2016

The introduction of these technologies offers the possibility of completely revising the role of industries that today have the ability to provide a sort of humanity to products, much higher than ever before, this offers to designer a new awareness, that of being the director of the flow that connects the Business-to-Business (B2B) and Business-to-Consumer (B2C) worlds, this flow made up of information that is turning into knowledge, becomes *value*.

3. DESIGNER

By definition, designer has always been the *mediator*, who therefore, thanks to his creative skills and design capacity, is able to conceive artifacts that the industry can produce and offer to the widest possible landscape of users.

The contemporary reality of design, and in particular of the figure of the designer, consists in its renewed role as director, becoming the one who has the role of weaving and establishing processes of value creation based on design dynamics in which the project focus is not on the author's artifact, but on understanding and analyzing the vastness of languages, contents, data, codes, which throw the designer himself towards open and participatory project practices, suitable for build new narrative points of view. This is possible by incorporating all the parts in the creation of the value chain, in which both users and industrials become *co-workers*. A system of this type "can be considered as a network of stakeholders and users, whose actions are closely related and interdependent" (Sbordone, 2017). The (*new*) designer must therefore be able to identify opportunities for new configurations with ever-different resources and application contexts that develop as organisms, and as such live in a state of constant dynamism, must be able to create automated configurations and allow the total personalization of performances, through participation and sharing of resources and processes.

4. USER

The history of design teaches that, since the dawn of this discipline, the founding goal of the same was to bring together form and function in the definition of products reproducible in a serial manner, therefore on a large scale, this was essential to achieve a democratization of the products themselves that could thus enter everyone's homes. This philosophy, which finds its highest historical expression in the Bauhaus School, has been the reason for many debates among the designers and theoreticians of the project culture. Ettore Sottsass Jr., in an interview, states that "the problem of design (...) is that it has various aspects. There is design as the Americans say *Business or nothing*, i.e. design that is oriented to the consumer product, to the product to be sold, or to the product to be used tout court. But I think there are also some design where one imagines things (...). Because design also has a profound relation-

ship, always, with existence. "(Sottsass). Until the 80s / 90s of the twentieth century, the consumer has often found himself in the condition of passively enduring that definition of design that from Sottsass is connected to the American method - *Business or nothing* - thus purchasing goods only for a question of style or fashion, which from time to time were proposed by the manufacturers. But since the early nineties something changes: the design process was reversed because, if in a first moment the company requested a shape from the designer, who consequently responded according to the canons of function and aesthetics, which was then produced and marketed and only arrived in final stage to the consumer, from those years onwards there is an ever greater importance given to the latter, until becoming a central part of the design process: designers design what users require through their needs, expressed or unexpressed, and only later the company experiments and finally produces. This method, called *User Centered Design* - UCD - has its roots in issues such as inclusivity, sustainability and experience: according to ISO / DIS 13407 (*Human Centered Design Process for Interactive Systems, 1998*) for UCD we mean a design approach identified by 4 different principles: an appropriate allocation of function between user and system; active involvement of users; iterations of design solutions; multidisciplinary design teams. In addition to this it is important for a truly user-centered design approach, to ground the design process on observation of the users' practices in the real world.

5. CONTEMPORARY DESIGNER IN THE KNOWLEDGE SOCIETY

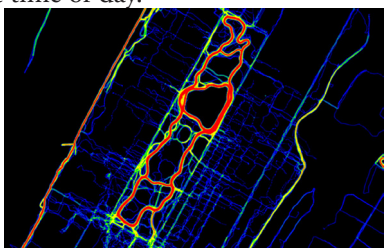
It is right to offer a reflection: if we look more closely at the object reality that makes up our contemporaneity, what we can easily notice is that, despite all the efforts of the theoreticians of the project culture, there is still a difference between what is preferred to do and what is done. What happens is that approaches such as participatory and parametric ones, as well as tools such as 3D printing and IoT, are converged by certain (*few*) with the intent to design sustainable, inclusive and iterable products (as is desirable), and from (*many*) other treatises as a form of fashion: this may be sufficient as long as we talk about doing technical training on designers (think for example to the academic course, where it is necessary, at least to begin with, to offer students a field of experimentation in which to feel free to *make mistakes*), but not if you enter the specific process of designing and producing goods that then end up in the hands of the end users.

We want to remember in particular the various experiments carried out within the university laboratories and the FabLab, where the students have the opportunity to *learn by doing*: the paradigm, introduced for the first time by the Bauhaus School, finds today with this formula - learning by doing -, its maximum expression. In fact, it is no longer enough, to educate future designers on the theory or to teach them how to design the lamp, the chair, the magazine, but it is necessary to train them on how hybridization has become a fundamental paradigm for designing (always) with attention to heterogeneous needs: doing an operation of this type means dominating the process, offering scalable application models that can be customized to specific requests.

5.1. Case Studies

Starting from an investigation on the literature, concerning the state of the art of scalable models and customized products, designed through the convergence of the approaches and technologies mentioned above, we want to mention some case studies, considered emblematic because, although belonging to different branches design, rooted in an active involvement of users, as well as in the establishment of multidisciplinary design teams.

Nike + Data Viz Highlights Urban Running Routes – Figure 3, it is a project of data visualization born from the collaboration between graphic designer Nicholas Felton who, together with 14 of his students at the Manhattan School of Visual Arts. The project aim is to analyze the metadata based on runners, Nike + users, in the period from September to December 2010. The strength of the project lies in the idea of movement, the runners are variable in movement in the definition of dynamic infographics, which represent a picture of the daily life of a slice of citizens, illustrating where people run and at what time of day.



[Figure 3] Nike + Data Viz Highlights Urbam Running. 2010

Bianconero – Figure 4, is defined as a high readability font, designed by Umberto Mischi, with the technical supervision of Luciano Perondi (designer and at the time professor of type design at ISIA in Urbino) in collaboration with Alessandra Finzi (cognitive psychologist) and Daniele Zanoni (expert in study methods in disorders of learning). The strength of this character lies precisely in its morphology, studied in every detail to facilitate reading for the *able-reader* and to avoid for those with dyslexia disorders any difficulties in reading. To do this, every single glyph has been redesigned, proposing a differentiation between them, in order to avoid the possibility for the reader to get confused, between similar elements, recognizing them more easily within the text, thus taking care of the efficiency and overall typographic quality. During the letter design phase, a fundamental role was played by the publishing house, which carried out constant tests in collaboration with CRC Balbuzia - the learning division of Rome - thus

offering designers the opportunity to boast constant feedback on the work already done.

[Figure 4] Bianconero. 2011

biancoenero® regular 15,5/22,5 pt

Virus è un gatto, un gatto vagabondo,
attaccabrighe e prepotente.
Il terrore di tutti i gatti perbene
che vivono sicuri con gli umani...

times new roman regular 15,5/22,5 pt

Virus è un gatto, un gatto vagabondo,
attaccabrighe e prepotente.
Il terrore di tutti i gatti perbene
che vivono sicuri con gli umani…

Algorithmic Lace – Figure 5, is an innovative biomedical project, born from the intersection of craft research and algorithmic design. The product is a three-dimensional lace bra for breast cancer survivors, *tailor-made* using a new methodology that exploits the algorithmic patterns, this type of texture allows to avoid certain aspects of the bra, that create discomfort after surgery, offering each woman to re-appropriate of her own self-confidence. The project, created by Lisa Marks, recent alumni of MFA Industrial Design at Parsons SCE and currently faculty at Georgia Institute of Technology, has been named one of the Lexus Design Award finalists for 2019

[Figure 5] Algorithmic Lace, 2018

In closing, there are two productive and tangible realities, considered important because they represent a general tendency in the definition of products that through the convergence of methods and techniques, allow to obtain high performing artefacts, showing however a very high attention to the presented needs as well as for the sustainability.

Enneper Pavilion – Figure 6, projected by Medaarch design studio, makes the parametric approach and the advanced manufacturing its theoretical and design basis: the system offers the possibility to modifying the conformation of the pavilion according to specific needs in terms of space and volume available. Thanks to the platform, end-users, in this case a company operator that requires the construction of a specific structure, can, through simple parameters – size and volume available – adapt the shape of the pavilion. This implies a consequent optimization of the resources, with consequent reduction of the waste of material and labour in the realization of the pavilion.

Fold Panel, realized by Wood-Skid, are sound-absorbing panels, designed to adapt to all possible requests related to specific needs, performance, functional and aesthetic. To do this, the company has designed a process in which, defined an area within which the panels are assembled - 110x110cm or 220x110cm - every single user, through the use of an interactive system, can decide the material and the type of structure - choosing how to distribute the three-dimensional texture - that best suits his needs.

6. CONCLUSION

Perhaps the most significant aspect for the realization of such projects is the exploration of a scalable model, able to act on many factors, over time, space and individuals, not only optimizing the design and production of individual artefacts, but also by enhancing the user experience, enriching the ways in which users interface with individual products, exploiting the possibilities offered by new ways of sharing knowledge. The knowledge society, characterized by complexity (Morin, 1993), globalization (Bauman, 199, Robertson, 1995), multiculturalism (Galli, 2006) and mutability (Schön, 1973), attributes to the moment of formation the very important function of "instilling both the desire and the pleasure of learning, the ability to learn to learn, the intellectual curiosity "(Delors, 1997, p.17), on which depend the quality of life of man in the third millennium and the possibility for society itself to guarantee innovation, development and progress.

A vision of this type embraces all the issues highlighted by the 17 UN Goals, among which perhaps the most emblematic in relation to the research topic addressed is: Make cities inclusive, safe, resilient and sustainable. Cities are places where one must live well and where everyone must have the opportunity to live in dignity. The gender difference, the social class and the economic condition, must no longer be factors of discrimination.[1]

[1] https://www.un.org/sustainabledevelopment/sustainable-development-goals/

[2] International Design Council – Ico-D – is a Council of independent Member organisations – a global network that shares common issues, commitments and standards. Members create a unified voice for the global design community and drive a high level dialogue on the leading role design plays in society, culture

This vision is aligned with the practices shared and disseminated by the International Council of Design[2], which Montreal Design Declaration states that "All people deserve to live in a well-designed world". The same David Grossman, president of the ICO-D from 2015 to 2017, argues that "the declaration reflects on two great results. For the first time, the design community, through multiple disciplines, speaks with one voice. This consolidation leads to the second result: international agencies are eager to collaborate with a united world of design. These results impact every designer " (Grossman, 2017).

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and the economy. Ico-D is the world's largest representative of the international community of professional designers.