
ServDes2018 - Service Design Proof of Concept
Politecnico di Milano
18th-19th-20th, June 2018

Service design in open production, distribution and organisation as a discipline facilitating democratic critique?

Massimo Bianchini, Venanzio Arquilla

massimo.bianchini@polimi.it; venanzio.arquilla@polimi.it

Department of Design, Politecnico di Milano, Via Durando 38a, 20158 Milan, Italy

Peter Gall Krogh

pkrogh@eng.au.dk

Department of Engineering-Design, Aarhus University, Denmark

Abstract

Service Design, as its name suggests, is mostly concerned with motivations for building new services and systems. Its driving factors are often the desire to improve human experience of these systems and to create leaner processes. In this paper, we point to the key qualities of service design and how complements from other disciplines may strengthen its analytical components, allowing a critical understanding of complex technological systems.

The first part of the paper aims to describe this general scenario of transformation. The second part is based on an initial literature review, mapping existing contributions that talk about the role of service design in the Fourth Industrial Revolution. The final aim of this part is to find emerging trends in service design, by analysing and comparing common and/or different disciplinary points of view.

These new trends could help discern possible new challenges for service design.

KEYWORDS: service design, fourth industrial revolution, openness, democratic critique

1. Exploring Service Design in the transformation of design, production, distribution processes: research objectives and methodology.

Service Design as the naming of the discipline suggest, is mostly concerned with the interest of building new services and systems. A driving factors of this is often improved human

experience of these systems, and more lean processes. As most other design disciplines Service design is concerned with producing novel human and societal relevant contributions, and less oriented towards delivering clear analysis and accounts of existing systems and revealing its features for public critique. However, the latter maybe an interesting research avenue to pursue. This paper aims to create a first state-of-art about the evolutionary path of Service Design within the so-called Fourth Industrial Revolution (4IR, McAfee and Brynjolfsson, 2014; Schwab, 2017; Schwab and Davis, 2018). In this paper, we point to the key qualities of Service Design and how complements from other disciplines may strengthen its analytical components and allow for critical understanding of complex technological systems.

Fourth Industrial Revolution is progressively characterizing itself by the technological convergence - 3D printing and biofabrication, robotics, Artificial Intelligence (AI), Virtual Reality (VR), and Augmented Reality (AR) - both in design, fabrication, and distribution processes and products-services systems. The rise of open and distributed forms of design and production enabled by digital labs, platforms and peer-to-peer communities are referred to an emerging small population of (technological and social) *augmented-users* or *super-users* (including extreme figures of grinders and cyborgs). People able to access and/or possess, control the means of design and production in order to be autonomous and independent. On the other side, the growth of a global digitized service economy is generating great benefits for millions of users but is also characterizing itself for and increasing in-humanization and automation in the production and distribution processes. Finally, an emerging third “sci-fi” way refers to a possible future service economy *developed by* and/or *focused on* non-human agents such as robots and animals. The nature of goods and services is evolving. Processes to produce and distribute goods and services are evolving. Needs, features and roles of the users are evolving. In the next future, a new service economy could be generated *by* non-human agents and going *beyond* human users. The first part of the paper aims to describe this general scenario of transformation. The second part of the paper is based on an initial literature review mapping existing contributions talking about the role of service design in the Fourth Industrial Revolution. Literature review work is extended to the world of management, industrial engineering, CS and HCI in order to know *if* and *how* these disciplines are identifying and/or evaluating opportunities and critical aspects generated by the progressive adoption of the new technological systems in design, production and distribution. The final aim of this part is finding emerging trends for service design analysing and comparing common and/or different disciplinary points of view. These new trends could support the definition of possible new challenges for Service Design.

A majority of today’s leading global companies are relying heavily on service design for production, distribution and organisation of goods and information. Sophisticated complex closed Information and communication technologies play a central role in this. None of the dominant disciplines (Computer Science, Engineering, Business intelligence) involved in these constructions work to provide a holistic image and account of consequences caused by these systems. Based on the numerous trouble and dark clouds on the horizon spurred by the use of new technology and the recent years experiences, not least the dreams of big data, AI, and robots there is a need for alternative understandings of such complex systems. Service design has a long tradition for pursuing a holistic perspective on systems balancing suggestive practices with analytical skills, including the will, tools, and methods for understanding also the tiniest details of exchanges within a system. Secondly, Service Design has worked across human and non-human actors (organisations, computers, rules and conducts etc...). This may position Service Design as a possible key discipline for critiquing the technology deterministic visions on tomorrow and deliver visions on a future we would like to live in. Service design may be this helping disincline. Service Design in the service of democratic discourse and actions.

2. Emerging scenarios and issues for Service Design moving from Third to Fourth industrial revolution.

2.1. Is the Fourth industrial revolution demanding Service Design (and viceversa)?

To have a quick overview of the actual presence, connections and contributions of Service Design on the 4IR, we made a first bibliographic recognition. We looked at contributions from different disciplines such as design, economy and management, social sciences, engineering. A first list of papers and articles has been selected using the research keys "Fourth Industrial Revolution", "Service Design", "Design", "Industry 4.0", "Servitization", "Open and distributed production". The search on scientific database¹ confirms that 4IR can be considered one of the prominent scientific topics for the next future, but until now seems there are not specific connections with Service Design.

The first recognition and the most explicit paper merging Service Design and Industry (not only 4.0) is related to some cases of adoption of service design tool and methods in industrial fields. Costa, Patricio, Frias, Morelli, and Magee used an integrated service design approach within the PSS design method to innovate the new product and service development of a mature industry. *"The results of the case study application show that the integrative PSS approach was able to support a company in its transition from a product-oriented mindset to a service mindset, allowing the company to create new product and service system value propositions with customers and expand the company design portfolio."* (Costa et al. 2018, p.140). Similarly, Iriarte and other co-authors developed an interpretation of the design and service design visualisation capabilities: *"that manufacturers can use as they make the transition to servitization. A change where usually the users play a fundamental and different role sometimes becoming co-author or author of the service."* (Iriarte et al. 2018, p.2).

About the change of Design, production and distribution processes, There is an increasing area of reflection connected to the new models and processes for or to manufacturing with unavoidable reflexes on design and service design. Morrar, Arman, and Mousa (2017) in *The Fourth Industrial Revolution (Industry 4.0): A Social Innovation Perspective*, reflect on the social dimensions of the Fourth Industrial Revolution to defining a political issue: *"With the transition to Industry 4.0, policy makers should think its global impact on current and potential social problems through the social dimensions of new technologies. Society at large should benefit from such industrial transformation, because consumer and producer are largely connected and both can participate in the production and consumption process."*

Rauch e many other co-authors (Rauch 2013 and 2016) reflected on the *Distributed Manufacturing System* (DMS) where the production is going to a dematerialisation process and become diffuse on the territories. This foreshadows more sustainable scenarios for production: *"DMS are an appropriate model for more sustainable production and appear therefore to be a suitable and potential manufacturing strategy to handle the related challenges of sustainable production in emerging markets."* (Rauch 2016, p. 130). Rauch and other authors sustains that design can become open, referring to the production of customised goods involving intelligent machines, factories and micro-factories and "users as designers": *"In the future, it will be increasingly difficult for manufacturers to keep pace with the rapid development of design tools. Not only product developers but also consumers today have access to design tools that a few years ago were out of reach (Leber, 2013). The end user, in the sense of Open Innovation, is more often directly or indirectly involved in the product development process. Product development, in the future, occurs not only within the company but also can be considered a collaborative process between the company and customer. As part of this development, centralized manufacturing systems are increasingly being replaced with decentralized production structures (Ueda et al., 2004). The vision of Open Innovation is that end users design and create their product using digital design and product development tools. They then forward the relevant data streams to capillary distributed services or production laboratories in their region, which manufacture the product using generative/ additive production technologies known from Rapid Prototyping."* (Rauch 2016, p.133).

¹ Scopus Elsevier, ISI Web of Knowledge and Google Scholar.

The "professional" design should evolve his role to design the full production process and the full chains, because manufacturing become a common service that can be offered to final users. Capgemini and SAP in the report *Empowering Discrete Manufacturers for the Digital Age*, states that, *"The digital transformation paves the way for new revenue streams, generated through innovative business models — such as mass customization or product-as-a-service— that enable organizations to collaboratively create value across corporate boundaries."* (p.16)... *"Service-centric business models have been in use for some time in the discrete manufacturing industries. Digitization can be harnessed in order to lower the barrier to generating lucrative revenue streams through product-related services."* (p.21). Deepening the role of design in 4IR, Gerlitz in his article *Design For Product And Service Innovation In Industry 4.0 And Emerging Smart Society*, states that the *"Role of design for innovations through user involvement related to Industry 4.0 or smart production processes is likely to be underrepresented in this context."* (p.183) *"Currently, design enjoys increasing recognition as an integral part in innovation-driven economy on organisational, business, societal and policy levels. Nonetheless, its integration within the industry 4.0 research streams is emerging, especially from the conceptual perspective... Design is perceived as a driving force for smart manufacturing, smart products and services connected with customers and consumers, increasing resource efficiency, business performance and competitiveness and level of innovations. Nevertheless, with regard to the findings, the intensity or external perception of design and its integration within the innovation product or process development process may differ. The reason behind this is a level of design tangibility and perception."* (Gerlitz, 2015; p.193)

Industrial Revolutions has considered workers in manufacturing and service companies mainly as *human factors*, similar to machines or proactively replaceable by them. The change of production models change this perspective introducing the users-designers as a new *human actors* in the process and bring to consider a new form of *Collaboration Productivity* (Schuh et al., 2015) based on new relationship between human and human, human and machine, human, machine and production systems. At the same time, recent technological advancement in design and manufacturing (VA, AR, Big data and AI) push to reconsider the presence of designers and their role in these new *Cyberphysical Systems*. Ferrari (2017) in *Design and the Fourth Industrial Revolution. Dangers and opportunities for a mutating discipline* reconsiders this possibility developing an historical recognition starting with Buchanan and the fourth dimensions of design where the fourth order concern with complex systems, and arrived at Dubberly & Pangaro (2015a). *"In the Fourth Industrial Revolution era, the role of design could be more than ever related to the process of discovering goals and learning what matters"* (Dubberly & Pangaro, 2015b). The Fourth Industrial Revolution, with the amalgamation of the physical, digital and biological spheres, presents a crisis to otherwise stable areas of design practice. A visionary article by Suzanne Labarre on *Fast CoDesign* entitled *The Most Important Design Jobs Of The Future²* (2016) talks about the evolution of designers in possible new professionals such as "cybernetic directors", "fusionist", "human organ designers".

In the field of Economy and management, many scholars are investigating the opportunities and challenges connected to the Industry 4.0 model (Xu, M., David, J.M., Kim, S.H. (2018), Davis, N., Samans, R. (2017). Experts like Frank T. Piller, Christian Weller, Robin Kleer (2014) are studying the evolution of mass-customization in manufacturing reflecting on a human-centered model of economic growth. When cyber future and machine driven production models are emerging, a reflection on the role of the humans in this perspective and also a reflection to a sustainable economic perspective give to the people new roles. Again, design and service design are not directly involved in these new challenges.

3. Designing services and Fourth Industrial Revolution.

² The article is based on interviews to designers at Google, Microsoft, Autodesk, Ideo, Artefact, Teague, Lunar, Huge, New Deal, and fuseproject in order to predict 18 new design jobs of the future. See www.fastcodesign.com/3054433/the-most-important-design-jobs-of-the-future.

Design, in broad terms, has a tendency to be communicated as object oriented (product design, fashion design, service design etc.) rather than impact oriented e.g. democratic design, sustainable design. The reasons for this are probably historical (Buxton 2009), and a dominant tool for such storytelling might be related to the Schumpeterian inspired conception that innovation is resource and object driven (Schumpeter 1934). However, it may be argued (equally relevant) that progress, new ways of organising everyday life and access to resources are socially motivated; consider: the Reformation, the Enlightenment, the Welfare state etc. In this paper we promote that it is time to shift the balance between the object of design to the impact of design. The maturing of Service Design in the context of new methods, organisations and tools for Industry 4.0 might be the midwife of such change.

3.1 Service Design and Fourth Industrial Revolution

The foundation of Service Design is built on shaping services substituting products. This point of departure embeds a concern for the value delivered by the service. Looking to the theories and practice of Service Design the field has historically mostly been concerned with modelling new services and less oriented towards analysis of current status; with a particular strong component and will to model human interests. Secondly, Service Design has a tendency to depict and model actions, results and reasons as predictable causalities and only with an increased complexity when mapping multi-stakeholder situations. Complementary to this, technology based visions of Industry 4.0 rarely model humans as part of the system beyond being the requester and receiver of goods. Furthermore, while visions of Industry 4.0 technologies are marketed as “open platforms” that are easy to control, the chains of working happen between machines and keep humans out of the loop. A key critique and option for service design in this context is the concept of “openness”. Open, in the sense that the system allows for human participation. The examples are growing - Fab Labs and new urban micro-factories such as Unto This Last or ambitious systemic models like Open source Ecology and TechShop franchising, however still with limited economic impact or are close to fail. These situations are hard-to-model systems produced by complex non-predictable multi-stakeholder relations – rhizomatic (Deleuze) in character.

3.2 Other disciplines and Fourth Industrial Revolution

Interaction design and the design of computational technologies has been delivering services for decades without calling it service design. Interaction Design is a crucial discipline in enabling Human control of machinery for Industry 4.0. However Interaction design is interested in the act of interacting with computers, while the impact of interactions strangely enough has attracted little attention (Taylor, 2015). There is a specific scientific focus and perspective on Design for Additive manufacturing (Thompson et al., 2016) but a general lack of knowledge on how Service Design can approach AI and robotics. A part of the literature review more focused on technological development in 4IR, obviously reveals a wide and prevalent interest of other disciplines (management science and engineering) in understanding how the whole set of 4IR technologies will have an operational impact on production capacity and management of production systems and what the impact on the economy will be. In particular, there is attention to understand on how these technologies can create new commercial channels (Daniel et al., 2015), how they transform supply chains to manufacturing more complex products (Holmström, and Partanen 2014; Oettmeier and Hofmann, 2016), and which business models can be developed.

3.3 “Openness” as a key to understand Trends in and for Service Design

The foundation of Service Design in collaboration with Interaction Design has the potential of driving the research and interest into the impacts of Industry 4.0 from perspective of democratising the technologies and opening them for civic engagement and production. The key notion in regard to the above is: “open”.

Openness in this context points participation; participations allows for human interferences and democratic control. By taking point of departure in the work on “participation” as it emerges in the book *Taking [a]part* (McCarthy and Wright 2015) we elaborate on the role of Service Design in the context of Industry 4.0 enlighten by the concept of “openness”. From the perspective of Experience-centered Design 4 themes for participation are brought forward in the book: *Taking [a]part* (McCarthy and Wright 2015). In particular they explore the notion of participation from a point of departure in Politics and Aesthetics. The themes of participation they point to are: 1) Design enquiry – how processes of participation are used to explore and enquire into design challenges; 2) Openness – how and for what participation is allowed and invited for; 3) Social Reconfiguration – how participation change the roles we adopt; and 4) Legacy – how participation manifest and define social infrastructures. Without going into depth of each theme we point to 2) *openness* as a key concept for how Service Design may serve as the complementary field of industry 4.0 technologies in the pursuit of true “open platforms” and how this field of research will point to how service design may develop rhizomatic approach.

McCarthy and Wright identify the following sub themes of openness: a) open for reading and interpretations, b) open for co-creation, c) open for adopting the facilities as a stage for performance. In the context of Service Design meeting open Industry 4.0 this may play out as in the following examples: a) Workshops and courses educating people to design/assemble their own 3D printer also invite people to interpret what a 3D printer may do for them. b) Co-create with IKEA – workshops and digital software packages allowing anyone to participate in the development and testing of furniture ideas and c) Barcelona Fab City (*fab.city*) – a visionary urban policy initiative where citizens may use publicly available facilities to stage their own inventiveness to nurture the imagination of others. The value delivered in these examples is not dominantly the product produced but the elevation of the human participants and the rhizomatic social relations that emerge from the services. Though the results of the above undeniably includes a service design contribution, the rhizomatic character of how these concepts infrastructure people is not possible to map and discuss with the current paradigms in service design. Secondly, it is our claim that adopting service design analysis perspective upon these services might reveal breaches and bridges for democratic critique.

4. Exploring the ServDes (low) feeling on “Producing, distributing and organising”.

A first exploratory literature review conducted for this positioning paper reveals two aspects: first, the socio-technical challenges characterizing the Fourth Industrial Revolution are becoming crucial by policymakers and hi-tech Industry while Service Design seems not yet focused on understanding and investigating this emerging paradigm. Nowadays, scientific investigation activities and actions on this phenomenon are mainly developed in other scientific contexts such as service logic, mechanical and industrial engineering, economy and management. Moreover, the three papers accepted and re-assigned to this track combined with the promotion activities of the track itself (we talk with ServDes organizers and ambassadors about the low interest) reveal other two aspects: Fourth Industrial Revolution is considered “far” or, on the contrary, “difficult to access” by researchers in Service design. In other words, service designers understand and recognize the importance to approach the Fourth Industrial Revolution, but at the same time many of them admit they do not know how.

The track “*Producing, distributing and organising*” has been reported the lowest number of papers submitted in all ServDes conference. The track has been ideated and structured in the same way as the other ones. Moreover, it has been promoted not only within design circuits but also within non-design networks/communities/think-thank close to the Fourth Industrial

Revolution, innovation and management, such as the German Division of Technology & Innovation Management (TIIM), thanks to the support of mass customization and open innovation theorists like Frank T. Piller from RTW Aachen / MIT Smart Customization Group. At the same, this track has also been promoted within the Fab Labs ecosystem. No papers come both from academic and grassroot contexts. Only the policymaker we invited has enthusiastically agreed to participate in this track. Finally, only entrepreneurs and industry managers have not invited to send us papers. Is this a failure? It's could be. Certainly, this low performance deserves some reflections. Are service designers really interested or not in these topics? Why?

The three papers accepted, confirm the first result from the literature review. Their topics intercept only marginally the research questions posed by the track, highlighting how it is appropriate try to find an evaluation key that can extend the scope of service design in the contemporary hyper-cyber complexity that characterize the Fourth Industrial Revolution. For example, seems to be a lack of multidisciplinary. Service designers did not try to write and submit papers working with industrial engineers, economists, and STS experts. These papers develop three different levels of analysis evidencing some arguments that can be used to reflect about service design and Fourth Industrial Revolution.

Frida Almqvist, in *Service design in the later project phases: Exploring the service design handover and introducing a service design roadmap*, introduce a methodological and critical reflection about handover in service design process. In short terms, service designers are mainly focused on preliminary research, concept definition and scenario building having a lower direct impact and influence in the development and implementation phases. This part is important because it highlights possible operational limits of the service designer in the activation of the service on the market (of whatever type and level they are), especially in the development of services dealing with technological aspects and complex organizations like those that will characterize the Fourth Industrial Revolution, such as care robotics or driverless mobility services. These services not only require creativity, but robust skills on enabling technologies developed thanks to the manual dexterity and the social ability to be connected with the new communities of practice (Frey and Osborne, Schwab). If we think to emerging digital manufacturing platforms (3D printing on-demand), the role of the designer is relevant but relegated in the early stage and limited in terms of economic impact.

Francesco Mazzarella, Val Mitchell, Andrew May, Carolina Escobar-Tello in *Wearing the Threads: Service Innovation with Textile Artisan Communities* demonstrate *how service design can be used to activate textile artisan communities to transition towards a sustainable future*. This paper provides a significant, complex and well structured study that stimulate to reflect on a crucial topic for service designer: the implementation of service projects. Mazzarella et al. sustain that the critical point is related to develop the projects focussing on how project times rarely coincide with those of implementation: *“the implementation of the service implies time, resources and contextual factors that go beyond the scope of this case study, therefore assessing the impact of the social innovation is left open for future work.”* One of the concepts underlying the Fourth Industrial Revolution concerns the acceleration of the development of innovation processes triggered in turn by the acceleration of technological innovation. The design of services, especially those involving extensive human user involvement, takes time. The progressive advancement of the forms of computerization and automation in the production and provision of some services (eg logistics) and will change the service experience and will probably have an impact on how the service designer approaches the design process and implementing it having the possibility of directly intervening on non-human agents carrying out the actions or on cyber-physical systems that control human operators. So, what opportunities and critical issues for the service designer in this area?

Satoru Tokuhisa, in *The Coconut Innovation Framework An Innovation Framework focusing on Resources*, proposes a new Innovation Framework, *this framework aims to develop service ecosystems by focusing on the resources of developing countries and industrialised countries and integrating them.*

The paper shows the role of service design, or in this case the service designer, in the definition of a complex project of local-territorial development based on the design a product-system related to Coconut. Tokuhisa follows the development of this project analyzes phases, tools and critical issues trying to define a model of replicable innovation (a possible case of *reverse innovation*, (Govindarajan, V., & Trimble, C. 2012). In its “hyper-local” being (Manzini, 2018), this paper reveals the ambition of the service designer to develop production models that in this case are put into practice starting from a developing country. Even in this case one might ask what is left? How will the process evolve when the service designer finishes his role?

The papers received show an attitude to experimental and action-research of service design in relation to the production and distribution topics. Moreover, the three papers provide concrete case studies and a methodological-instrumental reflection highlighting how service design acts mainly in the definition of service scenarios and related processes, above all the complex ones, but without actually entering in the implementation phase. Nowadays, the themes related to the new models of production, distribution and organization presuppose a maturity and a very strong competence on implementing services based on a complex of technologies. The processes of social innovation, where the service design thinking and logic are highly influential, are now consolidated with a robust scientific literature, projects and initiatives. This will also happen in the emerging paradigm of the Fourth Revolution Industries? Is it an area in which service design can or should invest? If we think the answer is YES, we need to start focusing on "why", "how" and "when".

Nowadays, when we talk about open and distributed production in terms of pro-am making, fabbing, advanced DIY, digital fabrication, we are referring to an emerging phenomenon not connected with the logic of Industry 4.0 (and vice versa). Moreover, the Fourth Industrial Revolution is mainly a “policy label” to stimulate the digitalization of manufacturing and service companies. These two emerging worlds seen from the Service Design perspective have a common problem: the kind of economy and society they generate. This concerns processes and projects where the interaction between products-services and users recognizes a role and a value for the latter. Neither in a world nor in the other do not yet seem to emerge "definitive recipes" of economic policy that are pressing for the development of a "Makers Economy and Society" (Wolf-Powers et al., 2016;) rather than an "Economy and Society 4.0" (Floridi, 2014; Helbing, 2016). Instead, the overlapping area among these two worlds seems a promising field of activity for service design.

A perfect example of this overlapping area is represented by *ManifatturaMilano* (manifatturamilano.it), a policy program aims to promotes the development of urban manufacturing and new digital craftsmanship starting from the manufacturing and artisan roots of the city and from the comparison with the experiences that are taking place in other European cities. It is part of the smart city strategy of Milan, which is based on two pillars: innovation and inclusion. ManifatturaMilano aims to define the vision and the policy projects to stimulate the growth of the new urban manufacturing ecosystem in Milan: support this emerging community to establish in the city, grow up their businesses and activities and create new jobs, regenerate suburbs and promote social cohesion. In 2017 a co-design process was started with many stakeholders in order to develop a tailor-made manufacturing strategy based on six pillars: studies and research, communication, laboratories and services, reuse of disused urban spaces, investment support, education and training. The first major initiative was the first edition of the *ManifatturaMilanoCamp*³ (March 17, 2018), an opportunity to converge and aggregate three communities linked to digital manufacturing projects very connected internally but poorly connected externally: the community of startups that realize projects, products and services with high technological content for Industry 4.0; the community of crafts and manufacturing SMEs present mainly

³ At Camp, for the first time, these three community were together in the same place. They met and shared their experiences creating a big networking event that saw the participation of 112 speakers from 88 different organizations, organized in 18 thematic sessions.

in the hinterland that innovate their production processes combining traditional know-how and new technologies; finally, the vibrant "urban" community of designers, makers, artisans, Fab Labs, coworking and self-producers.

5. New challenges for Service Design

To map, and include the design of technologies as part of service design become important for designers that operate in the Fourth Industrial Revolution. By limiting itself to the design of services, service design marginalises itself from impacting the technology that conditions the delivery of services.

Evolution of the skills of the Service Designer. The development of human skills is considered crucial in the Fourth Industrial Revolution. Design professionals seem have a low risk to be replaced by robotization and computerisation of work. In any case, designing in systems highly characterized by this risk needs skills to enhance the designer's capacity to design of new experiences for users in contexts such as augmented reality in various domains, new digital identities for clients, and automated services using intelligent machines. But these are also skills that enable a designer to use data strategically to develop highly-skilled and personalized services, to carry out more in-depth studies on client behavior, and to design projects that include experience in the use of products based on artificial intelligence so as to predict or anticipate users' tastes or needs. Moreover, there are skills that enhance the designer's capacity to operate in "open" organizational contexts increasing the ability to manage innovation processes, in particular creative skills to manage innovation processes characterized by a hybridization of design, science, and technology. Finally, can be also considered skills that enhance the designer's capacity to specialize for work in production contexts with convergent technologies.

Evolution of the design tools and techniques of/for Service Design. Many service design contributions, including those accepted in the Track 5, even when referring to the introduction of service design techniques in manufacturing companies, mainly refer to the use of analogical and static visualization and design tools (business model canvas, personas, blueprint, ...). The emerging field of Fourth Industrial Revolution is populating with technologies and processes that allow to process big data making them interact with AI and then explore reality or simulations in a virtual and augmented way. Being able to process huge amounts of data could be possible to calculate, "generate", and construct simulate scenarios differently. All this for Service Design means trying to explore a field where to experiment the transition from visualization tools to new virtual or augmented tools, trying to introduce different languages and practices through enabling technologies.

5.1 Conclusions

In relation to the (r)evolution of production and distribution models, the literature review (to be considered as *in progress*) combined with the analysis of the three papers presented on Track 5, begins to distinguish two fields for service design.

On the one hand there is the world of production-distribution of goods and services closer to the logic of social innovation. A world where users-customers-citizens play a more active, conscious and responsible role and where production and distribution technologies can be used in enabling, modifiable and controllable forms, co-evolving with the people and organizations. In this context, service design already has proximity and forms of contact with the dynamics of micro and self-production, with the theme of open production and with forms of collaborative and circular economy. On the other hand, there is the world of production and distribution of goods and services closer to the logic and dynamics of technological and market innovation. A world where the technological revolution works in favor of the disintermediation of production and services, pushing on computerization, the automation of human labor and the establishment of professions, "forcing" the evolution of

people and organizations. In this context, of such recent development, the service designer seems to have not yet found or defined his own space.

The Fourth Industrial Revolution, when it begins to unveil its full potential, will become a "hot" ground for the concept of innovation itself, including the risk of even questioning the role of humans as the only living species capable of designing and producing goods and processes. Service designers, to operate in this context, will be called upon to work with design choices that may include or exclude his peers, in favor of technological or market development logic. To play this "game" the service designer will presumably become a socially and technologically "augmented" professional, able to operate strategically within and between these two worlds, "equipping" himself with new skills and tools that allow to play a key role: "open" and "enable" the perspective and role of the user-citizen-innovator within the Fourth Industrial Revolution (and viceversa), finding new forms and ways to generate economic and social value.

References

- Buxton, B. (2007). *Sketching User Experiences: Getting the Design Right and the Right Design*. Morgan Kaufmann Publishers Inc.
- Brecher, C. (Ed.) (2015). *Advances in Production Technology*. SpringerOpen
- Costa, N., Patricio, L., Frias, R., Morelli, N., Magee, C.L. (2018). Bringing Service Design to manufacturing companies: Integrating PSS and Service Design approaches. *Design Studies*, Vol 55, pp. 112-145
- Rauch, E., Dallasega, P., Matt, D.T. (2016). Sustainable production in emerging markets through Distributed Manufacturing Systems (DMS). *Journal of Cleaner Production*. Vol 135, pp. 127-138
- Marilungo, E., Papettia, A., Germania, M., Peruzzini, M. (2017). From PSS to CPS design: a real industrial use case toward Industry 4.0. *Proceedings of The 9th CIRP IPSS Conference: Circular Perspectives on Product/Service-Systems*, pp. 357–362
- Morrar, R., Arman, H., Mousa, S. (2017). The Fourth Industrial Revolution (Industry 4.0): A Social Innovation Perspective. *Technology Innovation Management Review*. Vol 7(11)
- Bonvillian, W.B. (2017). *Advanced Manufacturing: A New Policy Challenge*. MIT Press
- Davis, N., Samans, R. (2017). *Towards a human-centered model of economic growth*. World Economic Forum
- Dubberly, H., Pangaro, P. (2007). Cybernetics and Service-Craft: Language for Behavior-Focused Design. *Kybernetes*, Vol. 9
- Dubberly, H., Pangaro, P. (2015). Cybernetics and Design: Conversations for Action. *Cybernetics and Human Knowing*, Vol. 22, nos. 2-3, pp. 73-82
- Eyers, D.E., Potter, A.T. (2015) "E-commerce channels for additive manufacturing: an exploratory study", *Journal of Manufacturing Technology Management*, Vol. 26 Issue: 3, pp.390-411, <https://doi.org/10.1108/JMTM-08-2013-0102>
- Ferrari, T.G. (2017) Design and the Fourth Industrial Revolution. Dangers and opportunities for a mutating discipline. *The Design Journal*, Vol 20

- Floridi, L. (2016). *The Fourth Revolution: How the Infosphere is Reshaping Human Reality*. OUP Oxford
- Gerlitz, L. (2015). Design For Product And Service Innovation In Industry 4.0 And Emerging Smart Society. *Journal of Security and Sustainability Issues*. Vol 5(2)
- Govindarajan, V., & Trimble, C. (2012). *Reverse innovation: Create far from home, win everywhere*. Harvard Business Press.
- Iriarte, I., Hoveskogb, M., Justela, D., Vala, E., Halilab, F. (2018). Service design visualization tools for supporting servitization in a machine. *Industrial Marketing Management* (article in press)
- Henriksen, D., Mishra, P., Warr, M., & The Deep-Play Research Group (2017). A Cybernetic Perspective on Design and Creativity: a Conversation with Dr. Paul Pangaro. *TechTrends*, 1-5. DOI: 10.1007/s11528-017-0232-y
- Holmström, J. Partanen, J. (2014). "Digital manufacturing-driven transformations of service supply chains for complex products", *Supply Chain Management: An International Journal*, Vol. 19 Issue: 4, pp.421-430
- Keywell, B. (2018). *The Fourth Industrial Revolution is about empowering people, not the rise of the machines*. World Economic Forum
- Laudante, E. (2017) Industry 4.0, Innovation and Design. A new approach for ergonomic analysis in manufacturing system, *The Design Journal*, Vol. 20
- McAfee, A., Brynjolfsson, E. (2016). *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies*.
- McCarthy, J. Wright, P. (2015). *Taking [A]part - The Politics and Aesthetics of Participation in Experience-Centered Design*. MIT Press
- Oettmeier, K., Hofmann, E. (2016). Impact of additive manufacturing technology adoption on supply chain management processes and components. *Journal of Manufacturing Technology Management*, Vol. 27, Issue: 7, pp.944-968
- Piller, F.T., Weller, C., Kleer, R. (2014). Business Models with Additive Manufacturing — Opportunities and Challenges from the Perspective of Economics and Management. in Christian Brecher (ed.) *Advances in Production Technologies*. Springer.
- Schwab, K. (2017). *The Fourth Industrial Revolution*. Portfolio Penguin
- Schwab, K., Davis, N. (2018). *Shaping the Fourth Industrial Revolution*. World Economic Forum.
- Schumpeter (1934): *The theory of Economic Development*, Cambridge, MA; Harvard University
- Taylor, A. (2015). After interaction. *Interactions*. Vol 22(5), pp. 48-53.
- Thompson, K., Moroni, G., Vaneker, T., Fadeld, G., Campbelle, J., Gibson, I., Bernard, A., Schulz, J., Grafh, P., Ahujai, B., Martinaj, F. (2016). Design for Additive Manufacturing: Trends, opportunities, considerations, and constraints. *CIRP Annals*, Volume 65, Issue 2, 2016, Pages 737-760
- Xu, M., David, J.M., Kim, S.H. (2018). The Fourth Industrial Revolution: Opportunities and Challenges. *International Journal of Financial Research*, Vol 9, No. 2
- Ustundag, A., Cevikcan, E. (2017). *Industry 4.0: Managing the Digital Transformation*. Springer

Wolf-Powers, Laura, Greg Schrock, Marc Doussard, Charles Heying, Max Eisenburger and Stephen Marotta. 2016. *The Maker Economy in Action: Entrepreneurship and Supportive Ecosystems in Chicago, New York and Portland*.

Links

<http://ingenioer.au.dk/en/current/news/view/artikel/studerende-bygger-et-halvt-hundrede-hoejtekologiske-3d-printere/>

<https://digit.hbs.org/submission/ikea-crowdsourcing-ideas-to-co-create-a-better-everyday-life/>

<http://fab.city>