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Multiple roles and enhancements of makers in the post-industrial design practices: An inquiry for non-expertise in design

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Abstract

The present paper aims to reflect possible enhancements of makers in design practices through the shared aspects of criticisms in industrial design. Such criticisms included industrialization's effects on the rationalization of design processes, separation of design tasks, and separation of the industrial design profession from the artisans and craftspeople. Makers' multiple roles in post-industrial production and their interpretations of industrial products provided the article for understanding their possible interventions in industrial design.

The main research question of this article is as follows: What are the possible enhancements of makers that are useful to overcome the problems of industrialization in design? The present study method included a literature review on various critical aspects of industrial design to demonstrate the ones shared by the makers. Selected quotations from the semi-structured interviews conducted with nineteen maker participants accompany the literature review to introduce their varied skills that emerged in the collaborative practices and their perspectives of making for the generation of new meanings in design. In the last section, makers' shared aspects with the critical views in design, such as their strategies for gaining autonomy in their practices and creating personal meanings, are discussed to overcome the separation of design tasks and rationalization processes in industrial design.

Keywords
Makers, Post-industrial design, Critical aspects in design, Multiple roles.

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1. Introduction

In the post-industrial society, makers revitalize the pre-industrial design practices such as applied arts and crafts to employ customization in situated conditions and generate self-driven values in their design projects. Makers use post-industrial technologies such as 3d printers, digital modeling, and computing to implement pre-industrial forms of design with personalization (Bunnell, 2004; Loh, Burry & Wagenfeld, 2016; Taylor &Townsend 2014). By doing this, they overcome the ongoing conflict between craft and design since the beginning of early modernism (von Busch, 2010). Makers did not inherit only customization from the pre-industrial forms of design but also critical values that included the "rejection of mass production and consumerism, a reclamation of uniqueness, individuality and the handmade, along with autonomy, empowerment and distinction" (Sabiescu et al. 2005, p.1). According to Boeva (2018, p. 42), the reason for this revival was the "lack of elegance in mass manufacturing" and craft maker's "mastery and skillful manipulation of material".

Maker activities involve praxis, a very central term for the design theory, which is "more than the exercise of technical skills and just doing things" and refers to the practice that associates *thinking with doing* (Crouch and Pearce, 2012). Their praxis involves problem-solving capabilities, artistic applications, interpretations, and generation of new meanings, as the present article exemplifies. Starting from this point of view, researchers interrogate the maker practices as non-expertise in industrial design without regretting their implicit notion of expertise in self-driven design practices.

Industrial design has previously been vastly criticized for its occupational border that separates the tasks of designers and the design processes. While this condition strengthened the industrial designer's position in the industry for creating market values, user expectations for generating personal meanings in design interrogated the values created by designers. Depending on the post-industrial opportunities, users became capable of developing design concepts and implement design decisions by blurring the lines between users and designers. Since makers have the capability of meaning generation and application of design decisions, they extended their roles as both users and designers in the post-industrial conditions.

In this case, we discuss that maker approaches in design processes, their collaborative knowledge production, and their interpretive meaning generation can overcome the criticisms for industrial design since makers generate new and autonomous insights in design projects. In this context, the present paper initially discusses how industrialization positioned the industrial design profession in contrast to non-expert designers and how it took part in the rationalization of design activity. Following this distinction, researchers discussed shared aspects of maker practices and critical voices in industrial design to overcome the problems of meaning generation and autonomy in design.

The significance of makers is that they eliminate two main dichotomies: the amateur and the professional, the user and the designer by their capabilities on generating autonomous decisions in design. Another feature of makers that is employable in industrial design practices is their wide variety of expertise in the solutions of the design problems within the collaborative environment in maker communities. Makers' personal achievements during their experiential performances in the design processes enrich the design solutions and makers become self-legitimate designers by their ways of making in the post-industrial era. In that case, maker practices are worth investigating to study which aspects can generate new insights in industrial design practice, such as better attachment of objects into a users' lives and autonomous decisions in design practices.

This paper is based on the broader concern of a Ph.D. research on maker culture that is conducted between 2015-2019 in Istanbul. An interpretive phenomenological study was developed to articulate the experiences and motivations of makers in this research. The main research question of this ar-

ticle aims to investigate the enhancements of makers in design practices to overcome the industrialization related problems in design. To achieve the results, researchers initially pursued a literature review on the relation between maker practices and industrial design as well as on the transformation of design processes and the critical aspects in industrial design. After having information about maker practices and concepts, researchers observed local makers in four maker and technology fairs and four meet-ups between 2015 and 2017. During the observations in maker events, people of all ages, gender, educational, and occupational backgrounds were participating in activities conducted in a collaborative and interdisciplinary environment. However, the researchers did not define these qualities as a criterion for choosing the sample group in this research. After observations, researchers decided to select the interview participants due to their making interests associated with the fields of robotics, electronics, coding, STEM education, digital technology integrated design, arts, and crafts.

Following observations, semi-structured interviews were conducted with nineteen maker participants between 2016 and 2018. Among the participants, there were seven engineers, six designers, two artists, two architects, a physicist, and a communication specialist who were actively engaged in making activities in the post-industrial sense. Both of the participants had at least a bachelor's level in occupational education, and some of them had a master-level education in the field of their occupational expertise. Some of the participants were employed in maker related jobs, and most of them were working in the contracted jobs in the interdisciplinary fields in which they use engineering, designing, or artistic skills in the problem-solution and meaning generation processes. Participants were employing their making skills both for the contracted jobs in specific projects and also for their meaning-making projects in everyday life. In this case, participants' ability to generate design solutions and new meanings in their personal projects was considered as a notion of expertise without considering their level as a criterion in this research.

2. Two dichotomies: The professional and the amateur, the user and the designer

Designer as a distinct individual "apart from trade and crafts" is a concept developed throughout the process of professionalization in the 19th century (Beegan & Atkinson, 2008, p.307). The designer was conceived as a professional who could guide the works of the artisan and understood the complex production processes in industrial society. "Indeed, the idea of the design profession is bound up with the establishment of creative individuality, the separation of tasks and the suppression of collaboration with artisans and craftsmen" (Beegan & Atkinson, 2008, p. 306).

Industrialization introduced the rationalization of the design process through the division of cognitive processes and manufacturing (Hermans, 2015, p.49). The division between "ideation and construction, design and making, professional and amateur, digital and physical" (Boeva, 2018, p.72) deskilled humans in everyday design and re-described the industrial designer as an expert in design that serves the masses. Professionalization concealed the fact that design skills could be cultivated by all humans (Cross, 2006; Fry, 1994; Manzini, 2015). However, the authority of the professional designer became questionable for those who implement personal design decisions without having expertise in occupational design practice.

Furthermore, the difference between designer and user in creating value is blurred by "typical activities of traditional collaboration, such as user tests, focus groups, and co-design workshops," (Hermans, 2015, p. 62) where the main objective of the designer was converting the user value to the market value. With user-centered and co-design approaches, the role of the designer as a decision-maker was distributed among different stakeholders and users. Designer as an enabler is motivated to assist the users with tools that would allow them to develop

design decisions. Users have a role in "ideating and conceptualizing activities in the early design phases" (Sanders & Stappers, 2008, p.5) as a part of a design team by their expertise of individual experiences.

Through post-industrial technologies, non-experts in design being partly a user and partly a co-designer began to implement their design ideas based on their personal preferences (Atkinson, 2010). The role of an industrial designer in "facilitating tools that allow one to make things" came to the fore instead of making final design decisions on behalf of people (Hermans, 2015, p.76). The role of the designer became decentralized by "allowing non-designers to reclaim the space of problem framing, issues formation, sense-making, and creativity" (Pierri 2017, p. 2953). Through the mentioned developments on the contribution of users and makers in the design processes, non-expertise of makers in design practices became questionable.

3. Transformation of design activity

During the 20th century, several aspects of design activity were highlighted in design theory, varying from rational ways to phenomenological ones in the design process. During the 60s, the design was defined as a rational problem-solving activity that includes linear processes by Simon (1969/2008). The rationalist approach evolved into second and third-generation design methods with the recognition of the complexity of generative processes and representation of the problem space (Bousbaci, 2008). Such concepts developed in this bounded rationality phase includes Horst Rittel and Melvin Webber's (1973) *wicked problems*; Bryan Lawson's (1979) *solution-focused strategy*; Harbert Simon's (1973) *ill-structured problems*, Allan Newell and Herbert Simon's (1972) *problem space* and *generative processes* (Bousbaci, 2008, p. 41).

Rationalist approaches excluded the unstable, uncertain character of the design process that depended on the designer's values, mind-set, and experiments during the practice (Cross, 1981; Bausbaci, 2008). After the 80s, Donald Schön (1983/2017) suggested the 'reflection-in-action' theory, where the body of knowledge was constructed through the iterative cycles of designer's inquiry during the practice. For Schön (2017, p. 21), designers construct this body of knowledge not just in their heads but through manipulation of the tools after a period of "intuitive and spontaneous performance". In contrast with the scientific tradition, Schön suggested defining the need and the problem during the action without any initial decision.

In further discussions, Dorst and Dijkhuis (1995) drew attention to the situation the designers find themselves in during the design activity, rather than considering the process and the cognitive skills of the designer as the main determinant of design practice. Similarly, Gero and Kannengiesser (2004, p. 376) emphasized that the recursive interaction of making and seeing in the situated environment that determines the course of designing. Akin (1996) mentioned the sudden acquisition of insight during the design process that was structured by several frames of reference between the tools of representation and design goals during the design process. Through these contributions, a multi-step process of design was associated with the designer's perception at work, including personal experiences and the influence of external factors.

4. Critical voices within industrial design

By considering users solely as statistical 'beings of needs and desires' (Findeli, 2001), design distanced itself from the main role of creating function and meaning for people and positioned itself based on the competitive market value. The role of the design profession became a "linkage between economic demands and the establishment of consumption" (Dilnot, 2013, p.336).

To tackle the proposed meanings of objects in the market, creating personal meaning through the appropriation of objects into a user's life was suggested for everyday design (Wakkary & Maestri, 2009, p.15) and open-design (Abel, B. van, et.all. 2011) strategies. These approaches encouraged modification and the production of design objects with personal attempts.

Critical design and non-intentional design approaches also questioned the meaning in terms of completeness and its impact on society. In these approaches, design scripts could be changed by designers' discourse on alternative production, and also by different user interpretations about the products (Bredies, Joost & Chow, 2009).

By encouraging interpretation in design, critical design, non-intentional design, everyday design, and open-design approaches foster the *unknown area of imagination* that allows "macro creation of cultural possibilities" and "micro-formative structures of meaning" (Folkmann,2014). These approaches motivate users to define their own needs and create design interpretations through their individual experiences instead of considering creativity as a product of the designer's cognitive process.

In addition to this, Storni (2012) suggested the importance of *thingness* as an attempt to deal with the unbound relation between the object and the subject. With the thingness strategy, users could have a better attachment with objects that are assigned by different interpretations of meaning during the life of the object. Similarly, ontological design (Willis, 2006, p.70) proposed the interpretive activity of designing worlds in which things and individuals symmetrically design each other by eliminating the distinction between objects and subjects.

Furthermore, Escobar (2015, p.14) defended the independence of design from the expert knowledge of the design profession for the better attachment of objects into the user's life. By considering multiple worlds significant for the earth, Escobar (2018) proposed the autonomy of design, which is developed with local knowledge in collaboration with communities.

5. Maker way of design

Makers employ design activities differently than the professional designers in case of reflecting their initial expertise with their personal design decisions. Makers produce in collaboration with other individuals without the pressure of being in a working condition that separates tasks and expertise. They interrogate their needs for industrial products and interpret objects for better attachment into their life. To meet their expectations from the objects, makers do not prefer to apply industrial approaches to design. By doing these, they tackle the dichotomies of the professional and the amateur and the user and the designer. As Participant 4 mentioned, they aim to gain autonomy to reflect their individual choices:

"*Our approach is not industrial. Because it includes mostly subjective situations. We are trying to promote the idea that users could avoid industrial products because I believe that it is independence when someone can give a different form to an object instead of the regular forms. On users, we are trying to raise this awareness through what we do.*" (Participant 4)

As Participant 4 mentioned above, industrialization is problematic in employing positioned conditions and fulfilling personal expectations. By employing subjective situations, makers both deal with the separation of designer tasks as Beegan and Atkinson (2008), Hermans (2015), Boeva (2018) mentioned, and also with users' psychological distance to the industrial products as Willis (2006) and Storni (2012) discussed within the context of the disconnection between subjects and objects.

Furthermore, makers prefer to be self-employed in their businesses to avoid the industrial working conditions even they are an expert in certain professions. By noticing their productive skills, makers prefer to spend their time in jobs that do not separate their tasks. For example, Participant 2 stated her preference in multi-skilled and self-employed working condition as follows:

"*I was working in the immense software world, at a technical workplace that produced automation machines. I felt lost in that enormous system. I was not able to see what I did in reality. […] My work required collaboration with other professionals in the factory. I quit*

that job since I found neither a story nor a spirit in it. I preferred to work in a field that I can interactively experience the work and see its effects. That is why I am in this field, in the field of interaction and experience design." (Participant 2)

Based on the participant report, as mentioned above, developing new expertise in the areas that she was an amateur became a way to avoid her profession under industrial conditions. As Cohen (2009) and Bell (1976/1999) mentioned, post-industrial working conditions require multi-skilled work and flexibility, and makers interpret this case by transforming their professional skills into self-employed, non-expert, and multi-skilled working conditions.

While in the industrial society, design profession legitimate expertise through "formalized education, institutions, and professional experience", in the post-industrial era, non-expertise builds an 'implicit notion of expertise that is local, skill-based, contingent and situated" (Boeva, 2018, p.111). Through social interaction in their working spaces, makers develop solutions in collaboration with different professional experts, including engineers, designers and artists, as well as experts in their personal knowledge. In this case, makers challenge the gap between designers and engineers as well as between designers and end-users (Lindtner, S. et al. 2016, p. 1398) by their personal expertise that they develop in the area of their interest. One of the participants mentioned how she conducted a project in collaboration with shared workshop members, who had diverse expertise:

"*We made a vending machine, in which you throw coffee beans instead of money. [...] We used a drill and installed something behind it. We did another part with a 3D printer. Inside it, we used pipes to mount the electronics. Then, we did the electronic parts ourselves. I made it with my friend in the same workshop that we shared*." (Participant 3)

As Participant 3 mentioned above, designing in a community allows the autonomy of the designer without being an expert in every field. This situation is what Boeva (2018, p. 76) mentioned as post-industrial conditions where one individual could both develop the conceptual design practice and materialize it without training in a specific profession. Thus, Participant 5 exemplified how a community generates knowledge through collaborative work by experts and non-experts as below:

"*You do not have the chance to do everything by yourself. You can become an expert on something up to a certain level. It is a great opportunity to consult people who worked hard on a specific issue, such as wearable technologies or coding. Everyone in the community is usually open to providing advice to others in commercial or non-commercial projects.*" (Participant 5)

As Participant 5 mentioned, collaboration in a maker community allows the production of projects in cooperation with individuals who have different levels of expertise. Through social networks and maker activities, interactions occur within communities where participants interpret the solutions within different frames and on different levels.

Furthermore, by joining a network, makers are inspired and motivated to design alternative products:

"*Seeing what they do. Sharing information with them. Seeing things they have done, getting inspired by them. Mutual sharing of information. Those are the purposes of being involved in the maker network.*" (Participant 6)

In shared spaces, as Participant 6 mentioned above, makers develop alternative working conditions in collaboration, challenge task separation, and transcend professional boundaries of design. Being in a maker collective is also vital to meet makers' frames of design as discussed by Akin (1996), Dorst & Dijkhuis (1995), Gero & Kannengiesser (2004) and Schön (2017) in the context of various solutions developed in situated conditions during the design activity. Through the common interest in building new connections, makers generate situated, local, and

community-based solutions that are embedded in their workshop culture, as suggested by Escobar (2018) for the autonomy of design.

As several critical approaches to industrial design aimed to encourage, interpretation is highly employed by the makers. In response, makers develop particular characteristic behavior such as utilizing unconventional and experimental methods (Jackson, 2010, p.21), attributing significance to curiosity and exploration (Himanen, 2001; von Busch, 2012), hacking strategies (Lindtner, 2014), and craft thinking (von Busch, 2010). As one of the participants stated, these strategies include using materials beyond their original function and experiencing possibilities other than the functional meaning of the objects:

"*So, you can use the kitchen grater to grate paint, or you can turn it over, hang it on the wall and use it as a brush box. So, it depends on knowing how to use it and the needs you have. It depends on what you want to play with or what you want to do at that moment*." (Participant 7)

As Participant 7 mentioned, building a new relationship with an object enabled her to do different things than the attributed function of the object. For makers, these types of intervention are types of world-building activities in which objects are integrated into their lives, as Storni (2012) identified in the concept of *thingness*.

Similarly, in order to speculate the meaning in design, artistic interpretation is another strategy that questions other possibilities about the condition of the objects (Kaya Pazarbasi, 2017). For example, Participant 1 mentioned her artistic interpretation and hacking strategy to extend properties of the material and to transform the object:

"*I mean, the last time I played with old floppy discs, I split them into two. There was a specific kind of fabric texture near the round disc. I painted them. I made pictures on them*." (Participant 1)

As it was suggested by Schön (1983/2017) and Gero & Kannengiesser (2004) on generating design knowledge, Participant 1 declared the act of *making and seeing* that supported her creativeness in material usage during the design activity. She reflected the uncertain character of design and gained new insights during the practice by her experimental approach to design.

6. Significance of makers as design practitioners in the post-industrial era

Makers share the critical aspects of design to deal with industrialization problems such as industrial designers' distinction from artisan and craftsman, separation of cognitive processes from the manufacturing, and elimination of experiential sides in the design process. Concerning these features, criticisms in industrial design expose the centralized position of the designer on meaning generation for users. Since industrial designers promote competitive market values for mass production as a part of their profession, meanings of industrial objects fail to meet the personal preferences of users. In that case, critical appraisals defend the better attachment of objects into the user's life and autonomy of design independent from the expert knowledge of the industrial designer.

Makers share critical appraisals and employ personal expertise to integrate the objects into their lives with individual meanings and preferences. Through collaborative practices, makers generate different frames of design and also become capable of developing new expertise. Through the contribution of makers to each other's work, design activity becomes a common and situated practice instead of a professionalized, rationalized, and separated practice that is based on dualities of the professional and the amateur, the user and the designer.

Makers interpret design decisions via experiments during the design activity that includes the personal acquisition of insights and intuitive, spontaneous performances in the situated conditions. This type of experiential attachment with the material world fosters the connectedness between the objects and the subjects and supports

cultural, community-based, local, and autonomous meanings in design. By this attachment, makers challenge market values and allow themselves to think beyond the industrial products.

In a maker network, unlike the hierarchical distinction between the novice and the expert, knowledge is produced through collective discussions between individuals from various disciplines. Through the appreciation of interaction, collaboration, and amateurism, this type of learning breaks the traditional relationships within the novice-expert dichotomy that was prevalent since pre-industrial design forms. In this case, makers bring enhancements in design practices by exposing the collective production of knowledge and implicit expertise in the design projects they contribute.

Finally, the industrial designer still has a function in mass production and mass consumption as an expert in design for specific production lines and markets. Makers, as experts in their own experiences, values, and practices, play the roles of both the user and the designer in design practices through conceptualizing, manufacturing, and testing at once. By doing this, makers challenge tasks and role separation in design practices and enrich their personal life by their enhancements on designed things. While makers become self-legitimized designers through social learning and open production opportunities in the post-industrial era, they play multiple roles as a producer, as a designer, and as a user. Thus, the role of the industrial designer becomes de-centralized by the world-building activities of makers and their autonomous decisions in design practices.

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References

Abel, B, V., Klaassen, R., Evers, L., & Troxler, P. (Eds.). (2011). *Open Design Now: Why Design Cannot Remain Exclusive*. Retrieved from http://opendesignnow.org/index.html in September 2019.

Akin, Ö. (1996). Frames of Reference in Architectural Design: Analysing the Hyperacclamation (A-h-a-!). *Design Studies, 17*(4), 341–361.

Atkinson, P. (2010). Boundaries? What Boundaries? The Crisis of Design in a Post-Professional Era. *The Design Journal, 13*(2), 137–155. Doi: 10.2752/175470710X12735884220817

Beegan, G. & Atkinson, P. (2008). Professionalism, Amateurism and the Boundaries of Design. *Journal of Design History, 21*(4), 305–313.

Bell, D. (1999). *The Coming of Post-Industrial Society*. New York: Basic Books. (Original work published in 1976).

Boeva, Yana. (2018). Break, Make, Retake: Interrogating the Social and Historical Dimensions of Making as a Design Practice (Doctoral dissertation). York University, Faculty of Graduate Studies, TORONTO.

Bousbaci, R. (2008). Models of Man in Design Thinking: The Bounded Rationality Episode. *Design Issues, 24*(4), 38–52. Doi: 10.1162/desi.2008.24.4.38

Bredies, K. Joost, G. & Chow, R. (2009). Designers and Users: Comparing Constructivist Design Approaches. *Proceedings of the 8th European Academy of Design Conference, Aberdeen,* 71–75.

Bunnell, K. (2004). Craft and Digital Technology [PDF file]. Retrieved from https://www.autonomatic.org.uk/archive/team/kb/craft%20and%20digital%20technology.pdf in September 2019.

Cohen, D. (2009). *Three Lectures On Post-Industrial Society.* Cambridge, Massachusetts, London, England: The MIT Press.

Cross, N. (1981). The Coming of Post-industrial Design. *Design Studies, 2*(1). 3–7.

Cross, N. (2006). *Designerly Ways of Knowing* [E-book Version]. Retrieved from https://www.springer.com/gp/book/9781846283000#otherversion=9781846283017 in September 2019.

Crouch, C. & Pearce, J. (2012). *Doing Research in Design*. Oxford : Berg.

Dilnot, C. (2013). The Question of Agency in The Understanding of De-

sign. *Journal of Design History, 26*(3), 331–337.

Dorst, K. & Dijkhuis, J. (1995). Comparing Paradigms for Describing Design Activity. *Design Studies, 16*(2), 261–274.

Escobar, A. (2015). Transiciones: A Space for Research and Design for Transitions to The Pluriverse. *Design Philosophy Papers. 13*(1), 13–23. Doi: 10.1080/14487136.2015.1085690

Escobar, A. (2018). *Designs for the Pluriverse: Radical Interdependence, Autonomy, and the Making of Worlds.* Durham, London: Duke University Press.

Findeli, A. (2001). Rethinking Design Education for the 21st Century: Theoretical, Methodological, and Ethical Discussion. *Design Issues, 17*(1), 5–17.

Folkmann, M. N. (2014). Unknown Positions of Imagination in Design. *Design Issues, 30*(4), 6–19.

Fry, T. (1994). *Remakings: Ecology, Design, Philosophy*. Sydney: Envirobook.

Gero, J. S. & Kannengiesser, U. (2004). The Situated Function–Behaviour–Structure Framework. *Design Studies. 25*(4). 373–391.

Hermans, G. (2015). *Opening Up Design Engaging the Layperson in the Design of Everyday Products* (Doctoral dissertation). Umeå University, Umeå Institute of Design, UMEA.

Himanen, P. (2001). *The Hacker Ethic and the Spirit of the Information Age.* New York: Random House.

Jackson, A. (2010). Constructing at Home: Understanding the Experience of the Amateur Maker. *Design and Culture, 2*(1), 5–26.

Kaya Pazarbasi, C. (2017). Contemporary Art and Critical Perspectives in Industrial Design Education. Design Philosophy Papers. 15(2). 119–132.

Lawson, B. R. (1979). Cognitive Strategies in Architectural Design. *Ergonomics, 22*(1), 59–68.

Lindtner, S. (2014). Hackerspaces and the Internet of Things in China: How Makers Are Reinventing Industrial Production, Innovation, and The Self. *China Information, 28*(2), 145–167. Doi: 10.1177/0920203X14529881

Lindtner, S., Bardzell, S., & Bardzell, J. (2016). Reconstituting The Utopian Vision of Making: HCI After Techno Solutionism, *CHI'16 Conference on Human Factors in Computing Systems*, San Jose, California, USA, May 7-12. Doi: 10.1145/2858036.2858506

Loh, P., Burry, J., & Wagenfeld, M. (2016). Reconsidering Pye's Theory of Making Through Digital Craft Practice: A Theoretical Framework Towards Continuous Designing. *Craft Research, 7*(2), 187–206. Doi: 10.1386/crre.7.2.187_1

Manzini, E. (2015). *Design, When Everybody Designs: An Introduction to Design for Social Innovation.* Cambridge, Mass: MIT Press.

Newell, A., & Simon, H. A. (1972). *Human Problem Solving.* Englewood Cliffs, N.J: Prentice-Hall.

Pierri, P. (2017) Decentralising Design. Raising The Question of Agency in Emerging Design Practice. *The Design Journal, 20*(1). S2951–S2959, Doi: 10.1080/14606925.2017.1352805

Rittel H. W. J. & Webber M. M. (1973). Dilemmas in a General Theory of Planning. *Policy Sciences, 4*(2), 155–169.

Sabiescu, A., Woolley, M., Cummings, C. & J. Prins. (2015). *Online Maker Communities: Craft and Engagement with Cultural Heritage, Communities and Technologies,* Limerick, Ireland, June 27-30. Retrieved from https://culturalheritagecommunities.files.wordpress.com/2015/06/ch-comm_2-0.pdf in September 2019.

Sanders, E., & Stappers, P.J. (2008). Co-Creation and The New Landscapes of Design. *CoDesign, 4*(1), 5–18.

Schön, D. A. (2017). *The Reflective Practitioner: How Professionals Think in Action.* London: Routledge. (Original work published in 1983).

Simon, H. A. (1973). The Structure of Ill Structured Problems. *Artificial Intelligence. 4*, 181–201.

Simon, H. A. (2008). *The Sciences of The Artificial.* Cambridge, Mass: MIT Press. (Original work published in 1969).

Storni, C. (2012). Unpacking Design Practices: The Notion of Thing in the Making of Artifacts. *Science, Technology, & Human Value, 37*(1), 88–123. Doi: 10.1177/0162243910392795

Taylor, J. & Townsend, K. (2014). Reprogramming The Hand: Bridging The Craft Skills Gap in 3D/Digital Fashion Knitwear Design. *Craft Research, 5*(2).

155–174.

Von Busch, O. (2010). Exploring Net Political Craft: From Collective to Connective. *Craft Research. 1*(1), 113–124.

Von Busch, O. (2012). Molecular Management: Protocols in The Maker Culture. Creative *Industries Journal. 5*(1-2), 55–68.

Wakkary, R. (2009). Anything Is a Fridge: The Implications of Everyday Designers. *Interactions, 16*(5), 12–17.

Willis, A-M. (2006). Ontological Designing. *Design Philosophy Papers, 4*(2). 69–92.