THE USE AND VALUE OF DIFFERENT CO-CREATION AND TOOLS IN THE DESIGN PROCESS.

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Abstract

When company representatives, academics, and design consultants engage in research and practice involving co-creation, it is usually conducted in a business context, driven by consumerism, and centered on innovation and creativity. However, the question here is the "creation of what". Since it cannot based on the assumption that all participants in the co-creation process have high technical and visualization capabilities. The results tend to be rather abstract highlighting merely the potential for new experiences or product service systems (PSS). Many participatory toolkits were developed for creating holistic spatial design solutions through arrangements, which somehow limit the designer´s creative space in developing monolithic stand-alone objects. Moreover, there are no other specific methods and tools, which downstream translate co-created experiences into tangible designed objects. With respect to the development of industrial designed products and involvement of different stakeholders, this article is intended to investigate, methods and tools, which can use in co-creation processes towards the form giving three-dimensional products.

Keywords: Participatory design, Design methodology, Collaborative design

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1   INTRODUCTION

The increasing interest is engaging in users and other partners in collaborative design results. Consequently, the application of collaborative design methods for managing problem identification and creativity is growing. In this article, the concept of co-creation is being discussed from a product planning and design perspective to determine its value for formgiving. Co-creation is considered to be an act of collective creativity by two or more peoples. According to Sanders & Simon (2009), many co-creation sessions occur today, within communities, in organizations, and among different stakeholders. For example, co-creation among companies and their business partners, co-creation between companies and their customers, co-creation among different type of users. In a co-creation activity, it cannot be assumed that all participants have equal compelling conceptual and visualization capabilities, questioning whether they share the same level of understanding of "what to create?" According to the authors, co-creation sessions are usually rather abstract, merely highlighting the potential of recent experience or concept of a product-service system (PSS).

As current trends in technology have helped to democratize creativity and facilitate stakeholder participation, it consequently created unlimited access to information and the ability to transmit globally. This trend has given designers a sense of empowerment as they see possibilities significantly to influence the business eco-system and their end-users. Bolton and Saxena-Iyer (2009), argued that co-creation occur in different stages of the design process. However, most frequently it is implemented to the Fuzzy-Front-End of Innovation (FEI). Here, stakeholders are invited to participate actively in the development of product and service ideas that may anticipate future needs. Furthermore, they are perceived to be the intermediates for communicating ideas and insights through Internet websites, e-mail, and social networks.

Existing toolkits (Sanders, 2006), are well defined and mature enough to make holistic spatial designs through arrangements. However, they somehow limit the designer´s creativity to develop monolithic stand-alone objects. At this point, no specific methods and tools can be found, which converted co-created experiences into tangibly designed objects, concretized by their inherent forms, textures, and colours.

In this article, the author aims to investigate several topics influencing co-creation activities in formgiving activities within the design process, as well as how they affect the communication of generating 3D designs. The author commences by elaborating on the roles and responsibilities of different actors in a co-creation process in Chapter 2. In Chapter 3, the author reviews the various types of co-creation values whereas Chapter 4 focusses on the design process, methods and tools for co-creation.

2   ROLES AND RESPONSIBILITIES OF ACTORS IN PARTICIPATORY DESIGN PROCESSES

2.1   The role of Co-creation in Form-giving

According to Akner-Koler (2007), the term from giving is derived from the Swedish and German words. Formgivning and formgeben which mean to give forms, as well as color, texture, sound, etc. to the concept, needs and desires of contemporary society. Within the context of industrial design, Smets et al. (2006) stated that, from giving is mainly concerned with features. According to Ali & Liem (2014), form-giving practices prefer to promote instinctive and explorative qualities rather than to employ established and structured methods for form development. In other words, formgiving is a distinctive activity in the process of analyzing existing and creating new products. Moreover, research on design processes and methods advocates a transition from user-cantered to human-centered design, where co-designing is changing the rules on how designers engage in formgiving. In a formgiving process, co-creation is about problem clarification, conceptualization, and materialization, where small groups composed of selected and predetermined stakeholders agree upon how to communicate the meaning of product forms to a broader audience. Transitions from research to design methods have extended user-cantered to human-centered approaches and changed the landscape of design practice by introducing a new field of practice, namely participatory design.

Participatory Design refers to the activity of designers and people not trained in design collaborating in the design and development process. In participatory design, actors are no longer seen as mere users, consumer or customers. Instead, they are considered "experts" in their understanding of living

and working conditions. Participatory design is the practice of the cooperative creativity. As elaborated by Sander et al. (2008), people can play a significant role throughout the design process and become co-designers, dependent on the level of expertise, passion, and creativity.

Participatory design activities between the designer and user happen in a two-stage process. Firstly, a common understanding and a platform for communication between the designer and user have to be established throughout the entire process. Secondly, implicit and explicit user needs are necessary to be aligned with the analytical and creative thought processes of the involved stakeholders. The designs resulting from the participatory process can be regarded as a form of conversation among the designer and distinct stakeholders. These conversations facilitate collective learning and the alignment of objectives, as well as design expectations in a participatory conceptualization process (Park, 2012).

2.2 The designer as a facilitator in Co-design activities

Although co-design relates directly to co-creation, Sanders (2006a) claimed that in the area of participatory design, co-creation and co-design has often been confused and treated synonymously with one another. In this article, co-design is referred to as a cooperative creative activity, applied throughout the entire design process. By these definitions, co-design is a distinctive part of co-creation. For a co-design session to take effect, stakeholders must be given the appropriate tools. At this moment, the role of the designer is to facilitate communication, creativity and envisioning among the stakeholders using a systematic process of creating, adapting, making and doing (Sander & Stappers, 2008). According to (Houstrup, 2010), most designers have professional intuition and experience. They can synthesis consumer needs, insights, and ideas into a holistic design solution, which makes them skilled interpreters, as well as indispensable drivers of a co-creation process.

3 THE VALUE OF PARTICIPATORY DESIGN

3.1 Types of Value

As mention earlier, co-creation activities involving companies, consumers, end-users, academics and practicing designers are usually centered on innovation and design. Based upon their professional and educational background, it cannot be assumed that all participants involved in co-creation activities possess comprehensive abilities to visualize and construct products and services. Those, who lack these abilities, need appropriate methods and tools to stimulate their creativity. Here, the value of co-creation is made explicit by determining how it can contribute to the design process in terms of methods, tools, and practices, as well as create extended value in the development of prospective products and services for selected stakeholders and users. (Liem & Sanders, 2013), (Cagan & Vogel, 2002). There are at least three types of values can be identified, which applies to co-creation. These are monetary, use/experience and societal value.

- Monetary Value

Equations According to Sanders & Simons (2009), the monetary value typically receives much attention in co-creation activities, which focus on business development and marketing. Monetary value, seen in the light of designing, is constituted by the desire to make money through the creation of innovative, sustainable and prospective products and services. It is based on transaction metrics of conversation between what the company offers and what consumer's experience. Sanders & Simons (2009) commented that monetary value co-creation does not require direct contact between the business and its customers. It can attribute to the fact that the conversation can be mediated by information and communication tools. For example, a web-based survey that asked consumers to select features of choice or the crowdsourcing of a vast number of respondents

- User or Experience

Values that determine user experiences have an impact on the ability of companies to transform user insights and requirements into products and services, which meet or preferably exceed user expectations. Moreover, co-creation that facilitates user experience also plays a significant role in developing brand values. The High brand value can have a significant impact on loyalty among existing and potential consumers, because of memories and lasting experiences. These consumers purchase the brand rather than the actual product.

- Societal Value

Social value is motivated by aspirations to improve sustainable ways of living. The collective visualization of ideas and needs can enhance the cooperative creativity among stakeholders, who involved in co-creation activities. The contribution of participatory design in generating societal value has led to a consensus among stakeholders on how to recover the quality of life.

4   PHASES OF THE DESIGN PROCESS

In a classic design process, the designer usually engages in analytical, creative and synthesis activities once the design brief has presented. On an operational level, this implies that the designer is very much involved in determining requirements (research). On top of that he or she proceeds by setting design directions (strategy), evaluating design (usability testing), and observes how the released product is being used in existing and new contexts. According to Sanders and Stappers (2014), a design process is characterized by four phases; pre-design, generative design, design evaluation, and post design. The pre-design phase, also known as the fuzzy-front end, systematic processes and methods are applied to address ill-defined problems and to determine the context for innovation, mostly at an abstract level. Possible implications are that deliverables cannot accurately be predicted in this phase. It can be a product, service, an interface, or something else. After that, contextual research is being undertaken to develop, design requirements, which can be used to structure and direct exploratory and generative designing activities. In the evaluative design stage, proposed design concepts are measured and further developed into a materialized design solution. In the post of designing stages, marketing, sales and distribution strategies are recognized to introduce the final design into the market. Complementary, after-sale service measures are established to enhance the total product-service experience**.**

4.1 Co-creation in the Design Process

A co-creation process always begins with understanding the needs of the different stakeholders and objectives of the project. Furthermore, when applicable, consequences of these co-creation activities can be extrapolated to more concrete design solutions. Distinctive research methods and tools, such as interviews, ethnographic research, personas, focus groups, background inquiries, and web analytics were utilized to enhance the understanding of the innovation context and clarify design problems. According to Sanders and William (2001),(Sander & Stapper 2008), (Metalmaki & Sleeswijk-Visser 2011) all people are creative can contribute to design if provided with appropriate toolkits, which can assist them in generating 3-D forms.

Table 1 has juxtaposed the distinctive values of co-creation with the different stages of the design process to determine where certain co-creation activities are most useful. For example, co-creation, which addresses monetary value, happens predominantly from the design to the after sales stages of the design development process. Value co-creation of use/ experience juxtaposed with the discovery, marketing, and sales stages whereas societal values mostly addressed by co-creation activities in the pre-design, development and design stages. According to Sanders & Simons (2009), the earlier co-creation activities are deployed in the design development process, the more impact it may have in successively creating value in all stages. When addressing societal values, co-creation activities are democratic and visionary, implying mainly a facilitative role of the designer. However, when user experience and monetary values are being targeted in the conceptualization, realization and marketing stages of the process, the designer gradually adopts a more creative and communicative role in co-creation sessions.

Table 1: Adopted from The co-creation of value in the design process, 2010,
http://www.slideshare.net/lideresacademicos/conferencia-elizabeth-sanders

Table 2 below addresses the application of different tools in value creation activities. Furthermore, it illustrates the connection of these tools with the design process, as well as with their exclusive co-creation aims. Table 2 juxtaposes the distinctive values of co-creation with the different stages of the design process, design phases, and tools. For example, the societal value is mostly co-created in the pre-design and conceptual design phases. Toolkits such as probes were applied in pre-design phases in order to enhance the cooperative creativity between the stakeholders who were involved in co-creation activities. Probes are small packages that can include any artifact (like a map, postcard, camera or diary). Probes come along with evocative tasks, which are given to participants to allow them to record specific events, feelings or interactions. The aim is to elicit inspirational responses from people in order to figure out their culture thoughts and values better, and provide inspiration for designers (Gaver, Dunne, & Pacenti 1999). Tim Brown, CEO of design firm IDEO uses selected design methods, such as Journey mapping to study clients in their environments. Instead of meeting them in focus groups or on an individual basis to conduct interviews and observations (Harvard Business Review, 2010). Hulkko et al. (2004) used "Mobiles Probes" in a pilot study on dual band mobile phone with GPRS connections and on the use of external accessories for digital cameras. In this pilot test, Hulkko used probes to give people tools to record, reflect on and express their thoughts on environments and actions. One of the aims of this method is to determine a communication link between the users and the designer and to inform and inspire the design team. Probes method can be applied to investigate design-related context, where preferences, social considerations, and functionality issues influence the acquisition and use of products.

Co-creation in the generative design phases distinguishes between the use of probes and generative toolkits. The use of generative toolkits is to promote dialogs between designers and users without seeing the designer as an expert. Hussain and Sanders (2011) discovered the challenges and implications of applying generative design tools to children with prosthetic legs in Cambodia´s countryside in participatory design activities. Moreover, the development of toolkits to facilitate and evaluate co-creation activities in the generative design phases constituted an act of value creation. For example, Babcock (2013), who was inspired by Liz Sanders and MakeTools.com, organized a brainstorming and prototyping session to create tools to utilize in their participatory research and rapid prototyping sessions. Use or experience/monetary value have predominantly been generated by marketing related co-creation activities in post design phases. At this moment, prototyping can be regarded as a fundamental activity of designing and design evaluation. Houde and Hill (1997) discussed that it was important to align the different types of prototypes with the intention to optimize design activities throughout all design phases. For example, designers at IDEO were employed to expand internal prototyping practices to embody the concept of experience prototyping' as an integrated part of the design process. In the after-sales stages, co-creation activities also aim to explore strategies and concepts for subsequent design projects. This monetary value again will be involved in pre-design phases and probes toolkits. As an example, IDEO design firm conducted several Human-centred Design (HCD) sessions in order to discover the community and its relationship to technology. IDEO has utilized toolkits such as interview, observation, and conversation of the divergent value of HCD to find out the community to facilitate analytical and creative activities.

Table 2: Co-creation value, co-creation and design phase grouped according to particular qualities

Co-creation value	Co-creation	Design phases	toolkits
Societal	Pre-design	Pre-design	probes
Societal/use or experience	Design research, Discovery	Generative design	Probes, generative toolkits
Societal/use or experience	Design	Evaluating Design	prototyping
Use or experience/monetary	Marketing sales and distributions	Post design	prototyping
Monetary (vision and definition setup)	After sales	Pre-design	probes

4.2 Methods and Tools in the Design Process

Methods and tools for conducting participatory design research have found their way into basic and advanced textbooks (Sanders & Stappers 2012), as well as practitioner-oriented guides (e.g. Kumar 2012; van Boeijen et al. 2013). These methods and tools can usually be adapted to a particular innovation or design context with respect to project theme, as well as the design process. The author discovered that selected methods and toolkits could be structured and organized to assist different groups of stakeholders in co-creation activities. Methods and toolkits help the team with insights and creativity in the pre-design, discovery, design, marketing, sales, and after-sales stages. However, one cannot be ascertained that co-created experiences can be directly translated into tangibly designed objects, which are concretely form given. According to Sanders et al, (2012) the only implicit way of involving participants in a form giving activity is by engaging them more frequently in "creative acts of making".

4.2.1 Pre-design Phase

In the pre-design phase (fuzzy front end), it is not very common for users and other stakeholders to play a pro-active role in strategizing new products and services. Normally, their involvement is predominantly evaluative. However, recent debates argued for a more design-led approach. According to Sanders and William (2001), there are research methods and tools that can harness and stimulate people with creativity in the primary "fuzzy front end", with given the appropriate tools. Examples of creative research tools are pre-meeting immersion tools and group meeting tools.

Pre-meeting Immersion tools. For the effective of co-creation meeting, the author realizes the participants are introduced to the methods and instruments in advance. They can then decide how to apply these methods and tools to translate their experiences into insights and creative ideas beforehand. Below there are three instances of pre-meeting tools, which can use individually or collectively. These tools are designed to allow participants to use their previous immersion activities to stimulate creative exploration

- Workbooks - A workbook can be considered to be the personal directory for gathering information detailed information about, objects people and people's preferences.
  Diaries/ day-in-the-life exercises - This platform provides people with an outlet to record details about their activities, which they frequently assumed.
  "Send a camera home" – using a camera complements what is being documented in the workbook and diaries and adds a visual dimension to the participant's experiences.
- Group meeting tools
  There are just a few examples of tools that can be used in group meetings. They are designed to allow participants to use their previous involvement to stimulate creative exploration.
  Collages, which articulate people's experience through pictures and words. It is about giving people a set of picture and word stickers to be arranged according to designers' instructions
  Brainstorming, which is a creative activity, where people produce as many ideas possible. The tone of his session is open to the inscription and tolerant. Brainstorming serves to promote a culture of building on the ideas of others generated from multiples perspectives and levels of expertise. Sanders and Williams (2001) claimed that concurrently using brainstorming and collages provides the participants to translate their experiences.
  Pilot testing, which according to Sanders and William (2001) are formal and structured process for evaluating market demands and product designs in a controlled environment. Pilot tests produce preliminary data about the client, markets, and revenues. Pilot testing within the context of co-creation in the form giving starts with disseminating proper descriptive and visual instructions to a selective tool of participants for instant feedback. As an example, LatAm Argentine, an energy company decided to redesign their building by involving all employees from operations to higher management in a co-creation activity with building consultants. A LEGO Serious Play facilitator was called in to run the co-creation sessions and analyze the results, which may have impacted future workplace design and management. The initial design was then presented and discussed with close and distant stakeholders.
  Velcro Modelling is a low fidelity three-dimensional modeling tool, which allows people to embody and express their ideas. Velcro kits consist of shape, buttons, and other items that facilitate creative exploration (Sanders and William 2001). Figure 1 show a sample of Velcro-Modelling kit.

Figure 1: A sample Velcro-Modelling Kit. (Adopted by Sanders and William, 2001).

4.2.2 Design Research, Discovery Phases

Design research is embedded in design and research-based design practices. Some design research methods and tools, which facilitate the participatory design, are, for example, cultural probes, and game storming. The latter is a typical Generative Design tool, suitable for visualizing 2D and 3D proposals early in the design process.

Cultural probes are artifacts used to provoke responses from individual participants. The aim of using probes by designers is to detect inspiration from user's reactions to their suggestions. These answers are then interpreted and applied by designers according to their discretion. Probes can take on an extensive variety of forms (such as diaries, work-book, cameras with instruction, games). Fieldwork constitutes of cultural probes. For example, Taking photos of people, artifacts, and the surrounding environment during fieldwork will make great references to overall research efforts. In contrast to probes, generative design toolkits guide participants to remain more involved in the designing of future contexts, scenarios, and planning of prospective services or products. In other words, with these toolkits non-designers can imagine and express their ideas about future living, work, and play (Sanders et al. 1999). With respect to this phase, the authors claim that Game storming is a suitable generative design tool. Co-design offers participants a participatory design method that helps them to explore and concretize anticipated needs and prospective ideas. In other words, using Design Games as a tool for co-creation activities should not be underestimated with respect to envisioning the future. According to Vaajakallio and Mettalmaki (2013), game design can be used as a tool for gradually engaging users and others design partner in co-creation activities earlier in the design process. The connectivity between codesign and gaming, the author identified that there are four main purposes result found out by employing the design games. There were, 1) for research, 2) for building design competence, 3) for empowering users, i.e. People who are not traditionally part of the design process but are influenced by design, and 4) for engaging multiple stakeholders. Nowadays probes and generative toolkits overlap each other to a large extent. For example, Mattelmaki (2005) described how design probes and generative toolkits engage different stakeholders back and forth in planning, creative dialogs, and design activities. According to Sanders (2000), generative tools reveal a new language for communicating through visual and descriptive components. Furthermore, Sanders (2000) added that a generative toolkit usually comprises of a scaled setting complemented by pre-determined components that can be arranged and juxtaposed in a variety of ways.

These toolkits made of simple 2D or 3D elements (such as pictures, words, phrases, block, shapes, buttons, pipe cleaners, wire)

4.2.3   Design Phases

Designing involves identifying alternatives that discovered through exploring problems and solutions which are highly complex (Mattelmaki et al. 2009).To enhance co-creation and design activities among the different stakeholders, 2-D, and 3-D visualization tools should be utilized to communicate research, conceptualization and materialization stages of the design process. Furthermore, the purpose of using collaborative prototypes is to facilitate contextualization, action, and reflection in co-creation workshops.

Prototyping is an indispensable tool for product and interaction design. Schøn (1983) argued that prototyping is about choosing a focus, making moves, and reflecting on core components of the design. Kelley (2001) characterized prototyping as an act of exploration before finding the right answer. According to Sade, (2001) prototyping is applied for idea generation, communication, and testing. Similarly, collaborative mock-ups aim to clarify the conceptualization and materialization as well as facilitate decision-making in the design process. Prototypes are physical manifestations of ideas and concepts. They range from rough ones (giving an overall idea only) to finished versions (resembling the actual result). The idea of using prototypes is to materialize a detailed concept, which incorporates technical, ergonomic and aesthetic functionality. Prototypes can be made from a very

wide array of materials including clay, foam, wood, plastic, simple digital and electronic components. The designer creates prototypes to envision their ideas and design intentions as well as to receive feedback from stakeholders in participatory design sessions. Our daily sketching and prototype work mainly happen using desktop applications. However, with the recent infiltration of mobile applications, digital sketching, and prototyping tools have been extended to be more real-time and interactive. An example, Doodler 3D pen that able to draws in the air or on surfaces. It is compact and easy to use and requires no software or computers

Virtual Prototyping is an alternative tool for co-creation alongside prototyping and gaming. MIT digital media technologies (Nagakura 2012), has proposed a 3D sketching application for volumetric designs that provides designers with intuitive body-engaging interaction styles and computational functionalities for exploring different design options. Throughout the prototyping activities using KINECT scanning solutions, 3D sketching tools establish the integration of visual objects and gesture –based interfaces. In this prototype, the virtual object continuously alternates, and the user can operate this object by pushing and pulling with the hands. A simple structure used for geometric representations. Another example figure 2 below, where virtual prototyping complements co-creation is through the involvement of collaborative three-dimensional sketching tools, such as Hyve-3D. Hyve-3D is a tool developed by the University of Montreal and was presented at SIGGRAPH 2014 conference in Vancouver. This 3D sketching system revolutionizes design interaction and collaboration through immersive interfaces for embodied and collaborative 3D sketching. The 3D images are the outcome of an optical illusion created by a widescreen high-resolution projector, `a specifically designed 5m-diameter spherically concave fabric screen and a 16-inch dome mirror projecting the image onto the screen. Hyve-3D contributes in terms of design to a broad variety of fields, such as industrial and architectural design, design engineering, game design, animation, and movie making.

Figure 2: Adopted from 3D sketching system 'revolutionizes' design interaction and collaboration University of Montreal researchers present their Hyve-3D system at SIGGRAPH 2014 Conference August 12, 2014

4.2.4 Marketing and Sales

In these final stages of the development process, the following methods and tools are most suited for co-creation activities.

Learning launches. These are experiments conducted in the marketplace quickly and inexpensively to gather market-driven data. Learning launches are design to taste the key underlying value –generating assumptions of potential new growth initiative in the marketplace. Ledithka (2010) Professor of Business Administration, and Ogilvie, CEO of Peer Insight introduced "Learning Launches" to test the critical underlying value-generating assumptions of a potential new growth initiative in marketplaces. Learning launches are expected to feel real to both launchers and customers. The goal of the launch is to justify the potential and attractiveness of a certain business initiative. Furthermore, learning launches can be seen as an extension of the co-creation process, which translates the concept into a low-fidelity prototype to be shown to clients.

4.2.5 After Sales

Companies implement collaborative methods to facilitate interaction with customers, dealer, suppliers, and employees, not only with respect to creating new products and services, but also to strategize follow-up initiatives. These follow-up actions can be the development of new or redesigned products, the implementation of after-sale service programs, or the construction of complementary brands and identities. After-Sales endeavors, companies, need to tap into experiences and feedback from users and other stakeholders, who are involved in the primary creation of the core product or service. In support

of co-creation, automotive advisory leader, Dietmar Ostermann, suggests that automakers should involve all stakeholders, including suppliers and distributors, in after sales co-creation activities to address minor product and service improvements, decrease operation costs and as well as a build brand awareness among clients (PwC's global press, 2013).

5 DISCUSSION

Research on design processes and methods advocates a transition from user-centred to human-centred design. (Sanders & Stappers, 2014). In these situations, co-creation changed the rules for designers to be differently engaged in design activities. In this paper, the authors analytically discussed the role of co-creation and responsibilities of actors in participatory design processes as well as restructured frameworks, methods, and toolkits according to the type of co-creations process. In particular, the use of participatory methods and tools in conjunction with different stages of the design process has been the focus of this study. For example probes, toolkits and prototyping constitute three approaches to making and were applied to support design thinking activities. For example, virtual sketching tools allow stakeholders to communicate on the same platform, with being physically present at a common site. The juxtapositioning of established literature on co-creation, methods, and tools, and design processes promotes a classification framework for showing these relationships as well as how these relationships contribute to co-creation value. The authors agree with Sanders (2009) that when addressing societal value, co-creation activities are democratic and visionary, and the role of the designer is mostly facilitative. However, as user experience and monetary values are being targeted in the conceptualization, realization and marketing stages of the design process, the designer should increasingly adopt a more creative and communicative role in co-creation activities. The intersections of the phases of the design process and different types of targeted values, demonstrate a significant potential in using typical participative methods in designing concrete product and services (Sanders & Simons 2009). Furthermore, the use of co-creation methods and tools, such as cultural probes (Gaver, Dunne, and Pacenti 1999) and generative toolkits (Sanders 1999) has resulted in more noticeable forms of exploration, conceptualization, creation and evaluation of the fuzzy- front end of innovation.

Form-giving practices aim to promote instinctively and explorative qualities rather than employing structures methods in generating pure ergonomic and technological, functional designs. From a creative and participatory design perspective, form giving is very much driven by methods and tools, where designers are expected to introduce analytical and generative 2-D and 3-D visualization tools to help non-designers to anticipate needs and imagine future design solutions. In this context, the role of co-creation using form-giving not only contributes to the development of shapes, colors, and textures. It also aims to respond to individual and societal needs by influencing the aesthetic qualities of the artifact and how these qualities complements meaning-making, technical, user functionality as well as production. On a final note, co-creation is indispensable for strategic and industrial design as it creates additional value throughout all its stages.

In the process of problem clarification, conceptualization and materialization, co-creation methods are valuable to capture and document the interactions among the participants and between the participants and object(s) in context.

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