

Design Thinking Methods and Tools for Innovation

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Abstract. Design thinking (DT) is regarded as a system of three overlapping spaces—viability, desirability, and feasibility—where innovation increases when all three perspectives are addressed. Understanding how innovation within teams can be supported by DT methods and tools captivates the interest of business communities. This paper aims to examine how DT methods and tools foster innovation in teams. A case study approach, based on two workshops, examined three DT methods with a software tool. The findings support the use of DT methods and tools as a way of incubating ideas and creating innovative solutions within teams when team collaboration and software limitations are balanced. The paper proposes guidelines for utilizing DT methods and tools in innovation projects.

Keywords: Design thinking · Design thinking methods · Design thinking tools · Innovation · Personas · Stakeholder map · Customer journey map

1 Introduction

Design Thinking (DT) has attracted the interest of both scholarly and practitioner literature because of the applicability of design methods for promoting innovation and the applicability of DT across many areas, such as in business [25]. The DT is regarded as a system of three overlapping spaces, in which *viability* refers to the business perspective of DT, *desirability* reflects the user's perspective, and *feasibility* encompasses the technology perspective. Innovation increases when all three perspectives are addressed. The DT's ability to solve more complex problems, so-called wicked problems [6], has designated it in the business milieu as a promising approach for innovation. A large number of design methods and tools facilitate the DT process and support fostering innovations in teams, consisting of both designers and non-designers. From a designer's or a human-computer interaction designer's perspective, this methodology incorporates ideation and creative process attributes, such as empathy for the user, and methods including rapid prototyping and abductive reasoning [19]. From a business perspective, the establishment of a deep understanding within a team of targeted users is one of the important components of DT methodology [22].

Businesses recognize innovativeness as a driving factor for business growth to maintain a competitive advantage in the market and as more likely to offer unique

benefits to customers [26]. Understanding how innovation within teams can be supported by DT methods and tools captivates the interest of business communities. However, there are few relevant studies [1, 2, 13] and a lack of specific design guidelines on how to foster innovations with DT methods and tools that could be used by teams of non-designers, such as in a business community. For this purpose, a case-based qualitative approach was employed in this study, extending a previous work on DT methods and tools [7]. The research design includes data collection across two workshops, in order to provide rich insights. The findings support the use of DT methods and tools as a way of incubating ideas and creating innovative solutions within teams when team collaboration and software limitations are balanced. In conclusion, the paper proposes guidelines for utilizing DT methods and tools in innovation projects.

The paper is organized as follows: Sect. 2 provides a review of relevant studies; Sect. 3 analyzes a list of DT methods and tools that could be used to foster innovations. Section 4 describes two workshops conducted with different setups, while Sect. 5 discusses the results and make suggestions for DT methods and tools. The study's limitations are presented as well in the Sect. 5, followed by the conclusions.

2 Design Thinking as an Innovation Approach

Companies and organizations need to innovate in response to the competition and rapidly changing market demands. For this reason, DT is considered a supportive approach for a range of business challenges that should be pursued by both designers and non-designers [25]. Especially for the first phases of innovation, DT has been argued as a successful method for generating ideas [24]. Several connections between DT and innovation, as well as factors affecting the growth of innovation, can be found in the literature [e.g. 4, 14, 25]. According to Harhoff, Henkel, and Von Hippel [17], “innovation is often a process to which several actors with complementary capabilities contribute.” Similarly, Baregheh et al. [3] defined innovation as a “multi-stage process whereby organizations transform ideas into new/improved products, service[s] or processes,” focusing also on the multidisciplinary aspect of innovation.

On the other hand, DT can also be viewed as “the application of design methods by multidisciplinary teams to a broad range of innovation challenges” [25]. Seidel and Fixson [25] studied the adoption of DT by novice multidisciplinary teams. “If design thinking is to be widely adopted, less-experienced users will employ these methods together, but we know little about their effect when newly adopted” [25]. Their study’s [25] implications are that novice multidisciplinary teams will more likely succeed in applying DT when they can be guided to combine methods, are aware of the limits of brainstorming, and can transition from more- to less-reflexive practices. Moreover, companies adopt multidisciplinary teams during DT processes as a strategy to increase team performance [30]. The process of innovation and how it is managed constitute a key strategic issue for companies that rely on multidisciplinary teams. In turn, the adoption of multiple design perspectives is expected to increase performance in terms of the quality of decision making or the innovativeness of problem solving [30]. West et al. [30] examined the relationships among team processes, leadership clarity, and innovation in a healthcare context. In the innovation

process, models of brainstorming imply that group creativity can benefit from multidisciplinarity, as brainstorming groups often generate creative and novel ideas, and the group setting is believed to elicit a higher level of cognitive stimulation [12]. Moreover, higher degrees of multidisciplinarity are associated with a broader range of knowledge, skills, and abilities available to a team [30].

A relevant effect of the DT process that may have on team collaboration is the divergent and convergent thinking [5]. During an innovation process supported by DT, a team needs first to broaden their thinking, making it divergent, allowing multiple inputs for their problem area. This creative part of the innovation process usually results in a correct definition of the real problem [5, 15]. In the phase of divergent thinking, searching relevant information and creating new about the task will give a better insight and will also balance the lack of entrepreneurial experience a team may have [15]. As stated by Gurteen's [15] "creativity and innovation concern the process of creating and applying new knowledge," supporting divergent thinking as a relevant attribute for innovation. The composition of a team is also affecting the process at this stage. As it was mentioned earlier, the multidisciplinarity is a relevant aspect to take into account when fostering and stimulating creative inputs [12] in divergent thinking. The last phase of the innovation process entails putting ideas into action, adopting a more convergent thinking [5, 15] and employ an innovative solution.

Garcia et al. [13] described a study whose workshops used service design tools as frameworks to generate, develop, prototype, and assess business ideas that could potentially become business opportunities. They argued that both a "designerly mindset" and the above-mentioned service design toolset might be transferred from design to entrepreneurship to support the development of new entrepreneurial ventures. Finally, Beckman and Barry [4] discussed strategies for encouraging innovation through education and design of organizations and work spaces, suggesting that design constitutes of two phases of design: (1) an analytical phase of finding and discovery and (2) a synthetic phase of invention and creation. They [4] proposed a combination of these theories that would lead to innovation through observational or ethnographic research, creating frameworks for understanding data, analyzing new customer needs, and developing solutions or new products to meet these needs.

Consequently, DT addressed by DT methods and tools is considered supportive for generating innovation and a number of factors could affect the development of innovativeness. Although DT methods have been connected with generation of innovations, how DT tools foster innovations has received little attention in existing research and captivates the interest of business communities.

3 Design-Thinking Methods and Tools

A large number of design methods and tools facilitate the DT innovation process. Alves and Nunes [1] surveyed various sources from both industry and academia and collected more than 164 methods and tools related to service design (SD). The suggested taxonomy of the selected 25 SD tools and methods [1] provides guidance to novice participants and enforces team coherence, while it can be supportive for practitioners.

Using a four-quadrant chart, Alves and Nunes [1] clustered the most relevant methods according to various dimensions, such as the motivation to use it, the audience, the representations used, and activities in the design process. The majority of these methods are used to understand the problem [1], and thus selecting the right methods is important especially in first phases of the DT process.

The DT process consists of five stages: empathizing, defining, ideating, prototyping, and testing [5]. Empathizing relates to direct interaction with users, on whom the definition is based. Ideation phase includes brainstorming and generating solutions, while the prototype phase implies rapidly making numerous prototypes. Finally, the test phase can also include the final implementation. From a design perspective, it is possible to address DT as the creation of meaning [20] and making sense of things [9]. Selecting the right tools is undoubtedly important for effective decision making and communication in a multidisciplinary team. The tools can be physical, such as a pen, paper, and whiteboard, or software tools with rich graphics that support the DT process. The tools can also be used to help a team adopt a new perspective on design tasks, to visualize the system's complexity and depending on the design stage reflect a convergent or divergent view of design.

The rest of this section presents six selected DT methods, with a corresponding, web-based software tool that can be used to implement each method. The criteria for choosing these methods lie in their visualization techniques and ability to enhance communication within multidisciplinary teams, but also in their simplicity in use by non-experts.

3.1 Personas

The persona method can help identify the user's needs and desires. A persona is “a user representation intending to simplify communication and project decision making by selecting project rules that suit the real propositions” [18]. Personas represent a “character” with which client and design teams can engage and use efficiently in the design process. The method is used for the development of marketing products, for communication and SD purposes, to reflect the human perspective of DT [28]. Personas can be used during the empathizing or defining phases of DT. An example of a software tool for creating personas is Smaply,¹ a web service that hosts and presents personas and other methods, such as stakeholder maps and customer journey maps. Smaply provides several options for describing personas, including ready-made avatars, quotes, options for collaboration, and engaging visualizations.

3.2 Stakeholder Map

A stakeholder map is a visual or physical representation of the various groups involved in a particular product or service, such as customers, users, partners, organizations, companies, and other stakeholders [28]. A stakeholder approach reflects the human and business perspective of DT. The interplay and connections among these various stakeholders can be charted and analyzed for various purposes. Curedale [11] argued for the

¹ Website: www.smaply.com.

importance of identifying key stakeholders and their relationships as part of the defining process in DT. An example of a software tool for creating stakeholder maps is Stakeholder Circle.² It was designed to put stakeholders on the management radar, facilitating regular updating of the assessment as the stakeholder community changes to reflect the dynamic nature of the project and its relationships.

3.3 Customer Journey Map

A customer journey map (CJM), which originated from the technique of service blueprinting [27], describes a collection of touchpoints from the beginning to the end of the service delivery, as seen from the customer's point of view. A touchpoint is defined as "an instance or a potential point of communication or interaction between a customer and a service provider" [16]. The CJM helps the identification of chances for service innovation and problem areas for service improvement [20]. It is a common perspective shared by design/consultancy firms and experiential service providers [21, 29], categorizing the method in the human and technical sides of DT. It can be used during the empathy phase. Visualization of a service user's experience can be presented by Touchpoint Dashboard,³ a web-based system for creating CJM. It uses common visual notations to unite a team and converts the information into an intuitive, data-rich map of a customer journey.

3.4 Service Blueprint

Introduced by Shostack [27], the service blueprint is a template that shows the steps and flows of service delivery that are related to stakeholders' roles and the process. Service blueprints show the actions between customers and service providers during a service delivery. It is a process-oriented method for the business and technical perspectives of DT and shows all actions, including technical activities. Such a blueprint may benefit designers in the early innovation process, such as defining a phase, by showing the series of actions of both in-front tasks—actions that can be seen by the customer—and back tasks—actions that cannot be seen by customers, such as those among employees in the back office. A web-based tool for blueprint diagrams is Creately⁴ that is based on the early version of the service blueprint made by Shostack.

3.5 Business Model Innovation

The business model (BM) innovation is about exploring market opportunities; the challenge is to define what the BM actually entails. The Business Model Canvas (BMC) [23] is a visual way of handling a BM and related economic, operational, and managerial decisions. Generally, a BMC describes the business logic of an idea, product, or service

² Website: www.stakeholder-management.com/.

³ Website: www.touchpointdashboard.com.

⁴ Website: <http://www.creately.com/>.

in a simple and visual representation. The BMC mostly reflects the business perspective of DT and can be effectively used in the ideation phase. An example of BM innovation web-based tool is Strategyzer.⁵ It includes the nine building blocks of a BMC with simple Post-it notes that can be placed on the blocks. It also supports economic analysis, conversations among users, and an engaging interface.

3.6 Rapid Prototyping

The rapid prototype (RP) is a quick formation of visual and experiential manifestations of concepts [22]. It can assist in determining which solutions are technologically possible. Prototypes can be created and quickly tested using the RP method. It can thus support communication in multidisciplinary teams in collaborative settings, such as workshops, by facilitating conversations and feedback regarding solutions for a particular product or service. The RP reflects more than the technical perspective of DT and supports the DT prototype phase, which should be robust and fast. An example of an RP software tool is Axure RP,⁶ which provides wireframing, prototyping, and the specification tools needed. It has a graphical user interface for creating mockups of websites and applications. Axure RP can help users generate quick ideas to immediately improve the design and obtain direct feedback.

4 Case Study

We conducted workshops with users to investigate how the DT methods and tools support innovation and collaboration within teams. To gain rich insights into the associations between innovation and collaboration, we selected two different setups in terms of the participants' backgrounds and motivations for using DT methods through the tools. The selection of DT tools for the workshops had the prerequisite of providing both convergent and divergent thinking in a task [14, 15] and simplicity in usage. Therefore, we selected a web-based tool that incorporates three DT methods, personas, stakeholder map and CJM. The Smaply tool was found to meet our requirements, with an intuitive user interface and attractive visualizations.

4.1 Workshop 1

The first workshop took place in January 2015 and was hosted by an academic library in a Scandinavian country. Six participants took part in a 2-hour workshop. Due to some organizational issues, four library staff members were present, together with two PhD candidates and the three authors of this paper. All the participants had previously joined different seminars and workshops [10], where the main method used pen, paper, and SD cards [8]; they were also familiar with one DT method (CJM). None of the participants had used Smaply before, and they had very good computer skills. The objective here

⁵ Website: www.strategyzer.com.

⁶ Website: www.axure.com/.

was to use the Smaply tool to transfer a service from a previous workshop, and the second task was to develop a new service. In their previous workshop some days ago, the participants used DT method, the CJM for a working project, using SD cards, post-it notes, and paper. The CJM envisioned how a university researcher could gain access to, borrow, and download e-books by using a library website.

Divided into three groups, all participants were informed about the process and were active during the workshop. Each one of the authors joined one group, with an assistive participant role during the process, mainly to facilitate and observe the flow of activities. The groups worked with one laptop each and in the same room, allowing communication and collaboration with one another. Field notes were taken during the process and screenshots of the generated material from Smaply were used as data collection methods. After a short introduction to Smaply, the participants worked consecutively on the three tasks, personas, stakeholder maps (Fig. 1) and CJM, with a small break among tasks. At the end, they joined a short discussion with the facilitators to share their personal reflections.

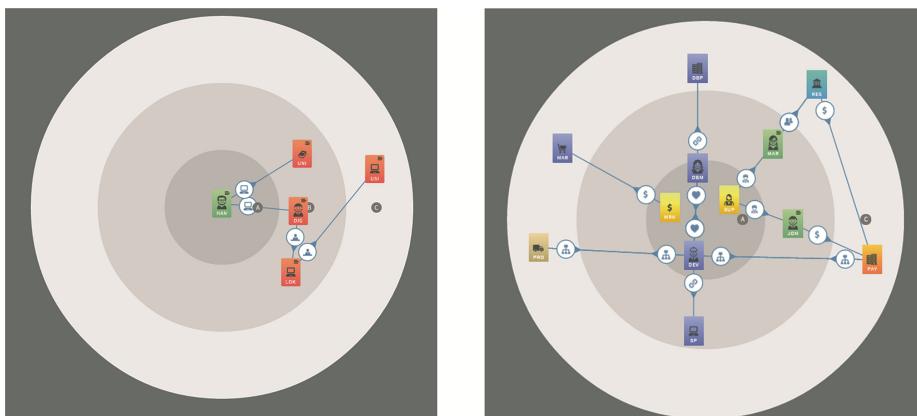


Fig. 1. Artifacts from Workshop 1 (left) and Workshop 2 (right)

4.2 Workshop 2

The second workshop took place in February 2015 and was hosted by university facilities. Seven participants, both MSc and PhD students, took part in a 2-hour workshop. The participants had no prior experience with workshops, but they had previously utilized other DT methods and tools (business modeling). None of the participants had experience with Smaply, but they had very good computer skills. The objective of this workshop was to use the Smaply tool as a part of their semester project, where they would utilize SD for a new application (app) service.

The participants were divided into three groups, with both students and one of the authors of this paper having the same role as in the previous workshop. All participants were informed about the process. The three groups worked with their laptops in the same room, allowing communication and collaboration with one another. Field notes taken

during the process and screenshots from the generated material were used as data collection methods. After a short introduction to the Smaply tool, the participants worked on the three tasks, with a small break among tasks. Finally, they joined a short discussion with the facilitators to share their personal reflections.

4.3 Results

Overall, the workshops had positive outcomes; the participants were actively involved and worked during the 2 h of the sessions. Once the participants became familiar with the tool and the process, it was easier for the authors of this paper to observe the process. Table 1 summarizes the results from both workshops, with the corresponding objectives, DT methods, and three related characteristics: type of thinking that DT reflects, collaboration, and multidisciplinarity of the groups.

Table 1. Summarized findings

Objective	DT method (with Smaply)	Type of thinking	Collaboration	Multidisci- plinarity
Workshop 1				
Redesign a service, design a service	a. Personas	Convergent	Method-driven	Yes
	b. Stakeholder map	Divergent	Method-driven	Yes
	c. Customer journey map	Convergent/ Divergent	Tool-driven	Yes
Workshop 2				
Redesign part of a service, design a service	a. Personas	Convergent	Method-driven	Yes
	b. Stakeholder map	Divergent	Method-driven	Yes
	c. Customer journey map	Convergent/ Divergent	Method-driven	Yes

The first main observation for the first workshop is related to the technical constraints of the tool. The objective to replicate a task from a previous workshop gave the participants training time to familiarize themselves with the user interface of Smaply. Creating personas seemed easier than the other two tasks, and one group enjoyed the simplicity of the interface. The other two tasks (stakeholder map and customer journey) were more complex for the participants, where they followed an iterative process to improve the first task (personas). Some participants mentioned encountering technical issues when performing the customer journey task in Smaply, which was the most important task for them (tool-driven collaboration). One group created three customer journeys, reporting “the lack of richness of Smaply” and other technical issues regarding icons, labels of buttons, space limitations, and difficulty in using option personas in customer journeys.

Another observation topic for the first workshop was how they will overcome the constraints of the tool. Generally, all the groups worked intensively, but they shifted the focus away from the real task. One group ended up with a new solution, apart from redesigning the service. For the other groups, the final results didn't provide new services and innovations, but the compromise between discussion and accomplishment of the task gave fruitful reflections on Smaply. One group followed a more cooperative pattern throughout the workshop, sharing ideas and supporting each other to accomplish the tasks. The other groups interacted more on problem solving for the Smaply interface.

The second workshop demonstrated different results. The first main observation was the extensive cooperation during the session. Before working on the tasks, the groups engaged in long discussions about different aspects of the tasks and tried to frame and conceptualize the tasks in relation to their previous experiences in DT methods (method-driven collaboration). Generally, the participants defined their roles in group work, where one participant was interacting with the software and the rest of the group members were discussing about how to proceed with the task. Especially after the first task (personas) the discussions opened up to the overall picture of the project and became more animated concerning project-related problems, such as how to solve dependencies among stakeholders. The groups also faced some technical issues with Smaply, but they were secondary in general, for example one group couldn't delete a stakeholder from the stakeholder map after the user created it. The discussions regarding Smaply were at the concept level, such as about the meaning of a concept such as "persona," but not at the technical level, for example, how to create a persona. The groups ended up with new solutions and fresh perspectives on the project.

5 Discussion

The use of DT methods and tools is a way of incubating ideas and creating innovative solutions within teams. Several connections between DT and innovation exist, as mentioned in Sect. 2. Our case study raised the issues of type of thinking, collaboration and multidisciplinary in teams as more significant for the growth of innovation.

The DT methods and tools should be handled by both designers and non-designers. Multidisciplinary teams, consisting of people with diverse competencies and backgrounds, are more likely to succeed in applying DT when they can be guided to combine methods and can transition from more- to less-reflexive practices [25]. Our participants had different backgrounds, and generated fruitful discussions during workshops. Our suggestion is to *engage different people with various backgrounds (business, technical, etc.) in order to establish a DT perspective*.

Additionally, thinking like a designer may improve the way companies and organizations develop their products and services. All three perspectives of DT are essential for innovation. Using human- and business-oriented methods, such as stakeholder maps, thus leaving out the feasibility of the technology, can spark innovation. On the other hand, relying exclusively on business and technical tools does not help project effective decisions, especially as the user may prefer another path. Including the user's perspective and combining convergent and divergent DT methods and tools are therefore critical.

Moreover, DT tools (Table 1) can be used in the first phases of the DT process and reflect both types of thinking. Our suggestion is to *keep both convergent and divergent types of thinking in DT methods or tools for an innovation project.*

The use of software tools that support DT methods is also an insightful way of working with teams. For example, using Smaply to visualize a stakeholder map might be fun and inspiring, enhancing the work with a visual exercise and an analytical tool. Engaging interfaces and visualizations help different people adopt new perspectives on projects that they might have lacked earlier, unless they deal with technical difficulties. Our suggestion is to *provide the participants with a training session in the DT method or tool.*

The value of using DT tools in companies is related to the adoption of a broader view on projects and an effective communication tool for multidisciplinary teams. The value for teams lies in their shared basis for communication, as they can embody their own ideas in real time, in collaboration with other partners. This procedure can lead to making better decisions and visualizing complex system problems and their potential solutions. Some limitations in our study prevent an unambiguous interpretation of the findings. We have to note that the generalizability of our results is limited, and further studies in the field are needed to strengthen the case. However, we think that our results suggest considering three characteristics when including DT methods and tools for innovation projects: multidisciplinarity of participants, embedding two types of thinking, and a training session in the DT method or tool.

6 Conclusion

Understanding how DT tools foster innovations is an area of increasing importance that has received little attention in existing research. To answer this, we suggest including three characteristics in our current understanding of utilizing DT tools, as it was mentioned above: collaboration, multidisciplinarity and twofold type of thinking. In view of the fact that organizations are encouraged to adopt DT in the teams where people may not have prior experience with such methods [25], more collaborative strategies and engaging tools are required. The results of the study suggest the adoption of a method-driven approach to collaboration while utilizing DT tools. The latter should be characterized by simplicity and ease of use in order to help the users' focus on the method. The need for DT methods and tools to cover both convergent and divergent type of thinking is in line with the holistic nature of DT. The list of methods and tools that we discussed here is only a starting point for additional work in this field. Further research might focus on how multidisciplinary teams use design methods and tools for innovation in each design phase and what the most suitable ones are. Another future research topic could be the functional diversity of a team that could maximize innovativeness by using these methods and tools. Case studies, field studies, or similar ones from businesses would be enlightening for this research area.

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