

Article

Enterprise Design Thinking: An Investigation on User-Centered Design Processes in Large Corporations

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Abstract: Design thinking (DT) is considered a “human-centered” or “user-needs” process that leads to business innovation. Promising practices of DT application in real life have gained popularity in business, such as IBM’s the loop, IDEO’s 3I model, Design Council’s double diamond model, and Stanford’s d.school model. However, many existing studies have targeted DT models in a small group setting, such as a startup environment or a small group in an educational institution. The primary purpose of this paper was to investigate how large corporate environments that have multiple departments with a waterfall culture define and apply DT in real use. The first part of this paper introduces the most popular DT models used in the industry and some insights into their use in the field; the second part examines the experiences of 20 professionals who have experience with DT in the large organizational environment through in-depth interviews. As a result, this paper offers three major insights regarding the use of DT in the field. The third part of this study suggests an appropriate enterprise DT model for large corporations based on the problem-solving activities already undertaken by employees. This study is important as the first step toward understanding DT implementation in large corporations.

Keywords: design thinking; user-focused; human-centered; enterprise creativity; problem-solving



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1. Introduction

Design thinking (DT) is an innovative process that shapes today’s new businesses [1]. DT offers a “human-centered” approach to innovation [2] that calls for the deeper understanding of human needs, the diverse framing of the question, and, as a result, more creative and effective solutions for the stakeholders. For example, recently, the product design process has emphasized users’ emotional responses to boost consumers’ purchasing motivation [3]. As DT further integrates emotional aspects into design, the resultant products align more with user needs [4].

Such focus on the users is what differentiates DT from the dominant mode of problem solving, also referred to as “scientific thinking” or “analytical thinking” [5]. Rather than employing known rules and patterns, DT pushes us to create something new, discovering new paths along the way. Accordingly, previous scholars saw DT as the “creation of artefacts” [6], “reflective practice” [7], a “problem solving activity” [8] and a “way of making sense” [9].

Pushing the horizon with such an empathetic approach has yielded some promising results in solving the most complex and persistent problems [8,10,11]. DT is applied in different problem sectors that require fast, effective decisions, such as health care, medicine, and tech industries. Other case studies show that DT has been effective in different government innovations in places such as the United States [11,12], Australia [13], Denmark [14], the UK [15] and New Zealand [16]. From a broader perspective, DT can

be incorporated into human-centered intercultural communication and culture policies, which can thus encourage the rise of cultural and creative industries, stimulating national economic growth and industrial development [17].

DT eventually gained popularity with practitioners for its effective approach to the business and management decision-making process [18], as well as to the fast-changing information technology (IT) field [19]. Given such exponential growth, both academia and industries are praising DT as if it were a cure-all for the economy [18]. Kimbell [20] suggested a few reasons for the popularity of DT: The first is the “new spirit” of capitalism, which calls for teamwork, multiple skills, and autonomy. The second is the nature of the industrial world, which is saturated with new products (and thus necessitates differentiation, and the use of products for self-expression rather than for survival). Finally, the new generation is looking towards the creative class, which involves not only musicians and artists, but also engineers and programmers [20,21]. All of these factors combine to demand a new organizational culture, and DT fits right in: it strengthens teamwork and autonomy, advocates for creativity in the workplace, and eases organizational change [22].

However, many of these studies were conducted as case studies on a partial group in an organization, or in a startup environment, wherein problems often involve a small number of stakeholders. Whether the same strategy works in larger and more traditional corporate environments—where (a) DT’s outcome involves multiple departments, and (b) a waterfall culture exists due to the hierarchical command line—is uncertain. As a result, this research investigates the current status of DT usage in the context of large multinational corporations, using in-depth interviews with the current workforce. Based on the interviews with employees who have experience with DT in a large organizational environment, this paper discusses how DT is used in corporate reality and presents a five-step DT model.

2. Background

DT is a process by which individuals and teams can understand users’ needs in order to create valuable product/service outcomes [23]. Although it seems like a relatively new concept, Johansson-Skoldberg, Woodilla and Centinkaya [18] stated in their article “Design thinking: Past, present, and possible future” that the history of DT began in the 1960s. Major academic discussion of DT started with Simon [6], who saw “designerly thinking” as an important process in the creation of artefacts. Schon [7] argued that DT was a reflexive practice, while Buchanan [8] saw DT as a means of solving difficult problem. More recently, scholars have defined DT as a “way of making sense of things” or “a creation of meaning”, which places more emphasis on the value-creation aspect of DT.

In 2013, Johansson-Skoldberg, Woodilla and Centinkaya [18] created a publication timeline of the literature on DT. The study showed there were 168 literature items on DT, including books, journal papers, practitioner articles, newspaper articles, and blogs, and the numbers rose from 1~15 per year to over 45 in 2009. Using Microsoft Academic (Microsoft, CA, USA), which enables keyword searching by year, we constructed a similar publication timeline for 2010 to 2019. Figure 1 shows that academia’s interest in DT continued to increase after 2009.

A similar publishing pattern has been identified by Micheli et al. [24], who also found that among the 104 articles published from 2009 to 2017, there is a significant lack of quantitative studies on DT. In other words, most of the published works take a descriptive, philosophical approach to explain conceptually what DT is, and how it was used in the authors’ experience.

Of course, such trends are understandable, given that the term “design thinking” developed in the fields of business media and publication, rather than as an academic concept. Today’s conception of DT has evolved from Simon’s “designerly thinking process” to an innovative way of thinking that ultimately changes how users approach problem management [25]. Specifically, DT refers to the designer’s thinking process, and how it considers human needs, which leads to both empathetic and analytical approaches to

design [25,26]. This means that there is no “fixed form” of DT, but rather, any existing tools and methods can become DT methods once they incorporate “human-centered” or “user needs” paradigms.

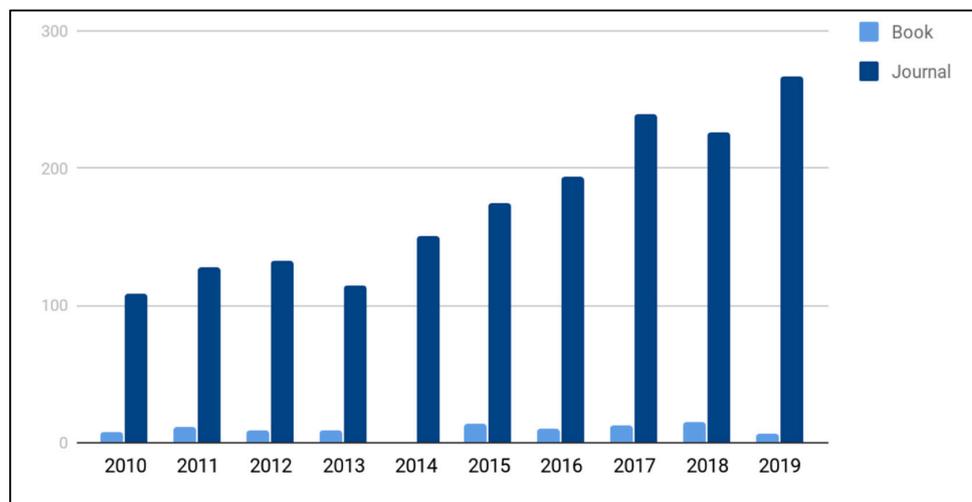


Figure 1. Books and articles published on design thinking.

As a result, various institutions in both industry and academia have come up with their own models of DT. For example, the Design Council (the British Council) suggested a double diamond model that consists of four phases, all starting with the letter D: (1) discover; (2) define; (3) develop; (4) deliver. This process incorporates two stages for divergence and another two for convergence [27]. IBM also has its own model, called the loop, which employs the rapid and continuous iteration process of (1) observing, (2) reflecting, and (3) making. IBM’s model is somewhat different from the other models, in that it is not just about the process. If we look closely, we can see that the loop works best when user-focused multidisciplinary teams are involved. Additionally, it seems to incorporate extra conditions, such as hills (aligning team outcomes), playbacks (reflecting), and sponsoring users (inviting users) [28].

IDEO is the leading company in using and continuously evolving DT methods. Its fundamental model, called the 3I model, has been covered countless times in online academic courses [29,30]. The 3I model consists of the following phases: (1) inspiration, (2) ideation, and (3) implementation. These phases, similarly to the double diamond model, experiment with the continuous convergence and divergence of thought processes (see Figure 2).

Finally, the most well-known model is the Stanford d.school’s five-step DT, which consists of empathizing, definition, ideation, prototyping, and testing stages. These stages do not necessarily proceed on a linear timeline, and the five stages are often part of an iterative process [32]. In this model, the empathizing phase is when designers start to understand who the users are and how they feel through desk research and collected data analysis. During the empathizing stage, designers determine the problem through qualitative research methods such as observation and interviews. Once the problem is found, the designers define the users’ unmet needs and re-frame what the challenge is that needs tackling. During the ideation phase, the stakeholders come together to brainstorm possible solutions to the defined challenge. Some of these ideas are selected for prototyping and then tested for further user feedback and decision-making [33]. Similarly, Beckman and Barry [10] proposed a design innovation process with four distinct stages—observations, frameworks, imperatives, and solutions—which is grounded in Owen’s view of design and Kolb’s experiential learning theory model.

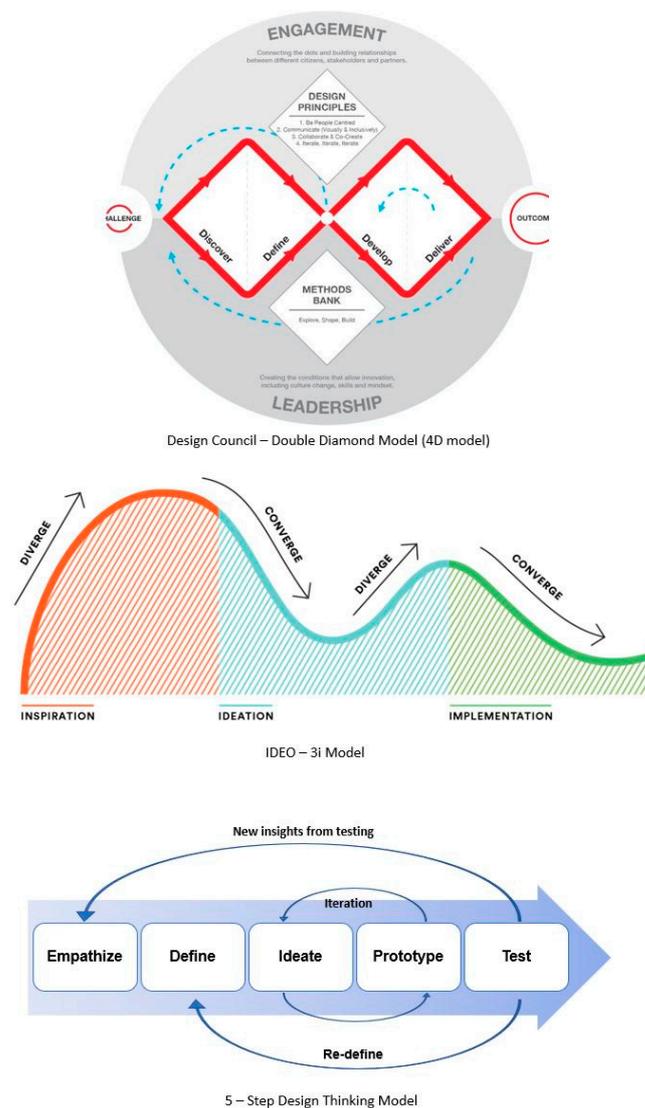


Figure 2. Examples of the existing design thinking models—double diamond model [27] (Reproduced with permission from Design Council, Design Council Web, Published Online, 2021). 3I model [31] (Re-produced with permission from IDEO, IDEO.org, Published Online, 2021.), and d.school 5-step model.

Although the DT models introduced here are discussed extensively in the literature, many of the studies are based on a single person’s experience, rather than a formal research method [24]. A number of scholars have addressed similar concerns by performing a systematic review of existing case studies. For example, Micheli et al. [24] conducted a systematic literature review and revealed eight categories of tools/methods used frequently in the literature. Among them, the most used were ethnographic methods, such as interviews and observations, and visualization and prototyping, such as drawing or 3D modeling, which enhances storytelling. More recently, Dell’Era et al. [34] analyzed 47 case studies, and found that DT practices in the field are characterized by four elements: creative problem-solving, spring execution, creative confidence, and innovation of meaning. These systematic and scholarly approaches have revealed more useful, ready-to use information concerning DT application than the conceptual models designed by the DT consulting firms. On the other hand, a large-sample multi-method study on DT application in practice showed that such DT methods are only used by a small portion in an organization [35]. In summary, whether it is a conceptual model or a practical tool/method, DT is currently adopted in a much narrower context in the actual field. This study aims to understand

how DT is adopted in large-scale organizations where hierarchical structures and inter-departmental tasks are the norm. The objective is to understand whether DT models, praised as the most effective innovation method in both the field and the literature, can still work within a corporate environment where barriers exist for creativity.

Moreover, the four most popular models each have unique strengths and vague differences in their use in the field. For example, the Design Council's double diamond model makes the co-design process easier, and is thus used in cases that involve two or more groups with separate roles coming together in the design process. The most popular field for this model is medical and healthcare, wherein two distinct agents (medical service providers and patients) need engage in co-design [36–39]. IBM's the loop, on the other hand, can be applied to ever-changing environments such as high-tech enterprises. As a result, the loop is often used for business consultation, wherein whole teams and sub-teams constantly change and there is no real "completion" of the service delivery process. Finally, Stanford's five-step model is the most well-defined, and has detailed guidelines that allow those in non-business fields to adopt and use it quickly. Perhaps this is why many DT practices in the educational field adopt the 5-step model [40–42].

The developing literature on DT has also shown that each of these major models has its own "area of expertise". This accounts for the fact that, while DT is about human-centered design, there are also environment-specific factors that play a role in its application. Some scholars differentiate these two aspects via the concepts strategic DT, which is all about the frame and processes, and designerly ways of knowing (DWK), which is more concerned with the mindset of the designers, such as their capacity for reflective thinking and abductive reasoning [43,44]. This paper also aims to separate these two, aligning with the view that although DWK, or the DT mindset, may be similar across all fields, the DT strategy, or the process, may be different in different fields. As a result, we hypothesize that the DT model for large-scale organizations will be different from existing DT models, which are often discussed in the context of isolated teams. By investigating the current application of DT in large corporations, this research aims to develop a preliminary model of corporate DT processes.

3. Interviews

Based on existing DT models and methodologies, we aimed to construct a DT model in the large-scale corporate environment. To do so, we investigated the DT methods used in large corporate environments. We interviewed 20 DT experts working in different corporate environments, such as Oracle, T-Mobile, Line, and Samsung. Here, we discuss the insights and general activity patterns found via the interviews. In addition, we asked the participants to detail their experiences with DT applications and their personal thoughts about DT in corporate settings.

3.1. Research Method

The aim of this research was to obtain a sense of how corporate environments that involve large numbers of people use DT (such as frequency, methods used, and factors that contribute to adopting DT). A similar study was performed by the Center for Design Thinking on how people learn design thinking in the field [35]. In their study, 24 respondents who had 0 to 35 years of DT experience participated in the interview; however, more than 75% of these participants had less than 4 years of DT experience. The interview focused on one question—"which learning channels did you use?"—which revealed that almost half of the participants sought DT learning from professional or educational institutions. However, in this study, the sizes of the organizations in which the participants worked varied from less than 20 to more than 50,000. To build a DT model for large organizations, we conducted semi-structured in-depth interviews with employees who were working, or had worked for more than 36 months, in a large corporate environment.

Based on the definition of "large enterprise" used by the OECD, which states that "Enterprise can be classified into different categories according to their size . . . (they) are

further subdivided into microenterprises (fewer than 10 employees), small enterprises (10 to 49 employees), medium-sized enterprises (50–249 employees), and large enterprises employing 250 or more people” [45], 20 participants currently working in a large enterprise/corporate environment consisting of more than 250 employees were recruited using snowball sampling methods. To make sure that our model was up-to-date, the 20 participants had to be currently “in-action” as regards the DT-related tasks. These participants had also held a leadership position in DT facilitation more than once, and all of them had master’s degree or higher in a related field. Additionally, we tried to vary the participants’ areas of expertise, to ensure our model of enterprise DT was not limited to one area. Table 1 shows the years of DT experience, the company type and the position held, as well as the background description, of each interviewee.

Table 1. Background description of the interviewees.

ID	Years of DT Experience	Company Type/Position	Expertise/Description
1	5 years	T-Mobile/UX Researcher	Human factors, HCI
2	5 years	Oracle/Researcher	Wearable design, quantitative research
3	4 years	PXD/UX Designer	Graphic design, communication design
4	15 years	Freelance design thinking consultant	Service design, design project consultant
5	23 years	Philips/Experience innovation leader	Design thinking
6	26 years	IBM ix studio/Experience innovation director	Design thinking
7	12 years	Seoul National Hospital/Medical service design consultant	Service design project director
8	22 years	Space Experience Innovation/CEO	Space experience innovation
9	5 years	Naver/Information architect (IA)	Service design
10	14 years	SK (Telecom)/Design thinking consultant	Service design
11	18 years	Samsung/Engineering architect	Architectural engineering
12	10 years	Hyundai/New service strategist	Innovation and start-up
13	18 years	CitiBank/Risk management	Client communication director, project management
14	3 years	Hyundai/Innovation strategist	New product development
15	6 years	Apple/Product designer	Design thinking, product management
16	7 years	SK/New product development	Service design, client communication
17	8 years	YouTube/Innovation consultant	Start-up, new product development
18	9 years	Google Korea/Product management	Market strategy, new product development
19	25 years	Samsung/Customer experience consultant	Design thinking, user workshop
20	15 years	Samsung/User interface designer	Wearable design, medical service development

Each interview took 1.5 h on average, and the participants answered questions by phone call or text message, maintaining live interaction. Two researchers conducted the interview, and the following are structured questions that were asked:

- I Ice-breaker: Can you tell me a little bit about yourself and what do you?
- II Does your current organization use DT methods? If you have, could you tell me how it was done (by team vs. individual, space, number of participants, use of methods and tools)? Please describe as specific as possible.
- III How frequent and how long do these activities take place within your team? (e.g., once a month for 1 h)

- IV Among the five steps of standard DT (empathize, define, ideate, prototype, test), which phase do you (or your team) spend most of your activities on and why?
- V Where do you think DT activities work best? (e.g., communication) and what kind of outcomes (report, wireframe sketches, 3d prototype etc.) did you get from your DT activities?
- VI Looking back on your experience, would you say that DT has solved problems that were difficult to solve before? Could you describe one example of a DT application and its effect?
- VII How do you feel when you face a complex, time-consuming, wicked problem at your workplace? What is your first reaction to these problems?
- VIII How do you feel about DT activities? What is your take on it?
- IX Would you use DT methods in the future? Where and why?
- X Lastly, would you like to add any comment or questions?

The questions were structured to start with smaller, more everyday concerns (easy questions), and then proceeded to higher-level, conceptual questions (difficult questions). This helps the participants to imagine what they do at work every day, and thus to connect their small activities to a larger perspective on DT. Depending on the response, unstructured and improvised questions were also added (e.g., “was working with teams easier with DT methods? Or harder? Why?”). Once the interviews were over, the responses collected through phone call were transcribed into text for analysis. For the analysis, we first summarized the common keywords and insights derived from each participant, and then visualized each DT step based on its usage. The interview was conducted in either English or Korean, depending on the participant’s native language. All the interview answers were directly transcribed into English by the two interviewers, who are Korean and English natives, respectively. The outcome is described in detail in the following section. Finally, based on the first two analyses, we propose a DT model for application in corporate environments.

3.2. Findings

The in-depth interviews also yielded insights into the participants’ personal views on corporate DT implementation. These insights are keyworded and summarized below.

- “In too deep”: During the interviews, we found conspicuous differences between participant responses to the question, “Does your organization use DT methods? If so, how?” This question divided the participants into two groups. The majority answered that they have used or are using DT methods, but some did not understand the question, and asked us to rephrase it. Through follow-up questions, we found that these interviewees were not sure how to define DT methods because they were, ironically, too familiar with them. One participant had said,

“... It’s starting to get very confusing. In my own mind, I don’t use the word DT because to me it’s the methods that count. DT started off as a type of framework/mentality then they just kind of expanded to include everything and anything... Where do you draw the line? If I do post-it ideation myself, I wouldn’t consider it DT but maybe someone will think it is?” (Interviewee #2)

Another interviewee mentioned that POSTA or SWOT analyses are not DT methods, but “just market research methods.” Interestingly, the more frequently participants used DT methods, the more they felt confused by what it meant. It seemed that because they were already working with a deeply human-centered mindset, they could not differentiate DT methods from traditional methods. For them, every process was user-centered, and there was no other way of doing things.

- “Application irony”: On the other hand, one of our interviewees strongly differentiated “creative methods” from “traditional research methods”. Apparently, their organization had a protocol for researching the market and individual users:

“... Trend report, monthly newsletters, annual reports are emailed to each team. We are only allowed to read the chosen reports, and attend selected seminars and conferences. Which ... basically ends up with the same desk research results.” (Interviewee #12)

Here, creative methods are almost forbidden, because the organization is too large, and every “new idea” demands too many resources. So, in this case, the use of DT is strictly limited. The team meet and ideate twice a week, but only with members who have the same level of knowledge. Post-its, affinity diagrams and brainwriting are used, but the aim of these activities is to come up with the most safe, non-risky and unanimous ideas possible.

This participant also mentioned that because “new product development” concerns “newness”, the general view is that user research only leads to incorporating unnecessary assumptions into the product concept. As a result, they only conduct interviews once the prototype has been released and potential customers have been identified for the product. This is the opposite of the DT process, in that it puts the product first and the users second. Ironically, they still attempt to use DT, because it helps team members share ideas and gain insights into organizational direction.

- “It’s not a panacea”: The majority of the participants were aware of the limitations of DT. Whether they were employing DT partially or wholly in a project, the interviewees knew that there were times when organizational needs came above user needs. Below are some quotes from the interviewees:

“... design thinking doesn’t work every time. I like that design thinking is a bottom-up style of problems solving. But, sometimes it is too time consuming, ... and sometimes, I feel like there’s enough data and data analysis is enough to make decisions.” (Interviewee #5)

“DT is not enough. It’s not the cure for all. Sometimes I feel like it’s just bluff and there’s no feasibility whatsoever. Also, in the end, aesthetics that sells is what really matters, which doesn’t get us far from the traditional way of approach.” (Interviewee #3)

“I think DT only works within some of the departments. We have a specialized department for DT, called ‘customer analysis’. But some of us call the department, ‘marketing alt’. Because, you know ... they are only useful for marketing. Not product developing.” (Interviewee #14)

One downside that was mentioned multiple times was time efficiency. Although there was consensus that DT enables the thorough examination of user needs, and thus yields essential ideas for business, it seems the corporate working process is often more focused on time efficiency than thoroughness. Because one tardy analysis or report can have vast-reaching knock-on effects in a massive multi-departmental organization, the investment of time into DT activities is a risk.

Additionally, unlike smaller start-ups, or teams where it might be less difficult for the stakeholders to gather in one place at the same time, large organizations encountered difficulties in scheduling a meeting with the decision-makers. As a result, rather than applying DT activities in everyday processes, the large corporate employers tended to schedule a separate time and space for DT activities. Accordingly, 13 out of 20 interviewees mentioned that they had separate rooms and materials for DT processes. These rooms were filled with whiteboards, markers, post-its, and sometimes DT toolkits, which help with enacting DT methods “when needed”.

- “Empathy method”: When asked if they would use DT methods in the future, participants gave positive responses. It was determined that the attractiveness of DT stems from its first, primary feature: empathy. Many participants mentioned that DT’s value depends on its ability to really help designers identify with users:

“In one project, we had to design the display for kitchen electronics. We collected data through in-depth interviews in San Francisco, and defined the problem space to figure out which service must be included in the display. We divided the users into age groups, job sector, and income levels, then came up with keywords for each user group. Then there

was ideation + affinity for which service to provide. Once big themes came up for each group, we were ready with the list of services we could provide. I was surprised by how rich the idea list was. We (the team) were able to comprehend each user group differently by their characteristics, and the ideas covered all of their needs thoroughly. I liked this bottom-up approach. These ideas were directly connected to the users, and I felt confident that this is what the users wanted.” (Interviewee #8)

“I will definitely use design thinking workshops and activities in the future. There’s not enough methods that center around empathy. Sometimes the data is not enough to read what the user really wants, and I think it is a really important part: empathizing.” (Interviewee #8)

4. DT Application Visualization

During the interviews, we asked the participants which among the five steps (empathizing, definition, ideation, prototyping, testing) they used the most during new product development (NPD) or new projects. Because not all organizations used the Stanford d.school model, we first explained the five steps and possible activities within each phase (e.g., ethnographic research falls under empathizing, while wireframing falls under prototyping). Figure 3 shows a visualization of the results. The heights of the blocks indicate the frequencies with which the “most used” phases were mentioned during the interviews. Below each step, the relevant keywords for each are listed. This keyword list was created through the web-based visualization tool Monkey Learn Word Cloud Generator, using the transcribed interview data. The order of the keywords is not related to frequency with which they were mentioned.

During the empathy stage, participants mentioned such keywords such as “diverse perspective”, “understanding inconvenience and fear”, and “real user.” Such keywords indicate that during the first stage, corporate employees focus on gathering and exploring different user voices and perspectives, specifically those that involve users’ pain points. During the define stage, the most frequently mentioned keywords were “organized”, “problem space”, and “complex issues”, which suggests that the define stage concerns identifying all the problems and setting the direction for the project. It could be summarized as defining the problem space and figuring out how diverse issues are connected. The third stage, ideation, was related to the terms “solution”, “collaboration”, “synergy”, and “team.” These keywords indicate that the third stage concerns coming together as a team to figure out the answers to the identified problems and issues. The prototyping stage was most associated with the terms “communication”, “build, and “consensus”, which act to organize what was laid out during the ideation phase. Finally, the testing stage was related to the terms “data analysis”, “traditional method”, and “report”, suggesting that this final stage concerns checking and recording what was found during the previous four stages, using numbers and figures.

Among the 20 interviewees, 10 answered that they use DT mostly for product/service ideation. It was suggested that DT ideation methods were most useful in the corporate environment, because they allow for meeting and communicating, which is often difficult to organize in larger entities where departments are divided by work characteristics and space. The DT ideation phase allows key stakeholders to come together in a single space, share their thoughts, and give feedback. It enables easy communication and collaboration, while other stages can be carried out independently by departments or teams. Prototyping was the second most frequently mentioned (by nine). However, the prototyping activities that were described by the respondents concerned the general prototyping (for testing) that was carried out by the prototyping or development teams. These prototypes were not part of ideation and exploration, but were using for functional and technical testing that yielded quantitative pass/fail reports rather than user-centered feedback. Only one interviewee mentioned that he uses paper prototyping for personal exploration of ideas and rapid peer feedback.

During the interviews, it was found that participants from large manufacturing corporations had a very different prototyping culture. Interviewees #1, #12, and #14 all mentioned how little space there is for idea exploration during the prototyping phase. Their prototypes were referred to as a “close to perfect” functioning model of the actual product, and none of the experts used rapid prototyping with paper, plastic or metal 3D printing. Interviewee #14 assumed that this is because of the high investment before the prototyping phase. That is, since more time and effort is put into developing the product’s blueprint, there is less room for exploring different visualizations. Once the product’s blueprint is completed, it enters mass-manufacturing.

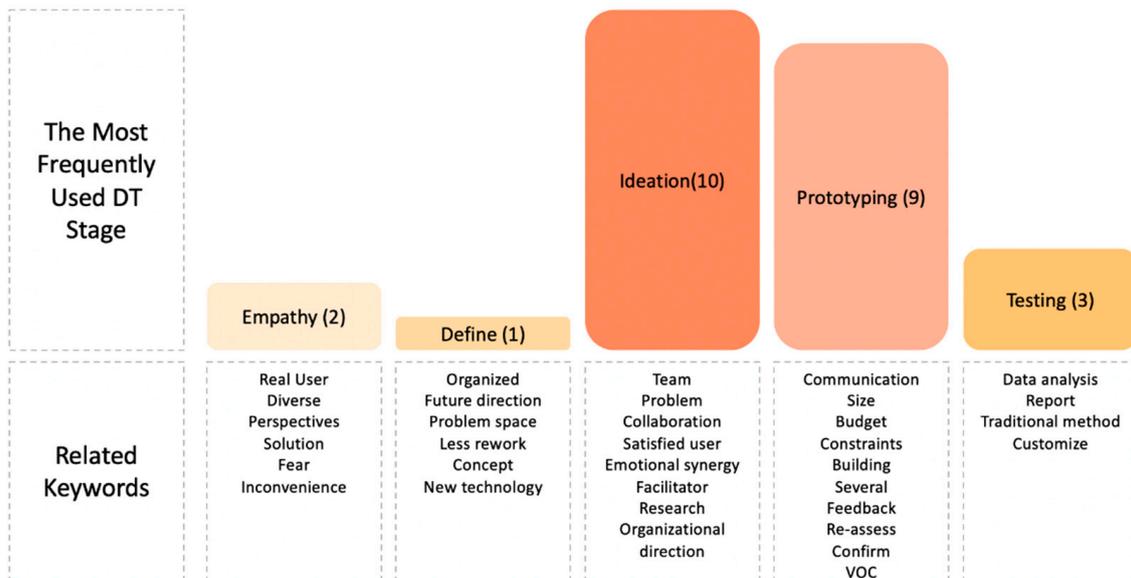


Figure 3. Five-step design thinking model visualization.

5. Corporate DT Model Proposal

Based on existing models and employee interviews, this paper proposes an enterprise DT model for large corporations, as below (Figure 4). After analyzing the keywords and interview contents, the proposed corporate DT model consists of a goal-setting phase, a departmental collaboration phase, and a communication phase.

Unlike the traditional five-step model, this corporate DT model has three steps, as described below.

(1) User-Centered Goal Setting: In large corporations that use hierarchical task lines, it is almost impossible to start with a small number of user studies. Rather than researching a few users and promoting empathy, large organizations focus on multiple research domains, such as market research, technical roadmaps, budget, manpower, etc. Based on market needs, organizational resources and the roadmap, a goal is set. As a result, corporate DT workshops often start with an already-defined problem, and DT activities often have an expected outcome (e.g., system wireframe, UX strategy, marketing strategy, etc.). This phase equates to a combination of the empathize and define phases in the original five-step model.

(2) Departmental Collaboration: Contrary to smaller startups, corporations often have different departments, each with specified expertise and experience. Once the goal is set, departmental roles and responsibilities are defined based on such expertise. Moreover, for these departments to ideate and collaborate, prototyping and testing must take place and must be repeated to ensure product sophistication. The prototyping–testing loop often takes place quickly and efficiently, collecting internal (organizational) assessments and user feedback. According to the interviews, most DT workshops and activities take place during

this departmental collaboration phase, which equates to a combination of the ideation, prototyping, and partial testing phases in the original five-step model.

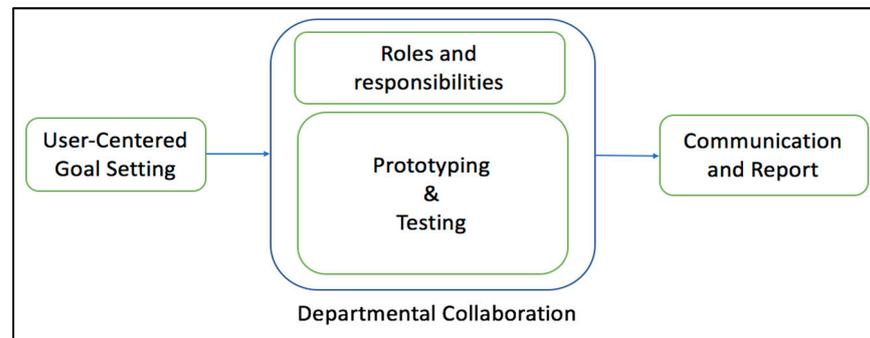


Figure 4. Corporate design thinking process.

(3) Communication and Reporting: Although it was never explicitly mentioned during the interviews, all of our interviewees talked about a sixth step. This is when all planned DT activities and workshops are completed, and all that remains is to summarize, record, and report what came out of the process. Because not everyone is able to participate in every prototype test, user feedback assessment, etc., the outcome of the testing phase must be recorded for organizational dissemination. Furthermore, even if all the project stakeholders participate in the DT process, the final product must always be presented to the other members of the organization, the possible users, and future investors. In large organizations, this phase is crucial to finalizing the project or product, and thus must be included in the DT process.

6. Discussion

This study investigated current DT models and the current status of DT application in large corporate environments. Through in-depth interviews with 20 professionals working in the field, four major insights were derived: employees of organizations that deeply incorporated DT into their product development process were not able to separate DT activities from traditional processes. For these organizations, DT was not a separate process or program, but a default task carried out every day. Second, the DT used in large organizations incorporates boundaries when it comes to creativity. Because exploring many different new ideas is costly, many of the organizations we interviewed applied DT in a limited context. The interviews also revealed that employees who adopt DT in their workplace acknowledge that DT does not work every time, and that some problems are better solved through a waterfall or technology-driven approach. Finally, the strength of DT was described to come from the bottom up, which allows for a comprehensive review of all the possible issues and problems.

In the second part of this paper, we investigated the status of DT use in the field. This revealed that the corporate employees who carried out DT activities had a somewhat uneven experience with the five steps. Their DT activities focused on ideation and prototyping, while empathy and defining activities were less prominent. Such a pattern underlines the lack of attention paid to investigating the “problem space” in large corporations. Understanding the problem space is a fundamental tenet of the DT process, as the first three phases (“empathy”, “define”, and “ideation”) all concern understanding the problem being addressed. However, in the larger-organizational context, the “problem” is often already given, and there is less motivation to question whether the problem is truly a problem—which means that the recognized essence of DT may be disappearing.

In the second part, we also listed keywords that were linked to each phase by generating a word cloud using the transcribed interview data. Based on the keywords and the interview analysis, we proposed a corporate DT model. This model consisted of three steps: goal setting, departmental collaboration, and communication and reporting. The current

study and our proposed model represent the first attempt to show how DT is actually used in the field, specifically in large waterfall corporations. Additionally, although DT has gained much attention in the business and engineering literature [18,20,22], few studies have addressed the actual employees' experiences of the application of DT. Moreover, contrary to existing popular DT models that have been defined and applied to organizational consultation and education, this study attempted to build a DT model for large organizations through a bottom-up approach.

Limitations and Future Works

This study is not without its limitations. First, the aim of this study was to understand DT implementation in diverse corporations through in-depth interviews. However, due to the use of snowball recruiting methods, the interviewees' backgrounds and daily tasks were not very diverse. For example, most of our interviewees worked in the UX department, which is often the most DT-friendly department in an organization. Due to the size and the division of tasks, it can be assumed that there are other departments that have more difficulty in implementing DT, or that may have no knowledge of it at all. On the other hand, this study can be considered a first step toward understanding DT implementation in large corporations. Future studies can expand the effects of DT by assessing departments and their characteristics.

In addition, a small sample size of 20 participants could raise the question of whether the results can be generalized to all large corporations. In order to overcome such doubt, we adopted the concept of "purposive sampling", as opposed to probability sampling, which focuses on information-rich participants to ensure research depth [46–48]. For instance, instead of choosing interviewees from the same organization, participants were recruited from diverse corporations. Additionally, to ensure that our participants are professionals with much potential information to offer, all the recruited participants had more than 3 years of experience in the field, as well as a master's degree or higher. To strengthen the findings and yield valuable information, future studies could add more participants and lengthen or multiply the interviews. This will allow the participants to expand their thoughts further, and yield deeper insights via longer interactions with the interviewer.

This study also targeted large corporations for in-depth interviews, as per the definition of OECD data, but different sectors and industries were not considered during the interview analysis. Classifying sectors and industries can help in developing different approaches in order to provide more specific and standardizable DT applications in large corporate settings. Although the differences amongst sectors and industries may appear subtle in the DT application process, as we interviewed people who are already using DT, the potential impact on corporate culture, especially for traditional industries where communication is usually vertical, can be significant.

In addition, this study's small sample size suggests that the conclusion may not apply to every employee working in a large corporate environment. Note that this study is only the first attempt to investigate the circumstances of DT-related tasks in corporate environments. The model suggested is merely the starting point of the corporate DT model, and a tremendous amount of additional research is required to understand the true nature of DT in large organizations. As a result, this study can be used as a guide for upcoming studies that focus on the relationship between a waterfall or hierarchical structure and DT. The value of this study does not lie in its completeness, but rather in its suggestions that can be built on and the possibilities it opens up.

7. Conclusions

Over the years, DT has gained popularity in the information technology and consulting industries for its ability to solve complex problems with creative solutions. Academia has proven the effectiveness of DT through countless research cases, and companies have focused on generating their own DT models. On the other hand, we found a possible gap between these studies and actual application. That is, many DT studies and case studies

are based on small-group participation, such as start-up case studies and school group studies. Whether the popular DT model works in larger-scale corporations that have a hierarchical structure and waterfall culture is uncertain. As a result, this paper investigated how employees of large corporations use DT in their everyday tasks. Through in-depth interviews with 20 employees working in various fields, we found that larger corporations use segments of the standard DT model, rather than following the whole process. Additionally, because of the large scale of the teams and their multiple stakeholders, most problems are more effectively solved through the waterfall process, in terms of the time and effort taken to solve the problem. Eventually, based on these insights and employee testimonies of their use of DT activities in the field, we proposed a corporate DT model that is more relevant to larger-scale organizations. Although this model is incomplete and should be developed further through additional research, it is meaningful in that it is the first step toward aligning the theoretical model with actual current field experience.

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