

# The Core of Design Thinking and its Impact on Digital Transformation in Healthcare

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**Abstract**—This study contributes to creating awareness about the potential of Design Thinking in healthcare. The review of the literature showed that this innovation-philosophy and paradigm has had a high impact on several sectors, especially the Information Technology sector, something that in its turn, impacts healthcare. Further research is needed to find solutions to remaining issues, like how to orchestrate dialog and co-creation with system-users, patients, different kinds of healthcare employees, and, e.g., policymakers. Although popular in practice, there has been a gap in academic literature, especially in Information systems, regarding the impact of Design Thinking in this context. Doing a literature review based on a central source of Design Thinking paradigm, Kees Dorst, the authors explore examples of such impact and generalize a picture of the state of art in this field. The impact of further research is then briefly discussed.

**Keywords**-healthcare; Design Thinking; Abduction.

## I. INTRODUCTION

All Recent design science research has advanced our understanding of the value of Design Thinking methodologies (Design Thinking) and of using the design process for public policy innovations [1].

Dorst's article «The core of 'Design Thinking' and its application» [2] lays out the theoretical foundation for Design Thinking. This fundament builds on Abduction as the third inference method of social science research (the first two being Induction and Deduction, respectively), and abductive reasoning is often described as “the core of Design Thinking” [2]. The term ‘Abduction’ stems from Charles Sanders Peirce (1839–1914), the founder of American Pragmatism philosophy [3], and describes an approach to science which commences with one or more observations and then seeks the simplest and most likely explanation.

There are two forms of Abduction, relevant to Design Thinking, explanatory and innovative [4]. In explanatory Abduction, the environment is scanned for truly surprising facts. While the rule may be known in other contexts, it is generally not familiar to the current one. Innovative Abduction produces an explanation (the design concept) for the desired value, the function, and an explanation (the form) for the design concept. “That is, we infer a new rule to explain the observation” (Op.cit.).

Design Thinking has several characteristics as a methodology and gives a new formula for creating value.

Design Thinking can lead to radical innovation through ‘reframing the challenge’ [5]. The ‘Thing’, what to invent or build, and ‘Working principle’, how to invent or do something, lead to the aspired values. By iteratively exploring the problem space and solution space, the best combinations of the best ‘what’ and ‘how’ to achieve the desired values are discovered. This design principle is comparable to the LEAN ontologies for avoiding wasting resources in innovation and production. For example, Ries in his book “LEAN start-up (...)” emphasizes “doing the right things” before and over “doing things right” [6].

Design Thinking can be traced back to 1950-60, but was defined as a term by Rowe in 1987 [7]. Design Thinking builds on the elicited practice of industry designers [1] and aims at finding surprises; unexpected user- or consumer needs and desires, as basis for product- and service innovations [8]. Organizations should focus not only on “high end” users (the most demanding customers, those who pays the highest premium today), but be concerned with the needs of ordinary users as overshot consumers are the segment were new competitive market entrants’ hits. This is an analogy to Christensen’s studies of disruptive innovation patterns, that also underpin this point [9] along with “Blue Ocean Strategies” [10]. Design Thinking can also be an analogy to Soft Systems Methodology [11], as Design Thinking is well suited for complex, ‘wicked’ problems or problematic areas [12].

Design Thinking as a scientific approach to design research has also been subject of critique in academia. There is a lack of rigour to research in Design Thinking [13]. Arguably, more rigid standards and protocols are needed; indeed, a protocol may be needed for designing innovation in general [14].

### Research problems

The whole of the healthcare sector needs rapid transformation to sustain a high, human-centred quality while increasing the production of services, due to an expected aging of the population in many industrialized countries. Digitalization of services and Digital Transformation of the whole sector are looked upon as both a goal and a tool to achieve this efficiency. ‘Digitalization’ is a term that means implementing new technologies together with changed business- and service models. ‘Digital Transformation’ encompasses the content of the term ‘Digitalization’, but in addition, it also means the parallel

comprehensive change to the organization, its clients, and the society.

Design Thinking is emerging as a methodology suited for facilitating these innovation processes, for human-centred design in the highly complex sector of healthcare. In this article, we examine the following questions:

RQ1. How is Design Thinking defined in healthcare, and what kind of Design Thinking methods are applied?

RQ2. What are the Design Thinking designer practices for dealing with complexity in healthcare?

RQ3. What are potential pitfalls in applying Design Thinking in healthcare, and what kinds of caution should be applied?

RQ4. What are the potential positive outcomes of applying Design Thinking methods, for the care providing organizations and for care-receivers?

The rest of this article is organized as follows: In Section 2, the methods applied to answer these research questions, namely, a literature search and analysis, are explained. Following this, in Section 3, the results of the search, and subsequent answers to the research questions are shown. In Section 4, the state of art is briefly summed up followed by a discussion of what are the remaining or new questions regarding this area. Finally, the article ends with propositions on avenues for further research.

## II. METHOD

A literature review was chosen as the method for eliciting answers to the research questions. Dorst's often cited 2011-article [2] was chosen as a starting point for a forward search conducted in January 2020 with the Google Scholar search engine. This resulted in 1089 books and articles.

A secondary search within these identified 254 books and articles using the term 'healthcare'. Screening these, we found 44 articles and books of relevance to the research questions. The articles omitted, although containing the search word, were found not concerned with healthcare, Design Thinking, or the combination of these two subjects. The 44 remaining articles were analyzed using the Nvivo application (Nvivo 12) for text marking and coding. Text-passages that could share light on the research-questions were coded under nodes created for each research question, with appropriate sub-nodes, marking the found answers and coded with keywords for node-names, related to the first set of nodes [the research questions). As a result, the nodes became placeholders for concepts or themes after the principles of Webster and Watson for literature reviews [15] and resulted in themes organized after concepts and insights. This procedure stimulated the validity of the coding process, since several cited articles, independently of one another, underpinned the same concept. Conflicting concepts could also be identified, contrasted and lifted for discussion and further research. The next section provides a summary of the results of this analysis.

## III. RESULTS

The results from reviewing the literature start with how Design Thinking is defined in healthcare, and with an overview of Design Thinking methods used. Then, Design Thinking designer practices for dealing with complexity in healthcare were identified along with potential pitfalls in applying Design Thinking in healthcare, and what literature says on how to avoid these. Finally, the results identify potential positive outcomes of applying Design Thinking methods, for the care-providing organizations as well as for care-receivers.

### A. Definitions of Design Thinking in healthcare, and Design Thinking methods applied

Tim Brown, president and CEO of IDEO, a consultancy company pioneering ideation and process innovation in healthcare, defines Design Thinking as 'human-centred approach to innovation that draws from the designer's toolkit to integrate the needs of people, the possibilities of technology, and the requirements for business success'. As such it is useful for dealing with open complex problems as in Information Technology (IT) and business development [16].

Guerra and Tripp [17] compare different design methods for large scale information infrastructures and find that the more traditional methods [Stakeholder management, Community participation, Charette design, Lean design and construction, and Value sensitive design) lack emphasis on especially the later stages in Hasso Platner's roadmap of the Design Thinking process. Hasso Platner's Design Thinking process is here defined as the steps: Empathize (with users), Define (the user-problem), Ideate (seek potential solutions), Prototype and Test [17]. The inclination of Design Thinking to put forward prototyped solutions for the users to test, before investing and implementing, seems unique for Design Thinking methodology. This way, Design Thinking assures that the design process is based on accurate assumptions and understandings of the problem at hand [18]. With such credentials, what can explain resistance to the application of Design Thinking? If a special outcome is desired, Design Thinking may pose a problem, 'because creative events or the emergence of creative ideas cannot be predicted and rating ideas according to creativity is not straight forward' writes Dorst and Cross in 2001, according to Garde [19]. Design Thinking is an intuitive decision-making practice. In environments characterized by fast-paced technological change contradictory, interdependent or changing requirements and information that may be inadequate or incomplete, like is often the case in healthcare, intuitive decision-making practices dominate over those which are evidence-based [20].

Design Thinking can be used as a framework for co-creation with both patients and employees in healthcare institutions. Design Thinking is a human- and needs-centric approach to innovation that is well aligned with the needs of the very labour-intensive healthcare sector [21]. Co-creation can be used by hospitals, e.g., to redesign whole departments [22]. Design Thinking has been implemented in many

different organizational settings. In general, if relatively rapid change is needed, as in healthcare, a change- or innovation culture is also needed. Creating an innovation culture is a dynamic process in which areas of tension and fundamental innovation dilemmas should meet, rather than follow a recipe to implement role models towards success criteria [23]. Prud'homme van Reine identifies nine innovation dilemmas that organizational cultures face: including holistic vs. segmented views of challenges, competition vs. partnership, Consistency versus Pragmatism, etc. Identifying and balancing these tensions may be necessary to maintain an innovative culture, but Design Thinking can promote such organizational development by emphasizing long term holistic values over short-term individual goals.

From the perspective of social innovation, many authors have seen the potential of Design Thinking to improve the quality of healthcare and public transportation. At the same time, many have been advocating for Design Thinking to be taught in universities to help students to become innovative professionals. Moreover, it has also been applied to industrial contexts, such as Small and Medium-sized Enterprises (SMEs) and large organizations [24].

Until recently, Design Thinking was not well received by academia, as the term does not give a clear indication of what field of research it should belong to [25]. Design Thinking alongside 'Lean Startup' [6] belongs to a brand of learning that can be perceived as experiential learning [26]. To accommodate such learning a multiple of Design Thinking models have emerged over the last two decades, like e.g., "The 5C model" with 62 method cards [27]. Another method 'Actor mapping flags' is used in the project "InnArbeid", a project for providing mentally challenged youth with vocational employment [28]. A four layer-model of insights into human needs has been devised [5]. Behind such methods lies a common epistemological origin in terms of innovative abductive reasoning [29].

An overview of different modes of Design Thinking is provided by Kleinsman et al. [30], called "Description of the four images of Design Thinking". It shows the role of Design Thinking in Purpose-driven innovation, Vision-driven innovation, Experience-driven innovation and Value-driven innovation. Cards and other artefacts of visualization and gamification of the idea-development process are employed in workshops with user representatives.

Some alternatives to Design Thinking as an approach to innovation, in healthcare and other sectors, are used in developing countries and emerging economies. For example, the TRIZ-model - teoriya resheniya izobretatelskikh zadatch, literally: 'theory of the resolution of invention-related tasks' was created by the Soviet inventor and science-fiction author Genrich Altshuller (1926-1998) and colleagues, starting in 1946. Conferences are regularly held on this theme [31]. Still, in these proceedings, there are also examples of the application of Design Thinking in a healthcare environment. Here, TRIZ is combined with Design Thinking, in the design of an exoskeleton specialized in the assistance of hemiplegic patients during their re-education (Op. cit.).

### *B. How Design Thinking designer practices are dealing with complexity in healthcare*

Under headers such as 'Design Thinking' and 'strategic design' practitioners and researchers advocate design as a way for dealing with complex problems within diverse fields such as business, the environment, and health care [27]. For improvement work in healthcare, there is a growing interest in applying Design Thinking [32]. Experienced designers systematically change their understanding of the problem space through framing the design problem at hand [33]. The core of the free-flowing design-practice entails expanding on what problem needs to be solved, as well as expanding on what type of solution might address the evolved problem. These two processes co-evolve, meaning that they iteratively inform each other [34]. Free flowing means that 'expert design practice shows that even the desired outcome can mutate with the adoption of a new frame, enabling designers much more freedom to step away from the initial paradox' (Dorst, according to Op.cit.). This is based on the logic of Abduction [35]. Using ethnographical methods like interviewing and shadowing sessions, where clinical practices are observed, designers highlight and prioritize the value they find in the ambiguity present in the organizational culture [36]. Designers then start from the aspired value. Based on this knowledge they infer a suitable working principle (the rule), and finally, they propose an object (precondition) which can produce this working principle, to deliver the aspired value [29]. Such reasoning thus demystifies the genius of entrepreneurship [37]. This also lowers the risk of new investments and inventions. Many technologies have failed when introduced to the market, as a result of lacking or not having the proper Abduction in their reasoning [38]. So, when using Design Thinking, before creating solutions, efforts are put into framing the problem to be solved [39]. Sometimes small changes are not enough, and radical changes are required to achieve the aspired values. New frames that support radical innovation might be introduced by gaining new perspectives from outsiders or developed by insiders through thematic exploration (Op. cit.). The activities of framing (to set up a first problem description) and reframing (to put the initial perspective under scrutiny and change it) describe what skilled innovation teams excel at [40].

Humans with long term conditions might feel that healthcare treats them as a condition rather than as a whole person. Taking a holistic view on such experiences, Design Thinking creates a new context, a better formulation of the problem in a different area and that helps to shift peoples' thinking into areas from where the problem was always unsolvable into where it is suddenly solvable [41]. Framing and reframing should be understood as a '(novel) standpoint from which a problematic situation can be tackled' [18].

One of the main principles that public innovation practices can borrow from design is the activity of (re-) framing problems [42]. The frame serves as a working hypothesis for how the solution should work in order to achieve an aspired value ('why'). In this way, the designer creates both a new way of understanding the problem as well

as a new way of acting within this problem in order to construct a new meaning [43]. A poor definition of the problem and its causes may falsely direct resources towards trying to solve the wrong problem [44]. Design Thinking has thus emerged as an innovative context framework to obtain a holistic picture of the state-of-the-art and to determine advantages for change [45]. The advantage of taking a holistic perspective first is that it tends to broaden the perspective taken and thus avoids short-sighted design biases, e.g., redesigning a tool rather than the activity-flow itself [19]. Figure 1 below illustrates how abductive reasoning reduces complexity and risk through abductive reasoning, framing and reframing the problem.

Thies [33] reports the case of the Primary Care Unit (PCU) in the County Council of Värmland, Sweden, where an appointment to see a doctor was hard to get. Normal waiting times for non-acute appointments were around 4-6 weeks. Acute meetings were taken care of the same day. However, the number of timeslots per day for acute meetings was limited, which highly influenced the workflow at the PCU, as well as the patients seeking help. A better IT-system for booking could be part of the solution, but it would be deceptive to range this as the whole solution. The underlying problems were bigger, with causes coming from the different actors' different perspectives and conflicting patterns of action. The value of the service designer lies in creating a holistic understanding of the problem as a basis for designing appropriate measures [34]. Complexity is enhanced by legal requirements stating that all patients should undergo an assessment before booking or being sent home.

Patient focus groups are often involved in governance of hospitals, e.g. planning new facilities., but decisions to be made by a clinic administration needs to consider clinical considerations as well as legal requirements that may be at odds with patient focus groups' perceptions of desirability. Transparency around the decision-process, making it more public may help to legitimize decisions. Design Thinking may help in this process [22].

Design Thinking can help in co-designing a holistic approach to achieving wellbeing as a value, in facilities for living and dying (palliative care) with dementia [46]. Design Thinking and user-centred design-process programs have also helped in creating successful new eHealth applications, e.g., The Connected Care start-up. Running since 2009, the start-up has been offering a self-healthcare solution for managing sleep disorders. 'In 2017, the 25+ employee-sized company was operating in 10 countries before it was acquired by a global electronics company a year later' [47]. Hardy et al [48] reports on how 'inclusive, user-centred design research' can improve therapies for Psychosis, through the development of the application, 'SlowMo'.

### C. Some potential pitfalls in applying Design Thinking in healthcare, and what kinds of caution should be applied

There are requirements for a successful implementation of a new technology in healthcare, even if the application seemingly is designed after Design Thinking principles. The Leavitt's diamond theory for change management applies

and states that implementation of new technologies must be accompanied by change in structure, tasks and people.

Orlowski et al. [49] reports on a case study using Design Thinking in redesign of an initial Design Thinking service innovation—the Nurse Knowledge Exchange (NKE). This strategy aimed at improving nursing communication and handover (between shifts) in the organization's hospitals.

The process, as in most applications of DT, was rapid and expert-led (i.e. controlled from start to finish by the design team), and it called on end users, who included staff from all organizational levels, but no patients, for contributions at various stages—particularly during interviewing/observing and field testing. The end-result was NKEplus. The authors described heavy resistance to implementation of the NKEplus strategy outside of the pilot site. The organization was used to, that Design Thinking-based innovations and change normally were coupled with training support and formal changes to work roles and position descriptions. The rest of the case study details re-implementation of NKEplus, a process that resulted in higher uptake and buy-in for NKEplus organization-wide.

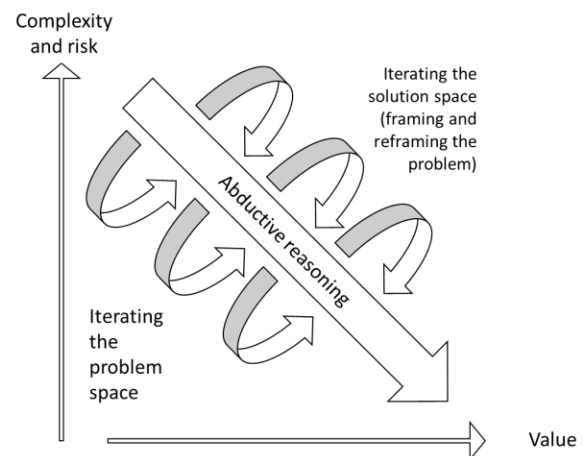


Figure 1. Abductive reasoning in innovation processes as in healthcare

Identifying the right venue and creating a friendly atmosphere may enhance the probability for a positive outcome. In the case of the 'Wellfayre' (a program for creating welfare innovations) thoughts about branding and the name 'WellFayre' (...) gave the idea of taking paper cups, cakes and juice, in keeping with a 'country village fayre' aesthetic. This was given a warm welcome (see figure 20). Each participant was comfortable, and conversation flowed freely. When deciding on the venue, the participants' health conditions were taken into consideration, i.e. their need for lifts instead of stairs [41].

Research on the role of Design Thinking in healthcare needs to consider the role of the designers. By observing what designers do, Cross summarized design abilities as "resolving ill-defined problems, adopting solution-focused cognitive strategies, employing abductive or appositional thinking, and using nonverbal modelling media" [39]. Furthermore, studies about design knowledge and expertise

also defined them in terms of how designers think and work through their tools, approaches, and ‘artefacts’ [39]. To be effective, a distance to the subject at hand may be needed.

A designer relies on hers or his personal integrity. An example: In the context of management research, studies have explored the effects of empathy on individuals and its influence on a group or organization. Empathy may be followed by an emotional contagion that can influence group behavior. Customer service representative may feel a degree of stress given the constant low-grade effect of listening to customers’ problems or negative feedback [25]. This issue could arguably underpin the case for using external resources for design research, as they may both have a degree of legitimacy, and a distance to the problems, needed to do an objective assessment that does not over-influence the solution-space.

*D. The potential positive outcome of applying Design Thinking methods, for the care providing organizations and for care-receivers*

Design Thinking may be a forerunner for other, more rigorous ontologies including Business Process Management and Modelling, Enterprise Architecture development [50] or ITIL [51]. Design Thinking has the potential to take you far into construction, like in making Ambient Intelligent Systems; ‘The design process included concept generation and evaluation. In both we followed techniques that supported the design practice. In the generation phase we followed the Design Thinking (...) framework’ [52].

Putting humans first may be the hallmark of Design Thinking. The advantage of design-led innovation is its creation of opportunities based on emotion-rich innovations in the product or services value, as perceived by the user. Empathy is ‘the ability to see and experience through another person’s eyes, to recognize why people do what they do’ [53]. Lupton [54] gives us a narrative from a typical process; ‘In a different project, I worked with designers to generate design artefacts for using in a participatory design workshop on digital health. The participants were drawn from healthcare consumer and practitioner groups, industry, and government agencies. They first took part in a group activity involving mapping the landscape of digital health technologies to determine which technologies were being used and the social relationships involved. The groups presented the maps to the other groups, explaining their choices and highlighting the positive and negatives aspects of the current digital health technology landscape. The other two activities asked participants to imagine future opportunities for new digital health devices or software, including making storyboards that inserted these technologies into narratives’ [54].

Using the ability to focus on emotional and social rewards, Design Thinking methods may improve public health. ‘In one particular project focused on diabetes management, an IDEO team discovered that traditional clinical goals of diabetes management (such as losing weight and controlling blood sugar levels) to prevent further progression of the disease were inadequate in motivating many patients to make healthy changes to their habits and

routines. By contrast, setting social and emotional goals (such as being able to walk a 5-kilometre tour or to dance with one’s daughter at her wedding) were highly motivating. As a result of this insight, the team made setting personal life goals (social and emotional) a core service element of the product they designed, changing the patient’s mindset from prevention to promotion in the process’ [55]. This way, Design Thinking may create whole new experiences from the user’s journey. (Design Thinking) tries to reframe the relationship between the user and the context in which the product/service are experienced. Philips Electronics, for example, developed Ambient Experience for Healthcare, a breakthrough application for reducing the anxiety and stress for patients - and especially for kids - when they undergo medical scans with Computed Tomography (CT) or Magnetic Resonance Imaging (MRI). By rearranging the layout of medical devices, introducing cartoons, video and relaxing images into the room, and using sound and interactive walls, the company fostered a new vision of the user experience’ [56].

#### IV. CONCLUSION

After In this section the authors sum up the answers to the research questions (RQs) as detailed in the previous section and discuss what other topics of interest remains unanswered. Regarding RQ1 (see Section 1), this study has answered the research questions as follows: Design Thinking is defined in healthcare as a human- and patient-centric approach to ideation and innovation, and several Design Thinking methods have been applied. This article has provided a few examples. The Design Thinking practices for dealing with complexity, “wicked problems”, like often found in healthcare innovation dilemmas, makes the methodology appropriate in this context. Design Thinking methods for dealing with complexity involves abductive reasoning, framing and reframing of the problem, as shown above as a response to RQ2, and illustrated in Figure 1. There are potential pitfalls in applying Design Thinking in healthcare, and such an approach does not annihilate the needs for normal change management procedures, like getting all employees on board as involved and engaged [57], and employing proper governance methods. This would be the short answer to RQ3., but literature reports many positive outcomes of applying Design Thinking methods, for the care-providing organizations as well as for patients. This article has touched on a few examples, as a response to RQ4. Unanswered questions remain around what degree of standardization of the methodology is warranted. On one hand, a strict protocol may ease adoption of Design Thinking methods. On the other hand, a too rigid protocol may make Design Thinking lose its flexibility and agility and make it less intuitive as an instrument for a dialog between experts and novices within a certain domain.

But Design Thinking is no ‘silver bullet’ and ideas may have to come from a lot of sources. Let us use the Primary Care Unit [33] as a speculative, imagined example of the importance of iterating between problem and solution. Here you could also mention Kim and Mauborgne’s 4-action

framework [10] – where the designer should ask what (what steps in the process) should be strengthened, reduced and simplified, eliminated and innovated, respectively - here for example innovating a digital advance diagnosis? The statutory analogue preliminary assessment of patients creates queues and obviously has little perceived value to patients, but requires a lot of time and resources. It steals, among other things, resources from the treatment (let's assume then that the caregivers who make the assessment are also the ones who will assist with surgical intervention, and which is then also a scarce resource). In addition, the physician performs his or her own assessment, so that the pre-assessment is quickly duplicated. A team of process innovators and designers with access to digital expertise might suggest a step ahead of the service, an online self-diagnostic tool, perhaps linked to artificial intelligence, that could collect data and speed up the admission session (serving as decision support for both) those who do the pre-assessment and for the doctor. Of course, such an idea had to be tested and piloted, in a dialogue with all stakeholder groups, as the details are quality-critical, but similar solutions do exist, e.g., the Norwegian IT-service company Diagraphit [58], offer pre-appointment diagnosis tools.

Further research could consist of case studies within concrete problematic areas in healthcare and public health. Such studies could inform both researchers and practice and devise how Ideally, health-institutions could shape co-creation arenas (real and virtual) where all stakeholders can meet, where ideas developed according to Design Thinking principles, which can then be pursued handing over plans and ideas to more rigid tools and methods.

#### *Limitations of this study*

A literature study like this is not an exhaustive overview over all relevant aspects and the authors may have overlooked sources that might provide new insight of relevance to the research subject.

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