MARIANA SOARES DE OLIVEIRA

DESIGN THINKING AS AN INNOVATION ENABLER IN HEALTHCARE

São Paulo

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Advisor: Prof. Dr. Eduardo de Senzi Zancul

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DESIGN THINKING COMO HABILITADOR DE INOVAÇÃO NO SETOR DE SAÚDE

Versão Corrigida

Tese apresentada à Escola Politécnica da Universidade de São Paulo para obtenção do título de Doutora em Ciências.

Área de Concentração: Engenharia de Produção

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ABSTRACT

This research explores the adoption of Design Thinking in healthcare contexts and its relationship to capability building for innovation in the era of Digital Transformation at an organizational level. This purpose is fulfilled by answering four research questions: 1) What is the construct of Design Thinking?; 2) How is Design Thinking currently applied as an approach for innovation in the healthcare sector?; 3) How can Design Thinking be institutionally adopted, and how does it relate to innovation management in healthcare organizations?; and 4) How does Design Thinking relate to capability building for Digital Transformation in healthcare organizations? The research questions guide an empirical case study and theoretical literature reviews conducted on the intersection of Design Thinking, innovation, Digital Transformation, and Dynamic Capabilities theories. To better explore innovation management in the context of the healthcare sector, the research establishes a multidisciplinary dialogue between engineering, management, design, and the healthcare sciences. The thesis proposes three resulting artifacts: a) A comprehensive construct for Design Thinking, accommodating the nuances and contextual dependencies of the approach; b) A hospital innovation process model integrating Design Thinking within an organization's innovation management pipeline; and c) A model for developing capabilities for Digital Transformation through Design Thinking. The thesis findings advance theory by characterizing the use of Design Thinking in healthcare organizations, conducting an empirical and systematic analysis of its adoption, implementation, and outcomes, and exploring its role as a social technology in building dynamic capabilities for Digital Transformation. For a practitioner audience, it acts as a reference for managers, executives and consultants willing to scale Design Thinking at their organizations.

Keywords: Design Thinking. Innovation. Healthcare. Digital Transformation. Dynamic capabilities. Capability development.

RESUMO

Esta pesquisa explora a adoção do Design Thinking em contextos do setor de saúde e a sua relação com a geração de capabilidades para inovação na era da transformação digital em um nível organizacional. Este propósito é atendido por meio da resposta a quatro perguntas de pesquisa: 1) Qual é o construto do Design Thinking?; 2) Como o Design Thinking é atualmente aplicado como uma abordagem para inovação no setor de saúde?; 3) Como o Design Thinking pode ser institucionalmente adotado como uma abordagem para inovação no setor de saúde?; e 4) Como o Design Thinking se relaciona com a construção de capabilidades para a transformação digital no setor de saúde? As perguntas de pesquisa guiam um estudo de caso e revisões sistemáticas da literatura buscando a interseção entre teorias de Design Thinking, inovação, transformação digital e capabilidades dinâmicas. Para explorar a gestão da inovação em contextos do setor de saúde, a pesquisa estabelece um diálogo muldisciplinar entre as áreas de engenharia, gestão, design e ciências da saúde. A tese propõe três artefatos: a) um construto abrangente para o termo Design Thinking, acomodando as dependências conceituais e nuances do termo; b) um modelo de processo de inovação em hospitais integrando o Design Thinking com abordagens para gestão de projetos; e c) um modelo para o desenvolvimento de capabilidades para transformação digital por meio do Design Thinking. Os achados da tese avançam o conhecimento teórico ao caracterizar o uso do Design Thinking em organizações de saúde, analisar sistematicamente e de forma empírica sua adoção, implementação e resultados associados, e explorar seu papel como uma tecnologia social na construção de capabilidades dinâmicas para a transformação digital. Para gestores, executivos e consultores da área, a tese serve como referência para entender como escalar o Design Thinking em organizações.

Palavras-chave: Design Thinking. Inovação. Saúde. Transformação digital. Capacidades dinâmicas.

TABLES INDEX

ILLUSTRATIONS INDEX

ACRONYMS INDEX

HCD	Human-centered Design
ISO	International Organization for Standardization
IT	Information Technology
NPD	New Product Development
RQ	Research Question
SLR	Systematic Literature Review
SUS	Sistema Único de Saúde (Unified Health System)
UCD	User-centered Design
USP	Universidade de Sao Paulo

LIST OF APPENDED PAPERS

Paper 1

Oliveira, M., & Zancul, E. (2022). Unveiling the Construct of Design Thinking: An Exploratory Study. Proceedings of the Design Society, 2, 41–50. https://doi.org/10.1017/pds.2022.5

Paper 2

Oliveira, M., Zancul, E., & Fleury, A. L. (2021). Design Thinking as an approach for innovation in healthcare: systematic review and research avenues. BMJ Innovations, 7(2), 491–498. https://doi.org/10.1136/bmjinnov-2020-000428

Paper 3

Oliveira, M., e Silva, G. D., & Zancul, E. (2023). Design and Early Evaluation of a Device to Improve the Sharp Count Process in Operating Rooms. Surgical Innovation, 155335062311709. https://doi.org/10.1177/15533506231170935

Paper 4

Oliveira, M., Zancul, E., Fleury, A. L., Dias, J. F., & Rahal, D. (2024). Hospital innovation process and organization evolution: From design thinking workshops to innovation outcomes. International Journal of Healthcare Management. https://doi.org/10.1080/20479700.2024.2318507

Paper 5

Oliveira, M., Zancul, E., & Salerno, M. S. (2024). Capability building for Digital Transformation through Design Thinking. Technological Forecasting and Social Change, 198, 122947. https://doi.org/10.1016/j.techfore.2023.122947

SUMMARY

1. Introduction

This chapter introduces the theme of this thesis. Section 1.1 presents the context and motivation driving this doctoral thesis's development, rooting the theme's relevance for both scholar and practitioner audiences. Section 1.2 articulates the research framing that outlines the thesis, stating the addressed research gaps, the overarching objective of the research, the research questions (RQs) formulated, and the papers that were produced throughout the doctoral program to answer the RQs, contributing to achieving the thesis objective and narrowing the identified gaps. Section 1.3 encapsulates the structure of the thesis, providing a guide for readers to navigate in this work.

1.1. Context and motivation

In the beginning of the 2000s, the Design Thinking discourse received notorious attention in management publications, books, and even on mainstream television (Brown, 2008, 2009; Johansson-Sköldberg et al., 2013; R. Martin, 2009; Micheli et al., 2019) claiming to be a new approach to solve complex problems inspired by the way professional designers think and work. Consultants and scholars created several prescriptive Design Thinking models, presenting structured step-by-step processes on how to adopt this new approach (Silva et al., 2020). Regardless of structured processes, Design Thinking uses attributes including but not restricted to creativity, user-centeredness, iteration, experimentation, interdisciplinary collaboration, and tolerance to ambiguity and failure (Carlgren et al., 2016; Micheli et al., 2019). Its claims of being a powerful approach to dive into consumers' lives (Brown, 2008) and the success of Design Thinking interventions led by researchers from Stanford University with notoriously innovative firms such as Apple (Auernhammer & Roth, 2021) accelerated Design Thinking's adoption intending to promote innovation in several organizations over the past 20 years. Nevertheless, its theoretical development in the innovation management field did not follow the pace of its adoption in organizations; theory in the area has grown to employ the term Design Thinking as an “umbrella construct” with a loose meaning that may hinder or even collapse theory development (Micheli et al., 2019). There is a need to provide a more established picture of the multiple interpretations of Design Thinking (Magistretti, Bellini, et al., 2022) and its analysis as an organizational phenomenon beyond tools and processes (Elsbach & Stigliani, 2018) for practitioners and scholars to understand the theme better.

Concurrently with the rise of Design Thinking in the practitioner world, the creation and popularization of digital technologies have quickly disrupted and continue to disrupt how people live. Invariably, the ubiquitousness of digital technologies has also disrupted how firms approach innovation in several forms: first, digital enabling technologies can augment product and service performance (Appio et al., 2021). Second, the logic for building digital innovation in products or services, which involve devices, networks, services, and content, implies a significant change in how firms organize and source capabilities (Yoo et al., 2010). Third, digital technologies enable relevant business model innovation beyond the complexity of technology adoption and development themselves (Warner & Wäger, 2019). Fourth, there is evidence that solely the adoption of digital technologies does not have a direct relationship with a firm’s innovation performance; instead, firm innovation performance, even in digital contexts, is highly dependent on creativity and research-related activities, and firms need to invest in these abilities to seek better performance in digital contexts (Usai et al., 2021). This multifaceted phenomenon that affects organizations at several levels, including their innovation processes, has been labeled Digital Transformation (Appio et al., 2021; Vial, 2019).

Digital Transformation is not exclusively an Information Technology (IT) phenomenon (Matt et al., 2015). It is dependent on a bundle of organizational resources and top management support (X. Zhang et al., 2023), and should be analyzed from the optics of business, society, and technology (Van Veldhoven & Vanthienen, 2022). Moreover, it is an ongoing phenomenon that is unlikely to be ever completed, as the technologies that will continue to drive it are yet to be popularized or developed (Appio et al., 2021; Kane, 2017). Firms must actively prepare for a fast-paced, ever-changing environment (Ceipek et al., 2021), and incumbents must reconfigure their pre-existing processes and organizational structures to succeed digitally (Sebastian et al., 2017) and maintain competitive advantage. To summarize, to thrive in a digitally transforming environment, firms must develop specific dynamic capabilities to endure these conditions. Reminiscing the Teecian construct for dynamic capabilities, firms need to foster their "ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments" (Teece et al., 1997, p. 516).

Upon this realization, recent works on innovation management have focused extensively on exploring enablers and capabilities for Digital Transformation. It is acknowledged that digital capabilities support the adjustment of organizational resources and emerging technologies, enhancing digital innovation (Zhen et al., 2021) and that the firm's digital dynamic capabilities contribute to sustaining its performance over time (Sousa-Zomer et al., 2020). Research articles have identified the required capabilities for Digital Transformation, their enablers, and their barriers (Ghosh et al., 2022; Warner & Wäger, 2019). Despite the awareness of the relevance of developing capabilities for Digital Transformation in employees, there is little understanding in the innovation management literature on how to actively source these capabilities in the workforce. Practitioners and scholars need a better comprehension of the processes and mechanisms for developing these capabilities to achieve solid innovation and Digital Transformation performance and enable further theorizing in the field.

The rise of Digital Transformation and the need to develop capabilities to navigate it gives researchers a new lens to analyze the pervasive adoption of Design Thinking in organizations. Recent works have explored the relationship between Design Thinking and the construction of Dynamic Capabilities for innovation (Kurtmollaiev et al., 2018; Liedtka, 2020; Magistretti, Ardito, et al., 2021), New Product Development (NPD) (Nagaraj et al., 2020), and for Digital Transformation (Marx, 2022). It is in the interest of this thesis to further unpack the processes by which firms may institutionally adopt Design Thinking and how this adoption unfolds into Dynamic Capabilities for innovation in a digitally transforming era, addressing a facet that is underexplored in this emerging area of interest in academic research and that is relevant for practitioners engaging in innovation management.

This thesis unpacks the relationship between Design Thinking and Dynamic Capabilities for innovation in the context of the healthcare sector. Following Flyvberg's (2006) typology for case selection, the healthcare sector is an extreme case for this research for three reasons:

i) The healthcare sector, especially healthcare providers, has characteristics that make organizational change and innovation challenging, such as decentralized structures (Aas, 1997), the need for collaboration among highly specialized professional groups with distinct knowledge bases (Ferlie et al., 2005), high job autonomy (Schultz et al., 2012); a healthcare professional-centered approach embedded in organizations (Martinez Ibañez et al., 2022); the obligation to suit strict regulation in clinical-related innovation (J. L. Martin et al., 2012); the prevalence of a risk-averse culture which hinders employee initiatives towards innovation (Khatri et al., 2009).

ii) Design Thinking has been extensively applied to healthcare contexts (Altman et al., 2018; Bazzano et al., 2017), which one can attribute to the facts that both Design Thinking and Healthcare disciplines are worried about caring for people, writ large, and that Design Thinking connects this care known leverages for organizations aiming to maximize their outcomes (Hargraves, 2018); this pervasiveness gives us a decent amount of data to work on to evolve the research.

iii) The healthcare sector has been sluggish in conducting its Digital Transformation (Massaro, 2023), and this may hinder care quality due to the lack of availability and actionability of health data (Torab-Miandoab et al., 2023). Hence, there is a pressing need to accelerate the conduction of Digital Transformation and innovation activity.

Given the complex nature of healthcare organizations, such as hospitals and insurance providers, it is reasonable that these institutions would naturally follow the trend of adopting Design Thinking and that they are subject to Digital Transformation as a matter of survival for the business. Practitioner-oriented management journals, such as Harvard Business Review, published several articles recalling anecdotal successful experiences of healthcare projects that employed Design Thinking or HCD (e.g., Brown, 2008a; Kim et al., 2017; McCreary, 2010). In the scholarly literature, frameworks for the adoption of Design Thinking in healthcare emerged (Cheung, 2012; Roberts et al., 2016; Valentine et al., 2017); reviews consolidated the newborn body of research on health interventions and products ideated using Design Thinking (Altman et al., 2018; Bazzano et al., 2017). Beyond adopting Design Thinking to develop products and services, research on innovation management in healthcare has pointed to Design Thinking as a competence required for innovation leaders (Glover et al., 2020; van den Hoed et al., 2022).

Given the relevance of the theme and aiming to explore the unveiling of Design Thinking, the remainder of this work will elaborate on the meshed intersections of Design Thinking, Innovation, Digital Transformation, and Dynamic Capabilities in healthcare, following the research frame outlined in Section 1.2.

1.2. Research framing

This section presents the research framing of this thesis. This paper-based thesis comprises five papers.

The first step to frame the research is to enunciate the research gaps that drive the investigation; Section 1.2.1 presents these gaps. Then, Section 1.2.2 articulates the objective of the thesis to direct its efforts to narrow the previously identified gaps. Section 1.2.3 elaborates on the research questions that drive the thesis to fulfill its purpose. Lastly, section 1.2.4 presents the design of the studies that compose the thesis and justifies the choices for their research methodologies given the nature of the RQs they intend to answer; this section also consolidates how the research gaps, research objectives, research questions, and research design interact with each other and drive the contribution of this thesis.

1.2.1. Research gaps

Given the background presented in Section 1.1, two significant research gaps are identified and posited as the guidelines for this thesis' investigation:

a) *Lack of standardization on what is labeled as Design Thinking hinders theory development.*

b) *Lack of understanding of if and how Design Thinking contributes to developing capabilities for innovation at the organizational level in the Digital Transformation era.*

The *first gap* relates to the non-standardization of what is reported under the label of Design Thinking. There are robust studies assessing Design Thinking interventions in the context of healthcare (Altman et al., 2018; Bazzano et al., 2017), but their interest lies in analyzing the impacts of the intervention itself, and they do not deepen the exploration of what is being called Design Thinking in those specific contexts and what, if any, are the opportunities for enhancing the claimed benefits of the Design Thinking approach in this context.

The *second gap* was identified throughout the investigation of the first gap. The reports of a few groups, platforms, or models to foster healthcare innovation in multidisciplinary teams and collaborating with end users and their outcomes seemed relevant for evolving the design of innovation offers in healthcare, but they were anecdotal (Brennan et al., 2009, 2010; Grocott et al., 2007; Neinstein et al., 2016). These research and development groups worked on robust ad-hoc projects, and they can provide limited insight into how established organizations could promote and conduct sustained innovation efforts at the same time they manage contemporary challenges such as Digital Transformation (Magistretti, Tu, et al., 2021; Marx, 2022) and innovation management (Magistretti, Ardito, et al., 2021; Magistretti, Bianchi, et al., 2022; Magistretti et al., 2023). Design Thinking's social approach to ongoing capability building (Liedtka, 2020) may empower managers and employees to overcome these contemporary challenges. Hence, there is an opportunity to investigate how Design Thinking relates to developing capabilities for innovation in the Digital Transformation era.

1.2.2. Research objective

Given these research gaps, this work aims to investigate the enactment of Design Thinking adoption in organizations and projects and its relationship to the development of dynamic capabilities that contribute to achieving innovation in the contemporary digital transforming moment, analyzing the organizational level in healthcare contexts. Hence, the purpose of the research is as follows:

To explore the adoption of Design Thinking in healthcare contexts and its relationship to capability building for innovation in the era of Digital Transformation at an organizational level.

1.2.3. Research questions

The thesis is composed of five papers that collectively achieve its objective; each paper is linked to one RQ to ensure the autonomy of each article as a stand-alone work.

First, the ambiguity around Design Thinking hinders theory development in the field (Micheli et al., 2019). Research intending to advance theory in a research field must depart from normalized constructs and premises. This need for establishing a common understanding regarding what is Design Thinking drives the first RQ:

RQ1: What is the construct of Design Thinking?

Second, a consolidated understanding of the state of the practice of the current adoption of Design Thinking as an approach for innovation in the healthcare sector is not available in the literature. Previous works have analyzed the health outcomes solutions developed using a Design Thinking approach (Altman et al., 2018; Bazzano et al., 2017). However, a rigorous evaluation of Design Thinking's operationalization in the healthcare sector from a process perspective remains a research opportunity (Bazzano et al., 2017). This analysis must be performed within cases to understand these dynamics in-depth and across cases to understand them in breadth, which leads to the second RQ and its subset of questions. Answering to the subset of questions answers the main question.

RQ2: How is Design Thinking currently applied as an approach for innovation in the healthcare sector?

RQ2-A: How is the application of Design Thinking in healthcare projects reported in scholarly literature?

RQ2-B: How is Design Thinking adopted as an approach for innovation within a project?

Third, the development of innovative healthcare solutions at scale is needed to achieve better health coverage (Bloom et al., 2018), with Design Thinking pointed as a competency domain that healthcare managers and employees must have to enable innovation readiness (van den Hoed et al., 2022) and fostering innovative work behavior listed as a priority for healthcare organizations (Baig et al., 2022). Design Thinking and its tools have been employed in healthcare in diverse but one-off scenarios, such as promoting interprofessional work (Cleckley et al., 2021), guiding discussions with patients (Annweiler et al., 2023; Casarett et al., 2023), designing services (Uehira & Kay, 2009; Vechakul et al., 2015), and developing hardware (Langell et al., 2019; Lopes et al., 2019; Oliveira et al., 2023) and software products (Denecke et al., 2018; Vilardaga et al., 2018).

In contrast with the emerging reports of one-off solutions, studies on effectively integrating Design Thinking into healthcare organizations are scarce, with a few exceptions. Martinez Ibañez et al. (2022) draw on several examples of interventions created in a Spanish hospital after adopting Design Thinking at an institutional level and their financial impact; however, they present a limited analysis of how the adoption process unveiled over time and its limitations. Eines and Vatne (2018) make a detailed evaluation of the process of ideating a new organizational-wide service model in nursing homes from the perspective of several individuals involved in the design process and recommend further research on the collaboration of staff, managers, and designers throughout the entire innovation process.

Beyond healthcare, as presented by Micheli et al. (2019), surprisingly little research has been performed to unveil the skills and competencies that need to be developed to introduce design in an organization and how to source these skills. Accordingly, tangible strategies to foster the mechanisms by which Design Thinking and its attributes – such as creativity, user-centeredness, and problem-solving (Carlgren et al., 2016; Micheli et al., 2019) – may be institutionally diffused within an organization are unclear and remain a research opportunity (Magistretti, Ardito, et al., 2021). Additionally, exploring the moment in the innovation process in which is more appropriate to employ Design Thinking is also necessary to advance this research field and provide recommendations for practitioners (Magistretti, Ardito, et al., 2021), as well as to better drive the use of Design Thinking in projects (Liedtka & Locatelli, 2023). Given this context, the third RQ is as follows:

RQ3: How can Design Thinking be institutionally adopted, and how does it relate to innovation management in healthcare organizations?

Fourth, Design Thinking practices are increasingly adopted in industries exposed to Digital Transformation (Dell'Era et al., 2020) and leveraging digital technologies (C. T. A. Pham et al., 2022). To withdraw from a simplistic depiction of Design Thinking as a normative set of practices, an emerging trend in the literature is the observation of Design Thinking from a capability lens (Appleyard et al., 2020; Liedtka, 2020; Magistretti, Ardito, et al., 2021; Magistretti, Tu, et al., 2021). The same happens with the Digital Transformation literature (Sousa-Zomer et al., 2020; Vial, 2019; Warner & Wäger, 2019).

Digital Transformation scholarship has extensively explored the role of digital technologies in the context of Digital Transformation. Still, there is a consensus that digital technologies are primarily imitable and hence are not a source of competitive advantage; firms need a workforce capable of deploying the digital resource base to obtain competitive advantage from digital assets (Usai et al., 2021; X. Zhang et al., 2023). Hence, organizations must develop their workforce to be digitally mature (Van Veldhoven & Vanthienen, 2022).

On the intersection of Design Thinking and Digital Transformation, Marx (2022) theoretically elaborates that organizations can employ Design Thinking to change the organizational setup and to build and sustain dynamic capabilities; Magistretti et al. (2021) argue that Design Thinking aids the development of capabilities to extend the knowledge base, debating perspectives, cropping solutions and information, interpreting the problem, and recombining factors towards targeting a technological opportunity.

Employing a capability lens for Design Thinking and Digital Transformation research is relatively recent, and the role played by the time when adopting Design Thinking to achieve capability building is still underexplored (Magistretti, Ardito, et al., 2021). As posited by Liedtka (2020, p. 78), "In a world where leaders are constantly admonished to think big and seek disruption, Design Thinking's social technology offers an alternative pathway – to start small and local by diffusing innovation capabilities throughout the organization." The opportunity to investigate Design Thinking as a driver for capabilities for innovation in a digital transforming era leads to the fourth and final RQ in this thesis:

RQ4: How does Design Thinking relate to capability building for Digital Transformation in healthcare organizations?

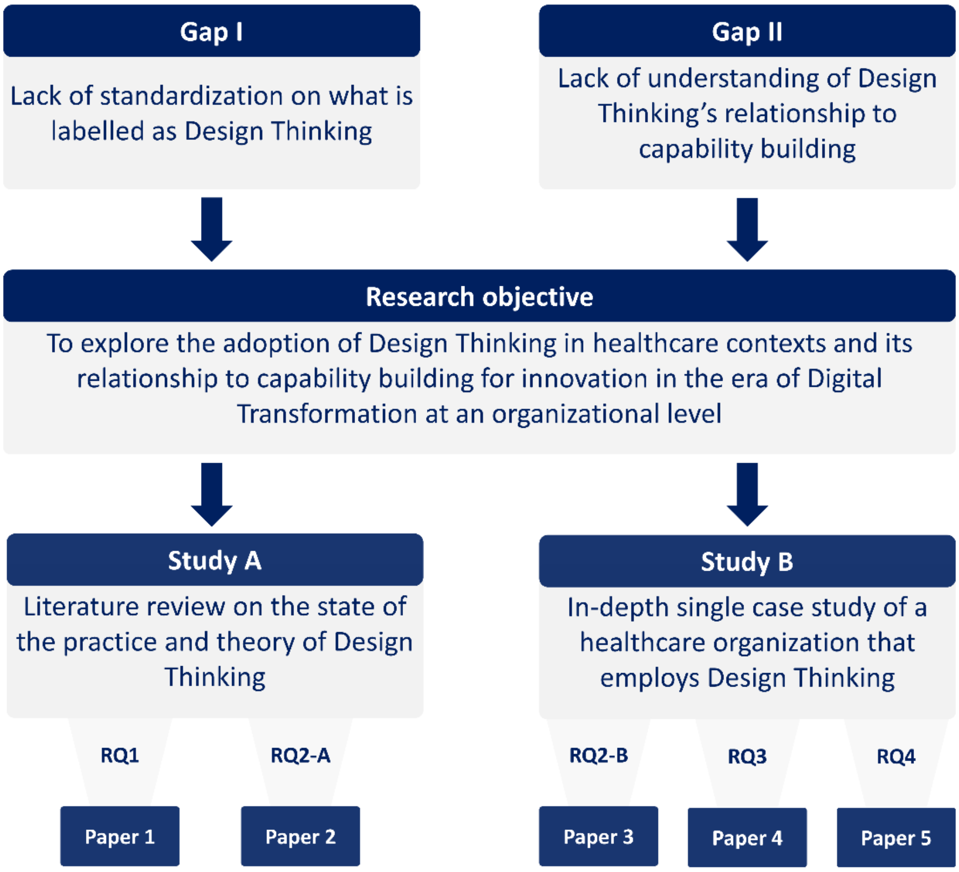
1.2.4. Summary of the research design and framing

The purpose of the research is addressed by two independent studies, namely *Study A* and *Study B*. *Study* A is composed of two independent systematic literature reviews (SLR) on the state of practice of Design Thinking in healthcare, which aims to identify avenues for future research. *Study A* addresses *RQ1* and *RQ2-A*, which are answered in *Paper 1* and *Paper 2*, respectively.

Study B was elaborated based on gaps identified while study A was conducted, and it is an in-depth case study of an organization in the healthcare sector that had consistently employed Design Thinking as an approach for innovation over six years; the study was exploratory and aimed to understand the dynamics, outcomes, and outputs of this adoption. *Study B* addresses *RQ2-B*, *RQ3,* and *RQ4*, which are answered by *Paper 3*, *Paper 4,* and *Paper 5*, respectively.

Figure 1 ties the presented research gaps, objectives, and questions to the studies conducted during the doctoral program and the five articles derived from these studies. The following paragraphs briefly explain each paper.

Figure 1 - Relationship between the research gaps, research objectives, studies, RQs, and papers in this thesis



Paper 1 (Oliveira & Zancul, 2022) answers *RQ1* (*What is the construct of Design Thinking?*), addressing a foundational gap in the field. Following an SLR of research on Design Thinking theory, the work proposes a construct for Design Thinking composed of a comprehensive conceptual definition and a set of properties that ground its enactment in tangible ways.

Paper 2 (Oliveira et al., 2021) answers *RQ2-A* (*How is the application of Design Thinking in healthcare projects reported in scholarly literature*). It consists of an SLR of 32 studies of healthcare solutions that claim to have employed Design Thinking in their development process. Several categories of interest were tabulated for each reviewed study, such as the disciplines and stakeholders involved in the development process, the Design Thinking stages and tools reported, and the intervention status. The paper analyzes the sample collectively in searching for future research avenues, which served as input for *Study B.* The paper contributes with an assessment of how Design Thinking and its tools are applied in the articles in the sample and by identifying avenues for research: a) creation of platforms and groups for leveraging the integration of individuals in health innovation projects, b) increased focus on the inspiration stage, c) e-health focused user research and d) lead user involvement.

Paper 3 (Oliveira et al., 2023) answers *RQ2-B* (*How is Design Thinking adopted as an approach for innovation within a project?*). It depicts the design of a device to improve the process of counting surgical needles in operating rooms, detailing the phases of need-finding, concept generation, concept validation, concept development, and market analysis. The organization analyzed in *Study B* was involved in the development of this device, and the development process employed the Design Thinking approach; hence, beyond responding to *RQ2-B*, it details one case that contributes to providing a better understanding of the outputs of the organizational practices in that context.

Paper 4 answers *RQ3* (*How can Design Thinking be institutionally adopted, and how does it relate to innovation management in healthcare organizations?*) by discussing a case study of a hospital implementing Design Thinking as a comprehensive organizational approach to innovation for six years. Results indicate that Design Thinking supported increasing and disseminating innovation practices across diverse areas and hierarchical levels but had to be complemented with traditional project management practices to enhance innovation-related business outcomes. The paper's contribution lies in elaborating a hospital innovation process model as a reference for healthcare institutions intending to develop innovation capabilities.

Paper 5 (Oliveira et al., 2024) answers *RQ4* (*How does Design Thinking relate to capability building for Digital Transformation in healthcare organizations?*). It departs from the same case study to theorize about the contribution of Design Thinking to developing capabilities for Digital Transformation, exploring the mechanisms that build these capabilities over time. The study identifies twelve capabilities as enablers of Digital Transformation, of which six are directly attributed to the Design Thinking domain and six to the strategic management domain and are indirectly supported by Design Thinking practices. The paper extends the understanding of the benefits of Design Thinking beyond its product development capabilities and elaborates on its role in organizing for innovation and Digital Transformation management.

Collectively, these papers contribute to achieving the research objective. Their contributions are innovative as standalone pieces, and jointly, they shape the innovative character of this thesis in providing a holistic understanding of the adoption of Design Thinking in healthcare contexts and its relationship to capability building for innovation in the era of Digital Transformation.

1.3. Structure of the thesis

This thesis is structured as follows: Chapter 1 introduces the theme and the framing of the research, elucidating the research gaps, research objective, and RQs; it provides a brief overview of the appended papers to the thesis. Chapter 0 presents an overarching literature review comprising the themes of Design Thinking, innovation in the era of Digital Transformation, and dynamic capabilities. Chapter 3 describes the methodology employed for the studies that compose the thesis. Chapter 4 presents a summary of each paper. Chapter 5 brings a discussion on the findings of thesis, consolidating the discussion of the presented papers. Chapter 6 brings the concluding remarks of the thesis, consolidating its main findings, implications for theory and practice, limitations, and identified opportunities for future research.

2. Literature review

This chapter presents a leveling literature review. Section 2.1 presents the foundations of Design Thinking and its multifaceted interpretations and representations in a few research streams. Then, Section 2.2 discusses the innovation and the Digital Transformation phenomena. Finally, Section 2.3 discusses the dynamic capabilities theory and how it may be related to the Design Thinking approach.

2.1. Design Thinking

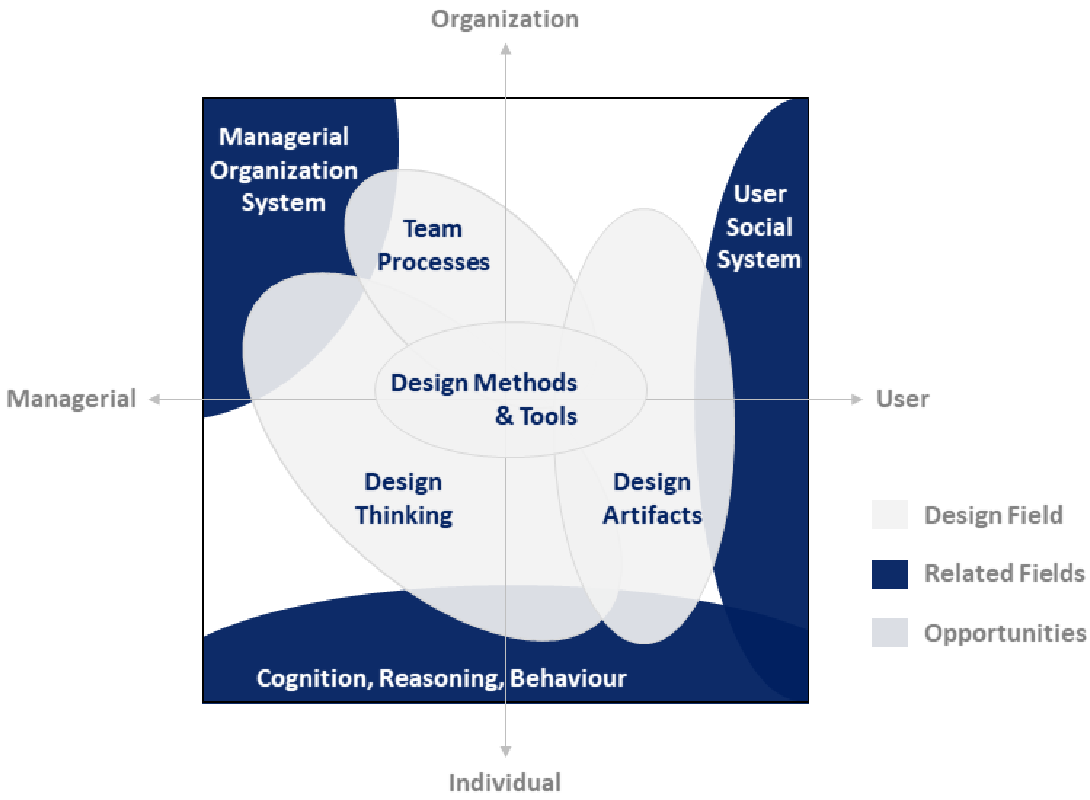
This section covers the literature on Design Thinking. Section 2.1.1 presents the rise of Design Thinking and its decoupling from the design discipline. Section 2.1.2 elaborates on the evolution of Design Thinking as a managerial discipline, starting with its history and covering its attributes, its enactment from a dynamic capability lens, its relationship to Digital Transformation, and its adoption at an organizational level. Section 2.1.3 summarizes the representations of Design Thinking processes. Section 2.1.4 enlightens Design Thinking's relationship to User-Centered Design (UCD) and Human-Centered Design (HCD). Section 2.1.5 promotes a discussion on the limitations of Design Thinking and elaborates on a few critiques of the approach

2.1.1. From Design to Design Thinking

"Design is to design a design to produce a design" (Heskett, 2005). The famous sentence reflects the nuances of the design concept as it acquires different meanings depending on its use as a noun, verb, or adverb (Giacomin, 2014; Love, 2002). This thesis is interested in investigating a specific field in the intersection of managerial organization systems and design called Design Thinking (Cash, 2020), as presented in Figure 2.

Design Thinking "captures the design practice and the way designers make sense of their task, and 'a way of thinking' that non-designers can also use" (Johansson-Sköldberg et al., 2013) for problem-solving and innovation. Coming from this understanding, Design Thinking may be decoupled from professional design practice and may be an approach employed by individuals from various backgrounds. To advance the discussion on Design Thinking, we must first elaborate on how designers make sense of their tasks and ways of thinking. Several researchers dwell on formulating theories regarding how professional designers think and work.

Figure 2 - A landscape of design research; adapted from Cash (2020)



Simon (1969), for example, understands design as an asset embedded in the artificial sciences and developed an experimental approach to design research by theorizing about the cognitive aspects of general problem-solving and decision-making. The author analyzed the structure of problems and identified two major categories: well-defined problems[1] and ill-defined problems[2] (Simon, 1973). In the design context, Rittel and Weber (1973) observed that designers tackle "wicked problems," a category of ill-defined problems originating in social settings, which are formulated considering confusing information, with different clients and decision-makers with conflicting values and priorities, resulting in complex, variable and fluid formulations.

For Buchanan (1992), design is an integrative discipline that connects sciences and arts to enrich human life, applying methods and tools to solve wicked problems in complex contexts. Schön and Wiggins (1992) evidenced that design is an educational practice within itself, and individuals involved in design activities must make an effort to reflect on the learning outcomes from each activity to reflect on how to improve their design capabilities. More recently, Krippendorff (2005) advanced the understanding of the role of designers by formulating that design is not only about creating artifacts but also about creating meanings as the core of the design process and using artifacts to communicate these meanings.

This focus transition from materials and products to services and experiences empowered the design discipline with a mandate for tackling wicked problems, using a human-centered perspective to reconfigure the artificial and social environment intentionally and meaningfully by building and employing material or non-material artifacts. From the early 2000s, in a digitalized rapidly-changing environment, this kind of problem-solving capability inherent to design became more and more desirable by organizations. IDEO consultancy firm led the movement of introducing design strategically in organizations, moving beyond their traditional product development

[1] Well defined problems have definite criteria for testing any proposed solution, one problem space to represent its initial problem state, and repeatable state changes towards possible solutions.
[2] Ill-defined problems have no clear boundaries and conditions, in which solutions vary considering different contexts and involved stakeholders.

offices; IDEO disseminated their way of working through management practitioner journals, books, and even on broadcast TV (Brown, 2008a, 2009; IDEO, 1999; R. Martin, 2009b). This way of working was called "Design Thinking."

Johansson-Sköldberg et al. (2013) package these streams on design research about the way professional designers think and act under the label "designerly thinking," separating them from managerial "Design Thinking." The thesis will not build on the discussion of "designerly thinking"; instead, it elaborates on the enactment of Design Thinking, which is highly intertwined with other stems of design research that will not be covered in this thesis.

2.1.2. Design Thinking as a managerial discipline

Design Thinking gained attention in the management press in the early-to-mid 2000s, firmly pushed by the reports of consultancy firm IDEO in management practitioner journals, books, and even on broadcast TV (Brown, 2008, 2009; IDEO, 1999; R. Martin, 2009). In a broad sense, Design Thinking was introduced as "a discipline that uses the designer's sensibility and methods to match people's needs with what is technologically feasible and what a viable business strategy can convert into customer value and market opportunity" (Brown, 2008, p. 2) and as a "human-centered innovation process that emphasizes observation, collaboration, fast learning, visualization of ideas, rapid concept prototyping, and concurrent business analysis" (Lockwood, 2009).

Many authors have explored Design Thinking in projects and organizations over the years. Still, most of the field's theoretical advancements relied on the achievements Design Thinking could drive in organizations and the process to guide them. Liedtka (2015) argues that the way organizations employ Design Thinking can be viewed as a practice and that the bundle of attitudes and tools embedded in this practice can mitigate bias in innovation processes independently of the innovation context; this practice embeds the creation of multidisciplinary teams (Seidel & Fixson, 2013), balancing analytical and intuitive thinking (R. Martin, 2009), and making use of an abductive logic for value creation (Dorst, 2010, 2011). Carr et al. (2010) reveal the tension in organizations regarding the boundaries between design and Design Thinking, defending the idea that if Design Thinking can be uncoupled from the design function as a distinctive way of solving problems, it could be scaled throughout an organization. Brown and Katz (2011) explain that the presence of design professionals work beyond design studios and their taking seats as executive chairs in board rooms reflects this movement of the design discipline becoming more strategic and less tactical.

To summarize, Design Thinking was described as an organizational resource for innovation (Kimbell, 2011) and a contingent set of routined practices inspired by professional designers[3] (Kimbell, 2012). Specifically, Design Thinking is a valuable resource when dealing with innovation challenges because it departs "from a narrow, technically oriented, or product-centric way of thinking" (Magistretti, Ardito, et al., 2021, p. 5) and leads to a market- and technology-oriented analysis. Design Thinking's adoption as a loose process drives the development of innovative solutions by applying an abductive logic to problem-solving, which enables the people involved in the innovation process to ideate and propose multiple solutions considering the firm's existing capabilities, technologies, and resources.

2.1.2.1. Attributes, taxonomy, and enactment of Design Thinking

Following the boom of research exploring the alleged achievements Design Thinking could bring to organizations, scholars began unveiling what attributes made Design Thinking reach these achievements. Following an empirical study, Carlgren et al. (2016)

[3] Further considerations on how Design Thinking is presented as a routined set of practices are made on section 2.1.3. Representations of Design Thinking as a process

propose a framework for Design Thinking based on five main themes (user focus, problem framing, visualization, experimentation, and diversity), later deployed in principles, practices, and techniques. This framework values flexibility and states that, depending on the context, Design Thinking may be employed “as a process, or as methods, a toolbox, a mental approach, a culture or a mix thereof” (Carlgren et al., 2016, p. 49). Similarly, Micheli et al. (2019) swept the literature on Design Thinking to explore its representations. After the analysis and codification of 104 papers, the authors came to a validated summary of 11 attributes that represent, on an aggregate level, the different nuances of Design Thinking. Table 1 summarizes the attributes of Design Thinking and various representations of these attributes derived from previous research.

Table 1 - Attributes and principles constituting Design Thinking; adapted from Carlgren et al. (2016) *and Micheli et al.* (2019)

Attributes/Themes	**Representations**
Creativity and innovation	Innovation; creativity; idea creation; discovery opportunities
User-centeredness and involvement	User/customer involvement; human-centeredness; working with extreme users; end-user profiling; empathy; non-judgment; social
Problem-solving	Problem-solving; wicked problem solving; constraints as inspiration; decision-making; challenge the norm; reframing; optimism
Iteration and experimentation	Iteration; experimentation; prototyping; reflexivity; reflective practice; curiosity; playfulness; energetic; learning-oriented
Interdisciplinary collaboration	Collaboration; stakeholder involvement; multidimensional team; conflict negotiation; interactive process; involvement of outsiders; participatory design; persuasion and communication; openness to differences in personality type and background; democratic spirit
Ability to visualize	Aesthetics; ability to visualize; elegance; style; thinking through doing; bias towards action
Gestalt view	Holistic approach; embracing complexity; integral intelligence; synthesis; systemic model; systems thinking
Abductive reasoning	Abductive reasoning; emergent; generative
Tolerance of ambiguity and failure	Acceptance of failure; ambiguity; handling uncertainty; risk-taking; tolerant of mistakes; openness to the unexpected; comfort with complexity and ambiguity
Blending rationality and intuition	Balance between declarative and modal logic; balance between exploration and exploitation; balance between intuitive and analytical thinking; balance between reliability and validity; divergent and convergent thinking; emotional and rational; integrative thinking
Design tools and methods	Ethnographic methods; personas; journey map; brainstorming; mind map; visualization; prototyping; experiments

In a different level of analysis, Dell'Era et al. (2020) define four typologies of how consulting firms provide Design Thinking services to their customers based on a study of 47 Italian firms. Each "kind" of Design Thinking identified by the authors is embedded in a specific context and addresses a different challenge (Table 2), highlighting the configurational nature of Design Thinking depending on the context and the strategy for its adoption.

Table 2 - Four kinds of Design Thinking; adapted from Dell'Era et al. (2020)

Design Thinking Typology	**Creative Problem Solving**	**Sprint Execution**	**Creative Confidence**	**Innovation of Meaning**
Addressed challenge	Inspire insights able to lead the development of creative and original solutions that can meet emerging users' needs	Accelerate the development process and reduce market uncertainty to quickly make and launch new solutions on the market	Promote new innovation mindsets to engage employees with a new set of approaches, practices, and methodologies able to stimulate innovation and change	Create new visions that represent radical reinterpretations of the strategic direction to follow
Contextual factors	Complexity and dynamism of user behaviors; demand for more sophisticated and personalized solutions	Tension towards execution and continuous updating; digital technologies empowering different experimentation strategies	Entrepreneurial opportunities for individuals; importance of work-life balance and personal purpose in the job	Easy access to innovative ideas; abundance of alternative options

Moving beyond its taxonomy, studies have analyzed the adoption and enactment of Design Thinking from a goal-oriented perspective. Design Thinking may be employed in the search for *innovation of solution*, which takes the form of investigating current user needs to capture value in the form of product or service and search for *innovation of direction* in the form of challenging existing assumptions about the market and envisioning new scenarios and experiences (Magistretti, Bianchi, et al., 2022). Hence, one might infer that depending on the firm's goal in adopting Design Thinking, it must actively seek to employ specific capabilities coherently with its goals.

2.1.2.2. Design Thinking as a dynamic capability

The management literature has explored Design Thinking's role as a dynamic capability in organizations. Liedtka (2020) argues that Design Thinking training spurs individuals to learn how to learn, enabling ongoing capability development; for this reason, Liedtka calls Design Thinking a social technology. Thompson and Schonthal (2020) explore the social psychology principles that allow individuals trained in Design Thinking to approach situational factors and succeed at the four Design Thinking tenets posed by Beckham and Barry (2007) – observe and notice, frame and reframe, imagine and design, make and experiment.

Hence, the value of applying Design Thinking in organizations is untangled in the form of a new product or service offerings and as a social technology that enables a firm to continuously build capabilities for ongoing strategic adaptation. It gathers a set of teachable practices that allow the development of innovation skills (Liedtka, 2020; Magistretti, Ardito, et al., 2021). Liedtka (2020) elaborates on what is social technology as follows:

> Although today we associate the term "technology" with digital or physical ways of accomplishing activities, historically technology had a much broader meaning. Derived from the Greek, meaning "science of craft," technology referred to the techniques, skills, and processes used to transform knowledge into practical outcomes. Focusing on the social technology lens cues us to innovation as a shared process and ties it to human emotions and the complex ways people intersect and solutions emerge.

Individuals exposed to Design Thinking training develop ongoing sensemaking capabilities, thereby developing the ability to rearrange tools for a given purpose (Rylander Eklund et al., 2022). Design Thinking training positively contributes to creative self-efficacy and problem-solving in managers (Roth et al., 2023), thus positively affecting managerial dynamic capabilities.

Studies have delved into the role of Design Thinking in building capabilities in several contexts, such as abductive reasoning (Garbuio & Lin, 2021), research and development in regulated markets (Appleyard et al., 2020; Magistretti, Allo, et al., 2021), entrepreneurship (Klenner et al., 2022), Industry 4.0 (de Paula et al., 2023), design of digital technologies (G. Wang, 2022), platform-based venture performance (Kamble et al., 2023), innovation (Magistretti, Ardito, et al., 2021), and Digital Transformation (Magistretti, Tu, et al., 2021; Marx, 2022).

2.1.2.3. The emerging intersection between Design Thinking and Digital Transformation

An emerging body of research approximates Design Thinking and Digital Tranformation scholarships. Departing from a cross-case study, Magistretti et al. (2021) develop a framework on how Design Thinking fosters the development of capabilities for Digital Transformation by extending the knowledge base, debating perspectives, cropping solutions and information, interpreting the problem, and recombining factors toward targeting a technological opportunity.

Marx (2022) builds a theoretically grounded proposal consisting of three ways in which organizations can employ Design Thinking to enhance their Digital Transformation efforts: using Design Thinking as a structured process to develop products or services, applying Design Thinking to change the organizational setup and transformation mechanisms, understanding that Design Thinking may empower individuals (Liedtka, 2015) and teams (Appleyard et al., 2020) to drive this change; employing Design Thinking to build and sustain dynamic capabilities.

It is essential to elaborate on the Digital Transformation phenomenon before further advancing the discussion on the intersection between Design Thinking and Digital Transformation. Section 2.2 will explore the existing literature on Digital Transformation and its relationship to innovation, and Section 2.2.4 will resume the approximation between the two streams of research.

2.1.2.4. Design Thinking at the organizational level

Organizational cultures marked by values related to productivity, performance, and siloed specialization may hinder the adoption of Design Thinking (Carlgren & BenMahmoud-Jouini, 2022; Elsbach & Stigliani, 2018). When effectively adopted, Design Thinking collective practices support strategic discussions across different areas (Knight et al., 2020) and help to break organizational silos.

Understanding how the adoption of Design Thinking occurs at an organizational level is underexplored in scholarly research (Elsbach & Stigliani, 2018; Micheli et al., 2019) with a few notable exceptions (de Paula et al., 2023; Magistretti et al., 2023; Randhawa et al., 2021; Wrigley et al., 2020). Randhawa et al. (2021) analyze how Design Thinking leverages the cognitive frame of middle managers in pursuit of ambidexterity. Wrigley et al. (Wrigley et al., 2020) describe organizational conditions that should be established before design interventions to avoid a “sugar-rush” effect in organizations adopting design interventions only to let them fade shortly after initial enthusiasm. De Paula et al. (2023) establish a managerial mental model to enable organizational change in the context of Industry 4.0 through behavioral strategies that can help materialize desired organizational behaviors in the context of change, and several of them are related to

Design Thinking. Magistretti et al. (2023) elaborate on nine Design Thinking practices developed at PepsiCo to foster the approximation between design and innovation.

Nevertheless, there is little insight into the mechanisms by which organizations widely adopt the practice of Design Thinking. Mechanism is employed here as a term referring to any activity or group of activities that can be performed by an individual or a group of individuals; a set of mechanisms will compose the enactment of Design Thinking within an organization.

There are research opportunities to explore preferred sequences for adopting Design Thinking tools depending on previous organizational culture (Elsbach & Stigliani, 2018) and whether Design Thinking can drive an innovation-prone organizational culture (Micheli et al., 2019). Hence, analyzing the adoption of Design Thinking in an organization in depth, exploring its relation to ongoing pressures, change, and initiatives within the organizations, and exploring the role of time in this process is relevant to academics and practitioners.

2.1.3. Representations of Design Thinking as a process

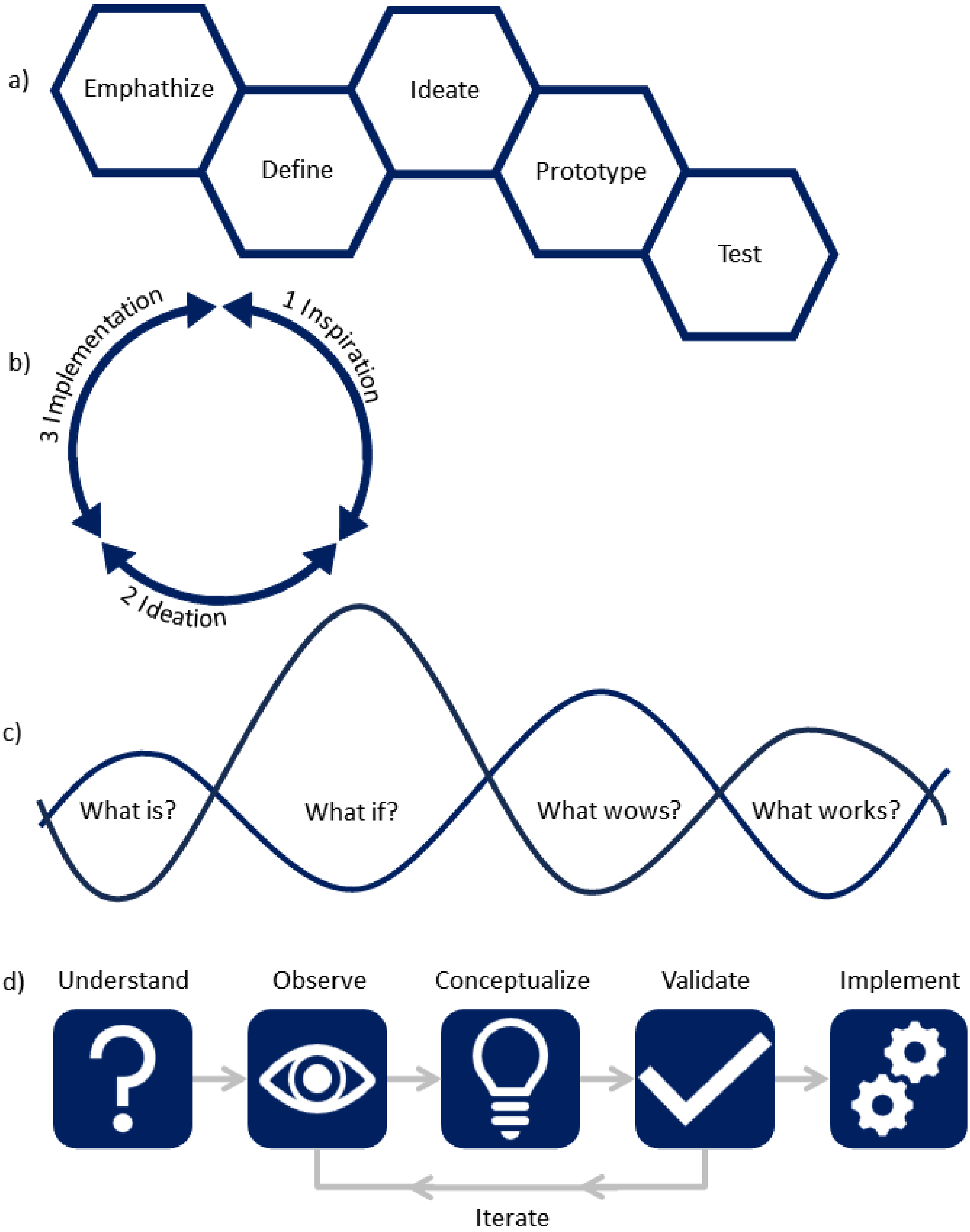
Design Thinking publication in academic journals, professional journals, books, business, and social media peaked after Brown's (2008) Harvard Business Review article was published (Johansson-Sköldberg et al., 2013; Micheli et al., 2019). Ever since, many toolkits (IDEO, 2011, 2015; Liedtka & Ogilvie, 2011), books (Lockwood, 2009), and practical guides (D.school, 2018) presenting prescriptive phased Design Thinking processes have been published – a selection of these prescriptive processes are represented in Figure 3). At their core, they follow the same overall logic on the pace of phases for problem-solving, even if they use different terms to describe these phases (Fleury et al., 2016; Johansson-Sköldberg et al., 2013; Micheli et al., 2019; Seidel & Fixson, 2013; Silva et al., 2020). Table 3 summarizes how the problem-solving phases are presented in each prescriptive process and how they overlap; the following paragraphs detail each phase.

Table 3 - Correspondence between Design Thinking prescriptive processes; adapted from Silva et al. (2020)

Design Thinking prescriptive process	**Macrophases**			
	Need-finding	Concept generation	Concept validation	Concept development
d.school (2018)	Empathize; Define	Ideation	Prototype; Test	
IDEO (2015)	Inspiration	Ideation	Ideation	Implementation
Darden School (2009)	What is	What if	What wows	What works
DMI (2009)	Understand; Observe	Conceptualize	Validate	Implement

The first phase is based on need-finding: understanding the core issue of the problem by empathizing with the user and discovering their explicit and non-explicit needs. Understanding who the users and stakeholders are is critical for innovation. Ethnographic research techniques, such as observation and interviewing, are recommended at this phase. This phase aims to enable individuals involved in the Design Thinking process to leave their places as consultants or experts and allow themselves to experience or at least perceive the problem as actual users, fostering empathy and a knowledge repertoire for the following phase (Liedtka, 2020).

Figure 3 - Representations of Design Thinking as a process. a) d.school (2018)*; b) IDEO* (2015)*; c) Darden School* (2011)*;* d) DMI (2009)



After the need is fully defined and the data gathered in the need-finding phase is consolidated, conceptualizing an actual solution starts in the second phase, concept generation. In this phase, individuals collaborate to create as many ideas as possible, usually done in brainstorming sessions. Sensemaking tools, like mind mapping, can be used to analyze the outputs of brainstorming sessions (Liedtka, 2015). The idea-generation process is recommended to occur as freely of judgment as possible, aiming to encourage bold and non-obvious ideas (Silva et al., 2020).

The third phase, concept validation, aims to validate the ideated solutions and get feedback from potential users. Innovation teams typically make extensive and iterative use of low-fidelity prototypes in this phase; it is essential to note that these prototypes aim to facilitate communication with potential users so that the solution can be further improved. Hence, prototypes must be built as cheaply and fast as possible to enable the team to discard non-suitable ideas and improve the promising ones incrementally rapidly.

The final macrophase is called concept development and differs among the models (Silva et al., 2020). d.school's process ends after a prototype is validated; nevertheless, having a validated effective prototype does not mean that the team has built a feasible solution since other issues such as market analysis, a manufacturing or implementation plan, and pricing play a relevant role in upgrading the prototype to a functional, reliable and desirable solution. This phase is less explored even in IDEO, Darden School, and DMI's processes. Still, they all reckon it is crucial to bring complementary competencies to the Design Thinking teams to assess feasibility and build an implementation plan for the solution.

Despite the graphic representations in phases (Figure 3), the Design Thinking processes are reported as highly iterative and non-linear, moving back and forth between phases and conducting activities of different phases concurrently. Several tools such as personas, brainstorming, journey mapping, and prototyping have been raised as instruments to enable the application of Design Thinking as a process and may be employed iteratively throughout the three phases (Fleury et al., 2016; Liedtka, 2015; Micheli et al., 2019).

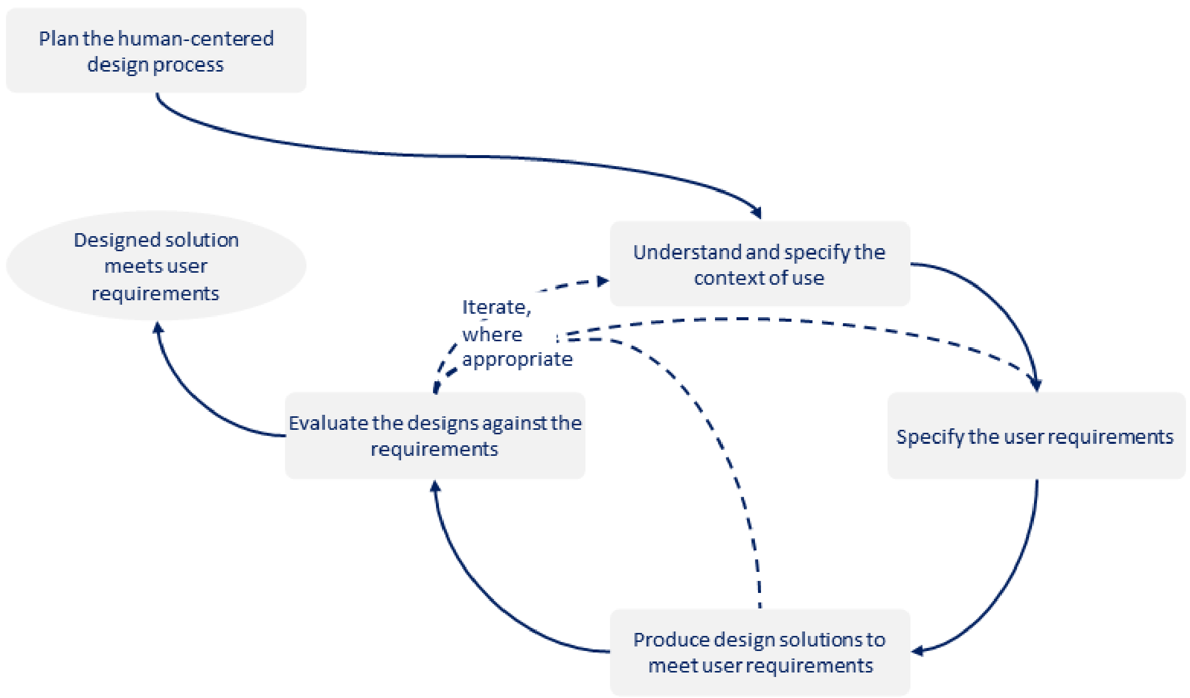
These prescriptive processes are replicable, and it is claimed that they can be used by any manager to pursue innovation and growth (Liedtka, 2011). Once individuals are familiar with a prescriptive Design Thinking process, it is expected that they will be able to reconfigure the process to whatever purpose they need, employing Design Thinking as a social technology that drives dynamic capabilities (Liedtka, 2020). The extensive adoption of Design Thinking as a process for managing innovation processes has been presented as an antecedent of organizational innovation at incumbent firms, with Design Thinking not only driving the management of innovation processes but also the mindsets of the individuals involved in these projects (Magistretti et al., 2023).

2.1.4. Notes on the relationship between Design Thinking, Human-Centered Design and User-Centered Design

As explained in sections 2.1.1 and 2.1.2, the term Design Thinking has been used to refer to the way professional designers think and work – a usage that was further packaged under the label "Designerly Thinking" (Johansson-Sköldberg et al., 2013). This thesis and the management literature employ the term Design Thinking, referring to a problem-solving approach inspired by the attributes and principles embedded in design practice, which include creativity, innovation, user-centeredness, iteration, experimentation, interdisciplinary collaboration, and tolerance to ambiguity and failure (Carlgren et al., 2016; Micheli et al., 2019). This broad definition and the naming of its attributes (see Table 1) ask for a disclaimer on its relation to two other popular discourses in design research: HCD and UCD.

On the one hand, Giacomin (2014) identifies HCD as a significant design paradigm alongside technology-driven design and environmentally sustainable design. The author identifies the roots of HCD in ergonomic sciences, with the International Organization for Standardization's (ISO) document 9241-210 (2010), which defines HCD as an "approach to systems design and development that aims to make interactive systems more usable by focusing on the use of the system and applying human factors/ergonomics and usability knowledge and techniques" (ibid, p. 2). ISO 9241-210 document also presents a framework (Figure 4) with a set of activities related to HCD that strongly resemble the representations of Design Thinking as a process presented in section 3.1.3 (Figure 3).

Figure 4 - Framework of HCD activities; adapted from ISO (2010).



On the other hand, UCD originated in the field of cognitive sciences to understand human-computer interaction from the underpinnings of psychology and artificial intelligence (D. A. Norman & Draper, 1986). Hence, the UCD discourse emerges as an array of principles and tools to bridge the gap between people and complex systems, such as computer systems (D. A. Norman, 1986).

> The final design is a collaborative effort among many different design approaches. But user-centered design emphasizes that the purpose of the

> system is to serve the user, not to use a specific technology, not to be an elegant piece of programming. The needs of the users should dominate the design of the interface, and the needs of the interface should dominate the design of the rest of the system. (ibid, p. 61)

In academia, the term UCD has been predominantly employed in computer science and related areas[4]. There is a recognized confusion on the definition of UCD/HCD and when to use each term (Campese et al., 2020). Despite etymological traditions, the terms HCD and UCD are often used interchangeably, as noted by ISO:

> The term “human-centred design” is used rather than “user-centred design” in order to emphasize that this part of ISO 9241 also addresses impacts on a number of stakeholders, not just those typically considered as users. However, in practice, these terms are often used synonymously. (International Organization for Standardization, 2010)

Building from these accounts, we may infer that the principles applied in Design Thinking are deeply rooted in HCD/UCD, meaning there is no Design Thinking without HCD/UCD. The opposite, however, is not necessarily true (Campese et al., 2020). Nevertheless, because of the continuous conceptual misalignments around which research in UCD/HCD and Design Thinking were built, authors might use the terms UCD/HCD when referring to Design Thinking and vice versa.

[4] A search in Scopus database on 13/05/2020 for the terms “’user-cent* design’ OR ‘user cent* design’" on document titles, abstracts or keywords yielded 7.988 document results, of which 5.332 are labeled on the “Computer Science” subject area. The next subject area with the most results, “Engineering”, has 2.314 documents.

2.1.5. Critiques and limitations of Design Thinking from the optics of the design discipline

Even though these prescriptive process models help to popularize relevant attributes of the design discipline, such as abductive thinking, gestalt view, and human-centeredness (Micheli et al., 2019), it is essential to acknowledge the limitations of the application of simplified Design Thinking process models. As presented by Cash (2020), Design Thinking represents only a fraction of the areas of knowledge in the design discipline (Figure 2), and it may be reckless to apply a prescriptive model without considering that.

The following sections build a critical argument departing from an analysis of the limitations of applying Design Thinking prescriptive models using Beccari et al.'s (2017) proposition of six axes to a philosophy of design as a guiding thread for this analysis, delineating a reflective conversation regarding the consistency between the Design Thinking discourse and design's philosophical foundations. This discussion is not included in the papers that compose this thesis. Still, it is relevant for a broader debate on the capabilities enabled by Design Thinking and their relationship to other capabilities fostered by design disciplines.

2.1.5.1. <u>Design Thinking and the six axes to a philosophy of design</u>

To delineate the six axes of a philosophy of design, Beccari et al. (2017) argue that the discipline of design is concerned with an ongoing creative articulation of meanings, affections, values, or realities. This creative articulation does not exist in a vacuum and is affected by its surroundings. Beccari et al. (2017) packed the nature of these surroundings into six axes concerned with how design relates to logic, aesthetics, ethics, epistemology, ontology, and the social world. These axes do not intend to be exhaustive; instead, they provide a few pathways for reflection. Table 4 presents a summary of the six axes, as well as a brief description of them and a few practical concerns within each axe.

Table 4 - The six axes to a philosophy of design. Adapted from Beccari et al. (2017)

Axe	**Description**	**Practical concerns**
Design and knowledge	Design is seen as an instrument of knowing.	Designerly ways of knowing; relationship between scientific knowledge and design knowledge; balance between intuition and cognition in creative processes
Design and reality	Design is seen as an articulator of ways of being.	Ways of facing reality; questions regarding the reasons for being and the different ways of being; interpreting and acting on reality through design
Design and values	Design is seen as an articulator of moral values.	Moral foundations of project orientations; moral of material items; the relationship between technology and morality
Design and language	Design is seen as an articulator of meanings.	Visual grammar; iconic meanings; meanings of objects and images; rhetorics
Design and sensibility	Design is seen as an articulator of affection.	Perceptions of beauty; appreciation of artifacts and images; affection in creation; aesthetics experiences
Design and culture	Design is seen as a socio-cultural product.	Development of cultural perceptions; culturally established borders between art and design; the role of design in cultural practices of production and consumption

The following sections present a discussion on Design Thinking discourse and prescriptive models from the optics of each axe.

Design Thinking in the optics of design and knowledge

The axe of *design and knowledge* might be the one that hits closer to home when discussing managerial Design Thinking. This axe concerns how the knowledge specific to the design profession is formed, including its relation to traditional scientific and academic expertise. The practical concerns related to this axe include design’s use of abductive logic for creative articulation (Dorst, 2011), how design’s main object of study is related to uncertainty and indetermination (Buchanan, 1992), and how designers inherently will absorb knowledge from other fields in an ongoing creative effort of understanding, mediating, and modifying meanings through material and non-material artifacts (Beccari et al., 2017).

Indeed, the core of the prescriptive Design Thinking models in management scholarship presented in Table 3 is to mimic the designer's cognitive pathway when investigating a problem. One relevant difference is that Design Thinking in management stresses innovation benefits, while the studies on Design Thinking in design scholarship stress the benefits of creativity (Goldschmidt, 2017). Hence, Design Thinking in management changes the locus of the design discipline from its ability to continuously turn established configurations into more desirable ones to its capacity to generate on-demand innovative solutions.[5]

Management reports on Design Thinking present the individuals involved in it as a "bundle of capacities" driven by a replicable toolkit of activities originated in the way professional designers think and work, in which design is seen as a means to develop this bundle of capacities. Still, the end product of design is of little importance (Lee, 2021). While the Design Thinking prescriptive models might be positive for popularizing designerly techniques, these managerial, mechanical ways of acquiring knowledge using prescriptive methods of Design Thinking to produce outputs cannot refrain from the reflective ways of developing expertise and making desirable change that is on the core of design.

Design Thinking in the optics of design and reality

The axe of *design and reality* reflects how individuals involved in design activities articulate the symbols and icons represented in the real world and the individually perceived imaginary world.[6] Design as a reflective practice is permeated by framing and reframing meanings. This framing and reframing are only as extensive as the individual's

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[5] A thorough discussion on the perceived value of human-centered design has been conducted by Hargraves (2018): while human-centered design and Design Thinking onthologically are concerned about caring for people, they are often presented as a capacity for problem-solving.

[6] We remount here to Plato's Allegory of the Cave as a representation of the inconsistencies between the "real world" and the "perceived world"

(or individuals') involved in design activities imagination repertoire and their willingness to expand this repertoire regarding the different contexts of human life and living, making an effort to mitigate the inherent bias each individual carries. As presented by Wang (2013, p. 13):

> […] imagination fills the gap between perception and reason and assists cognition in two important ways: first, by synthesizing sense perceptions into a coherent representation of reality, and second, by enabling the intellect to judge future actions prudently and wisely. (J. Wang, 2013, p. 13)

A Design Thinking prescriptive toolkit or a Design Thinking instructor in a workshop might mention the need to frame and reframe reality when diving into a context. Still, it is naïve to believe that an average individual can perform autonomously an unbiased assessment of a multifaceted reality in a time-constrained setting following a 1-hour lecture or 1-hour reading about framing and reframing. Again, while Design Thinking is relevant for popularizing the way designers think and work to all sorts of individuals, it cannot be taken as a substitute for involving a professional designer.

Design Thinking in the optics of design and values

One may also look at Design Thinking from an analysis of *design and values*, considering these values as attributes of a collective morality in a preestablished context. While designers are inherently makers, resembling the technē paradigm (J. Wang, 2013), the craft of the designer is to turn preestablished conditions into more desirable ones. This can happen through the design of an object, a graphical piece, a service, or any other material or non-material artifact.

However, who can determine which condition is more desirable than another and under which optics? Hargraves (2018) presents that, in the context of healthcare, while human-centered design interventions often claim their success based on efficiency gains, for example, if one were to consider the roots of HCD and Design Thinking, the goal of a design intervention should be the better care of a human being. Julier and Kimbell (2019) pose a critique on how Design Thinking interventions with a focus on social change pass on an illusion of change, but they primarily result in inapplicable solutions due to the level of abstraction and disconnection concerning the challenges imposed by effectuating social change in the real world. These real-world complexities are precluded in favor of simplifying the context of the problem for a better application of Design Thinking prescriptive models.

Design Thinking in the optics of design and language

When thinking about the interaction between *design and language*, it is easy to envision that a designed artifact is read by an individual through a lens of the symbolic systems of brand, status, and meaning revolving around both that artifact and that individual. Designers and advertising professionals hold a privileged position and set of capabilities in actively pushing a vision to mold the symbolic systems around artifacts in a way that intentionally conforms to or disrupts how a society (or a parcel of a society) reads that artifact.[7] Verganti (2017) argues that designers use their guts to drive this exploration and creation of meanings, while managers do not, as they are typically instructed not to rely on gut feeling and base their actions on analytical and system thinking. While Design Thinking allegedly attempts to develop designerly capabilities of creating meaning in managers, because of the way Design Thinking is packed in

[7] Verganti (2008) presents a compelling argument of how design is essencial to attribute meaning and needs to technological innovation, and hence enable the technological improvements to generate disruption in a society.

processual, analytical, and prescribed ways, it partially expunges this serendipitous and intentional disruption of meaning embedded in the design practice.

Design Thinking in the optics of design and sensibility

Moving beyond the dimension of the meaning of symbols referred to in the last section, the feelings evoked by a designed artifact in individuals from the optics of *design and sensibility* need to be considered. Human living is mediated by how humans interact with the artifacts revolving around them, and the aesthetics of these artifacts give life form and induce an affective reaction. Individuals might, for example, be repulsed or attracted to an artifact depending on its aesthetics. Design Thinking frameworks, however, diminish the potential of the aesthetic dimension of artifacts (Barsalou, 2017). This happens due to the Design Thinking prescription that any prototype is a good prototype (Verganti, 2017). Nevertheless, as pointed out by Goldschmidt (2017), the stage in which the designer has sufficient information to propose a prototype is later than sooner in ideation, and other tools, such as sketching and digital modeling, should be extensively explored before moving to build prototypes. This strategy helps to better define the early prototypes worth building and to assure that these prototypes are more effective on the feelings the designer wants them to evoke. Striping design of its aesthetical dimension reproduces chronically a suboptimal form of design (Lee, 2021).

Design Thinking in the optics of design and culture

Finally, there is the axe of *design and culture*. Design is a crucial driver of society's culture through media, consumption, entertainment, and technology. Norman and Verganti (2014) recall how the evolution of video game consoles switched gaming from an isolated activity performed by lead users to a group activity performed by expert users through online gaming to a group activity enjoyed by virtually any individual who had access to specific consoles with accessible games that could be controlled through gestures and body movements. This evolution shifted gaming from solitary to family activity, modifying Western society's relationship with gaming and giving it a new meaning within these cultures. This power of design to transform (and be transformed by) cultures is not fueled by the prescriptive practice of Design Thinking; Design Thinking tends to foster incremental rather than radical innovation (Verganti, 2008).

2.1.5.2. Summarizing the reflection on Design Thinking from the perspective of the six axes of design

This section intends to be reflexive rather than definite. This reflection builds on the argument that, with Design Thinking, “Management has not moved closer to design. Design moved closer to management” (Verganti, 2017, p. 101). This is not to say that Design Thinking prescriptive models are not valuable. Indeed, they are relevant for popularizing designer techniques and ways of working. Still, they must be considered a limited depiction of the design discipline rather than a surrogate for it. As explored in the remainder of this thesis, other benefits can be attributed to adopting Design Thinking when analyzing it from the optics of innovation management that may justify its adoption. Nevertheless, it is relevant to acknowledge its limitations relating to other areas of interest in the design discipline.

2.2. Innovation in the Digital era

This section presents a multifaceted overview of Innovation and how it is related to the Digital Transformation phenomenon. Section 2.2.1 introduces the discussion by establishing a concept for innovation. Section 2.2.2 describes how the Digital Transformation phenomenon has changed innovation dynamics and how firms must learn to exploit and explore digital technology to develop innovative uses of the new offerings powered by Digital Transformation. Section 2.2.3 delves into the capabilities firms must create to navigate a Digital Transformation. Section 2.2.4 reveals the underlying relationship between Digital Transformation and Design Thinking. Section 2.2.5 briefly summarizes the particularities and need for Digital Transformation in the healthcare sector.

2.2.1. Establishing a concept for innovation

Innovation is widely accounted for in scholarly research as a critical source of competitive advantage for firms in rapidly changing environments (Crossan & Apaydin, 2010). Schumpeter is widely known as the pioneer in innovation research with his book "The Theory of Economic Development" (1934) theorizing about how the ongoing creation of innovations – new goods, methods of production, markets, supply, or organizational structure – is a critical driver of development in a capitalist economy.

Since Schumpeter's foundational work, several research streams have streamlined the concept of innovation by considering several dimensions (Crossan & Apaydin, 2010), such as:

i. The spectrum between *invention* and *innovation,* in which *invention* refers to the capacity to create new artifacts and meanings while *innovation* refers to the effective implementation of *inventions* in a market (*Oslo Manual 2018*, 2018)
ii. Magnitude of innovation, including *incremental*, *radical,* and *really new innovation* (O'Connor, 2008)
iii. Nature of innovation, including explicit innovation in the form of products and tacit innovation in the form of new meanings (Verganti, 2008)

This thesis takes inspiration from Lisa Carlgren's (2013) work and refrains from making judgments regarding the magnitude and nature of innovations and considers innovation as the activities that drive the *development of innovative offers*. This means that inventions are considered a prerequisite for innovation. Still, if a firm has engaged in inventions to promote innovations but somehow failed, the firm is considered to have engaged in innovation activity. *Innovative offers*, *solutions* or *outputs,* or *innovations* are the novel solutions emerging from innovation activity, whether tangible or intangible. *Innovation processes* refer to the steps undertaken within the design of a single *innovative offer*. *Innovation management* refers to ensuring a healthy portfolio of *innovative offers* and adequate formal structures for *innovation processes*.

2.2.2. Innovation in the context of Digital Transformation

Vial (2019) defines Digital Transformation as "a process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies." Hence, by definition, Digital Transformation is intrinsically linked to providing innovative offers using digital technologies.

Digital Transformation and adopting digital technologies broadly impact firm innovation by introducing new offerings that surpass sectorial boundaries, integrating digital and non-digital assets, and enabling new ventures and business models (Nambisan et al., 2019). It is important to note that digital technologies here act as operand and operant resources (Lusch & Nambisan, 2015). As an *operand* resource, digital technologies are employed to facilitate a previously established operation – for example, through the support of knowledge flows (Chen & Kim, 2023). As *operant* resources, digital technologies directly impact the creation of innovative offerings due to the increase of possibilities of features within them, incrementing digital capabilities into objects that previously had a purely physical materiality (Yoo et al., 2012), and by pulling a value stream to enable the reconfiguration of these solutions due to their specific needs for product design and architecture (Yoo et al., 2010).

There is evidence of the benefits of Digital Transformation in firm innovation. Departing from a sample of Portuguese companies, Ferreira et al. (2019) disclose that organizations that are more intense in implementing new digital processes successfully maintain or increase market share, increase business turnovers, and present a higher volume of innovation offers in products and services. A prior study has noticed that firms are inclined to adopt an innovation portfolio while conducting a Digital Transformation and that these portfolios tend to shift throughout the transformation processes (Z. Zhang et al., 2023).

Previous research that has acknowledged Digital Transformation may positively impact innovation output has highlighted that Research and Development (R&D) investments and innovation investments are mediating factors in promoting innovation and that firms enabling a Digital Transformation tend to increase these investments (Zhao et al., 2022). The mere adoption of digital technologies is not a driver of innovation performance itself, since innovation depends on creativity and other human traits (Usai et al., 2021). Digital Transformation, then, is likely to be subordinate to other resources, such as financial resources or human capital, and if digital technologies push the standardization of knowledge too far, their adoption may impoverish a firm’s creativity and hinder value creation (Usai et al., 2021).

Hence, since Digital Transformation and the adoption of digital technologies trigger significant changes in an organization’s value proposition and regular operations (Matsumoto et al., 2022; Matt et al., 2015; Usai et al., 2021; Van Veldhoven & Vanthienen, 2022; X. Zhang et al., 2023), they will invariably disrupt innovation offerings. To enable optimal usage of the new possibilities enabled by Digital Transformation, the firm must be able to exploit digital technologies successfully, but exploiting technology alone will not be a source of competitive advantage (Usai et al., 2021). The unique traits that make firms competitive in the era of Digital Transformation are related to the capacity of humans to deploy the digital technology resource base in the best service of the organization (Usai et al., 2021; X. Zhang et al., 2023). Hence, firms need to develop capabilities to explore innovative business opportunities and ways of working unlocked by the new attributes powered by technology.

2.2.3. Capabilities for navigating a Digital Transformation

In a digitally transforming era, firms must position themselves to compete in an unpredictable environment (Sebastian et al., 2017), navigating a process that is unlikely to be ever complete because the technologies that drive it and innovative solutions associated with it are constantly being developed (Appio et al., 2021; Kane, 2017).

Zhen et al. (2021) state that an organizational digital culture and digital capabilities support the arrangement of organizational resources in the face of a Digital Transformation, driving firm innovation performance. Culture is " the pattern of shared values and beliefs that help individuals understand organizational functioning and thus provide them norms for behavior" (Deshpande & Webster, 1989, p. 4). A digital culture is a culture applied in a digital domain.

Like any cultural change, building a digital culture requires top executives' involvement and support (Ceipek et al., 2021). Previous work has explored digital culture change and the development of digital capabilities at an executive level (Yeow et al., 2018); nevertheless, research on how to drive these assets at an employee level remains underexplored. In a Digital Transformation landscape, firms must develop dynamic capabilities to create, expand, and modify their resource base, as they are a source of competitive advantage (Sousa-Zomer et al., 2020). Hence, there is an opportunity for research to explore the nature and drivers of digital capabilities (Annarelli et al., 2021).

Warner and Wäger (2019) propose that organizations can improve their workforce's digital maturity by redesigning internal structures and navigating innovation ecosystems. On a macro level, Design Thinking has been presented as a process that enables Digital Transformation (Correani et al., 2020).

Overall, Digital Transformation is resource-intensive for firms (Guo et al., 2023), and it is necessary to maintain a competitive advantage in the digital era and provide innovative value for their customer base (Kane, 2017). While Digital Transformation scholarship has extensively focused on adopting digital technologies (Matt et al., 2015; X. Zhang et al., 2023), they are mainly imitable and may not be a source of competitive change (Usai et al., 2021). The unique traits that make firms competitive during their Digital Transformation are related to the capacity of humans to deploy the digital technology resource base in the best service of the organization (Usai et al., 2021; X. Zhang et al., 2023). Hence, they need to train the workforce to be digitally mature (Van Veldhoven & Vanthienen, 2022), or their investments in digital technologies are not likely to be effective.

2.2.4. Connecting Design Thinking and Digital Transformation

While the streams of research on Design Thinking and Digital Transformation have grown independently, they are contextually highly connected. For example, dynamic capabilities required for Digital Transformation (Annarelli et al., 2021; Sousa-Zomer et al., 2020; Warner & Wäger, 2019) are strongly connected with the attributes of Design Thinking (presented in Table 1). For example, Sousa-Zomer et al. (2020) demonstrate that a risk-taking culture is an enabler of Digital Transformation, which can be directly associated with the Design Thinking attribute of "tolerance to ambiguity and failure" coined by Micheli et al. (2019). Similarly, Warner and Wäger (2019) state that rapid prototyping is an enabler of digital seizing, which is correlated to a few of Design Thinking's attributes coined by Micheli et al. (2019): "ability to visualize," "design tools, and methods" and "iteration and experimentation."

The value of Design Thinking is underpinned by the fact that it gathers a set of teachable practices that allow the development of continuously building capabilities for ongoing strategical adaptation (Kurtmollaiev et al., 2018; Liedtka, 2020; Magistrettiet al., 2021), which is a necessary ability of firms willing to navigate the digital world. The prevalence of an organizational-wide mental model that leverages Digital Transformation is essential to navigate it (Sousa-Zomer et al., 2020). Design Thinking and its diverging-converging nature promote the environment necessary to create this collectively embraced mental model (Beckman, 2020; Carlgren et al., 2016).

2.2.5. Digital Transformation in the healthcare sector

While the healthcare sector is deemed sluggish in implementing Digital Transformation (Massaro, 2023), its success depends on its ability to digitalize (Garcia-Perez et al., 2023). The sector has historically focused on high quality and efficiency and has failed to employ technology to fulfill these goals (Garcia-Perez et al., 2023). Digitalization challenges related to the availability and actionability of health data hinder care quality (Torab-Miandoab et al., 2023), highlighting the urgency of addressing this issue. Moreover, the success of digital health strategies is dependent on user adoption — regardless of whether those users are physicians, patients, or managers — and how these strategies are implemented (Garcia-Perez et al., 2023), thereby emphasizing the need for adopting user-centered strategies involving both customers and the workforce.

2.3. The capability approach

This section presents a few constructs and definitions relevant to the theory of the capability approach. The capability lens is adopted in this thesis to analyze Design Thinking and Digital Transformation; hence, this section aims to anchor this lens on the more common and widely accepted definitions of the literature. It does not intend to bring new definitions or provide an exhaustive review of the theme. Section 2.3.1 provides an overview on the concept of operational capabilities. Section 2.3.2 extends this view toward the concept of dynamic capabilities. Section 2.3.3 proposes a typology for analyzing dynamic capabilities.

2.3.1. Operational capabilities

A capability is a firm's ability to deliberately deploy its resources to perform an activity that aims to achieve a desirable outcome reliably and satisfactorily (Amit & Schoemaker, 1993; Helfat & Winter, 2011). Considering a hypothetical firm in a stationary state, i.e., a firm that performs the same activities with the intent to achieve the same outcomes to serve the same customer base, the firm's ability to conduct these routines and earn its living is deemed as an operational capability (Winter, 2003). An operational capability enables the functioning of a firm on an exploitative business structure, e.g., on an established business that is not undergoing a rapid change in any aspect that may drastically modify the operation[8]. These operational capabilities are also known as zero-level capabilities (Helfat & Winter, 2011; Winter, 2003).

While these operational capabilities are necessary for ensuring the firm's survival on a day-to-day basis, they cannot ensure its adaptability to a changing scenario. On the one

[8] An example of an operational capability is a hospital's ability to maintain its pharmacies supplied with the adequate drugs according to the hospitals planned surgeries and expected emergencies; avoiding waste is a supply capability essential to maintain its operation.

side, the development of operational capabilities helps the firm to guarantee reliable and predictable performance; on the other side, in rapid change environments, these same capabilities may become the rigidities that will refrain the firm from adapting (Schreyögg & Kliesch-Eberl, 2007). In other words, operational capabilities pose as a resource for exploiting a firm's assets, while they limit the exploration of emergent opportunities (March, 1991; Schreyögg & Kliesch-Eberl, 2007).

Firms need different capabilities to efficiently manage and react to uncertainty and explorative situations. These other capabilities enable the firm to reconfigure its resources into more favorable settings, given the scenario's transient state[9]. Hence, firms infused in environments that are subjected to any rapid change require not only the operational capabilities that will ensure their earnings in the current scenario; these companies also depend on dynamic capabilities, i.e., routinized capabilities that enable the firm to modify its operational capabilities in response to environmental changes (Helfat & Winter, 2011; Winter, 2003).

2.3.2. Dynamic capabilities

The construct of dynamic capabilities is defined in Teece et al.'s (1997) influential work as "the firm's ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments" (p. 516) seeking sustainable competitive advantage. In other words, dynamic capabilities enable the firm to deliberately modify and build operational capabilities[10] (Winter, 2003).

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[9] The term "current transient state" refers to the scenario to reflect the fact that the reconfiguration of the firms assets is made in a given time, answering to what was known to the firm at the given time (*t+0*). As the scenario is in a continuos transition, it is expected that at a time *t+N* the reconfiguration efforts would result in different favourable resource setting.

[10] The line that separates what is a dynamic capability and what is an operational capability might be blurry in some scenarios, as discussed by Helfat & Winter (2011). However, discussing what differs dynamic from operational capabilities in a broad, generalizable sense is beyond the scope of this work. Since this theoretical lens will be used to analyze an empirical setting in *Paper 5*, the discussion of what capabilities can be read as dynamic capabilities will take place in the context of the case.

It is noted that there has been a lot of discussion in the literature regarding the consistency and validity of the construct of dynamic capabilities (Peteraf et al., 2013; Schilke et al., 2018). The research field has built itself around two main definitions of dynamic capabilities (Peteraf et al., 2013; Schilke et al., 2018). The first stream is grounded on the Teecian definition presented in the beginning of this section. The second stream is built around Eisenhardt & Martin's (2000) work. The Teecian definition has been problematized by Eisenhardt & Martin (2000) as tautological and flawed in its boundary conditions, using the following arguments: first, in truly rapidly changing environments, dynamic capabilities would take a character of improvisational processes that come at the risk of collapsing themselves and, although they may be a source of competitive advantage, it indeed is not sustainable. Second, in moderately changing environments, these dynamic capabilities would take a character of best practices. Although sustainable, the competitive advantage resulting from them is somewhat irrelevant as they are primarily imitable and substitutable (Eisenhardt & Martin, 2000).

Peteraf et al. (2013) derive a contingent, reconciling view of Teece’s and Eisenhardt’s works, which is adopted in this thesis. They posit that even if the dynamic capabilities are enacted as best practices, best practices are not built overnight, and they may still be a source of sustainable competitive advantage in contingent settings. Hence, Teece et al.'s (1997) and Eisenhardt & Martin's (2000) constructs may logically coexist, and this thesis employs the capability lens of this interpretation.

The capabilities that support NPD are an example of dynamic capabilities: they are routinized and deliberately conducted to reconfigure service or product offerings, modifying how the company serves its customer base (Winter, 2003). It is important to note that even between dynamic capabilities, there is still a hierarchical organization of the capabilities: for example, the dynamic capability of deriving new product meanings is a temporal antecedent and is hierarchically above the dynamic capability of redeploying production assets to achieve these new meanings, as the first is a precondition to the later.

2.3.3. A typology for analyzing dynamic capabilities

Teece (2007) has proposed a framework to bundle three dimensions of dynamic capabilities: sensing, seizing, and transforming.

Sensing dynamic capabilities relates to the ability to analyze and source signals that might influence new reconfiguration opportunities for the enterprise. These signals might come from different sources, such as a customer, supplier, R&D team, or other enterprise or business ecosystem actors. Also, signals might come in different shapes, such as a consumer complaint, a new technology offering from a supplier, and a new market trend. Sensing-related routines "involve learning, interpretation, and creative activity" (Teece, 2007). Individuals involved in sensing-related routines should have access to the mentioned signals, interpret them, recognize opportunities for the enterprise, and shape the development of these opportunities – whether they will impact the customer base, its employees, or its suppliers. In other words, sensing dynamic capabilities are discovery-related capabilities.

Seizing dynamic capabilities relates to acting upon the signals scouted when employing the sensing dynamic capabilities. These include striving inside the organization for new project resources, defining new business models, and managing complementary activities and suppliers for new service or product offerings. Individuals involved in seizing-related routines must have an influential leadership behavior, as they need to slide through different hierarchical levels inside the organization to gather allies that will ensure both the feasibility of the seized opportunity at a tactical level, as well as the endurance in the funding and political support in seizing the opportunity, in a strategic level. In other words, sensing dynamic capabilities are planning-related capabilities.

Transforming or reconfiguring capabilities relates to continuously rearranging and redeploying firms' tangible or intangible assets to exploit the previously sensed and seized opportunities. These capabilities rely on enabling organizational decentralization enough to mitigate centralization-related rigidities in decision-making but not too much as to refrain from strategic alignment; hence, they are also dependent on efficient corporate governance. In other words, sensing dynamic capabilities are executing-related capabilities.

Organizations willing to maintain sustainable competitive advantage must be able to exploit all three presented dimensions of dynamic capabilities (sensing, seizing, transforming). Otherwise, they might face the risk of not being able to define or execute an effective strategy[11].

While the seizing-sensing-transforming framework is helpful for a macro-level, segmented analysis of a firm's capabilities, these dimensions do not directly reflect the mechanisms by which dynamic capabilities are built and enacted in firms. To further ground the framework and refrain from becoming a tautological construct, scholarship has established a lower unit of analysis inside each dimension, called a microfoundation.

The microfoundations of dynamic capabilities refer to the underlying components that enable the enactment of dynamic capabilities through routines and capabilities (Teece, 2007) or "how dynamic capabilities operate on the ground" (Schilke et al., 2018). A microfoundational analysis is context-dependent, bounded by the microfoundation's

[11] See, for example, Vuori & Huy's (2016) recount of Nokia's operation in the late 2000s. Their recount mentions that the firm did indeed have quite efficient sensing capabilities such as to scout for new market opportunities and emmerging technologies; however, the firm did not have the seizing capability of taking these scouted opportunities in actionable forms into strategic planning and resource allocation, as the strategic planning had a high esteem of the firm's historical leadership position when hardware was the main source of value capture in the market, and was not willing to believe that there was a switch towards software becoming the main source of value capture in the same market. As the firm was not able to take the scouted signals into strategic planning, the employment of the firm's transforming capabilities was not actually contributing to sustained competitive advantage, as the firm's resources were deployed considering a biased (and even numb) pathway charted by the firm's strategic plan.

initial condition, evolution process, time, and industry-dependent factors (Felin et al., 2012; Teece, 2007). These micro-level components may be clustered[12] into three main types: individuals, social processes, and structure (Felin et al., 2012). Understanding the mechanics of microfoundations enables us to assess how micro-level routines may drive macro-level firm performance (Felin et al., 2012) and propose a more deterministic and reliable orientation to what firms must do to achieve a particular goal.

The dynamic capabilities theory (with or without a microfoundational lens) has driven research in several management fields, including innovation (Peteraf et al., 2013; Schilke et al., 2018). Teece states that "dynamic capabilities are about adapting, orchestrating, and innovating" (Teece, 2007). Unsurprisingly, the dynamic capabilities construct has been used as a theoretical lens to analyze several research fields outside strategy, such as design management (Santos et al., 2018), innovation management, Digital Transformation (Sousa-Zomer et al., 2020), and more recently, Design Thinking (Magistretti, Ardito, et al., 2021).

As presented in section 2.1.2, Design Thinking is a context-dependent practice and will assume different meanings in different contexts (Johansson-Sköldberg et al., 2013). The field of Design Thinking has evolved primarily, grounding itself on process- and practice-based analysis, which has led to a lack of coherency in this field of research (Magistretti, Ardito, et al., 2021). Recently, scholarship has shown an effort to reconcile the theoretical and practical perspectives of Design Thinking as an approach to innovation by theoretically rooting the enactment of Design Thinking with established management approaches, such as the dynamic capabilities approach (Liedtka, 2020; Magistretti, Ardito, et al., 2021); this thesis builds on this stem of research. Hence, we elaborate

[12] As presented by Felin et al. (2012), while the microfoundations may be segregated for convenience when analyzing the phenomena, the microfoundations do not exist in a vacuum, meaning that they are intrinsicaly ingrained with one another following a temporal and even causal hierarchy.

further on why we believe Design Thinking may be studied using a dynamic capability theoretical lens.

3. Methodology

This section presents an overview of the methodologies employed in this thesis. Section 3.1 resumes the research design that was outlined in the introductory chapter. Section 3.2 offers the methods for *Study A.* Section 3.3 describes the procedures for *Study B.*

3.1. Research design

At the beginning of this research, Design Thinking was an approach reasonably established in professional practice but still somewhat controversial among scholars and scholarly literature. Around fifteen years had gone by since Design Thinking emerged as a buzzword and a management fad following the publication of acclaimed practice-oriented books and articles (Brown, 2008a, 2009; R. Martin, 2009b) yet empirical investigations on the applicability and effectiveness of Design Thinking were scarce and further studies were required (Micheli et al., 2019). The interest of academia in further exploring Design Thinking is evidenced by special editions of journals such as the Journal of Product Innovation Management (Spring 2022) and California Management Review (Winter 2020) and by a growing body of literature in the field in the past three years. Ilustrating this growth, the Scopus search for works with “design think*” in title, abstract, or keywords, yields 1012 results 2009 to 2013, 2442 results from 2014 to 2018 and 5048 results from 2019 to 2023.

Due to the relative scarcity of research regarding how Design Thinking is adopted in organizations – within and beyond the healthcare sector – both at a project level and an organizational level, the area can be considered an intermediate theory field according to (Edmondson & Mcmanus, 2007) classification; accordingly, research in the field should "identify key process variables, introduce new constructs, re-conceptualize explanatory frameworks, and identify new relationships among variables" (Edmondson & Mcmanus, 2007, p. 1167) to advance knowledge.

The thesis research methods were defined to advance knowledge, considering the maturity of theory in the field. The research is split into two studies (A and B), which resulted in five papers that compose the core of the thesis, as presented previously in Section 1.2.4. A summary of the papers is shown in Table 5.

Table 5 - Summary of studies that compose the thesis and related papers

Study	**Method**	**Topic**	**Papers**
A	SLR	Establishing a Desing Thinking construct	Paper 1
		Exploring the state of the practice of Design Thinking in healthcare	Paper 2
B	Single case study	Reporting the design process of a medical device using Design Thinking	Paper 3
		Formulating an innovation process model for healthcare organizations using Design Thinking	Paper 4
		Presenting a dynamic capability model for Digital Transformation enabled by Design Thinking	Paper 5

3.2. Research methods for study A

Study A is composed of two separate SLRs with different objects of analysis. As the enactment of the Design Thinking approach is context-dependent (Carlgren et al., 2016; Micheli et al., 2019), SLRs are appropriate research approaches to explore the state of Design Thinking practices (Gough et al., 2012; Grant & Booth, 2009). Section 3.2.1 presents the SLR and analysis procedures employed in *Paper 1*, which enabled the establishment of a construct of Design Thinking scholarship while observing the inherent ambiguity within the concept, answering *RQ1*[13]. Section 3.2.2 presents the methods employed in *Paper* 2, in which an extensive search allows for an aggregate appreciation

[13] *What is the construct of Design Thinking?*

of the literature and captures several configurations in which Design Thinking is adopted in the healthcare sector, answering *RQ2-A*[14].

3.2.1. SLR analysis and procedures for exploring the Design Thinking construct

To ensure a replicable method for establishing the construct, the first step in the methodology for *Paper 1* consists of conducting a Systematic Literature Review (SLR) using the Scopus database. The search yielded 5.570 records, of which 21 were selected for the final sample. An in-depth content analysis of the 21 selected papers was conducted following sample selection to formulate a Design Thinking construct. The formulation of the construct follows Wacker's (2004) directives for developing a conceptual definition, proposing a construct composed of a formal definition and a set of associated properties.

3.2.2. SLR procedures for exploring scholar reports on the application of Design Thinking in the healthcare sector

The first step for conducting this SLR was to search Scopus, Web of Science, and PubMed databases for articles that reported Design Thinking interventions in healthcare. The review followed Preferred Reporting for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher et al., 2009a). The search yielded 224 non-duplicate articles and reviews, of which 32 were selected for inclusion. Following sample selection, all articles were analyzed based on a series of criteria relevant to Design Thinking in healthcare, such as the tools employed in each Design Thinking phase, the readiness of the solution reported, the medical specialty the solution targeted, the nature of the solution developed (e.g., medical devices, software, services), stakeholder involvement, among others.

[14] *How is the application of Design Thinking in healthcare projects reported in scholarly literature?*

3.3. Research methods for study B

Study B is a single case study of a healthcare organization that has employed Design Thinking as a structured approach to innovation for over six years. Section 3.3.1 presents the rationale for case selection and a case vignette. Section 3.3.2 exhibits the data collection procedures. Section 3.3.3 discusses the strategies for data analysis employed. The study was the foundation for *Paper 3, Paper 4,* and *Paper 5*.

3.3.1. Case selection

The selected case is a healthcare organization investing in adopting Design Thinking as a structured approach to innovation for over six years. Due to previous product development collaborations, the organization had a solid relationship with Universidade de São Paulo’s (USP), especially with the research group in which this research was developed. This pre-existing relationship enabled the group to become acquainted with the application, the outputs, and the outcomes of adopting Design Thinking over time and ensured access to the organization. Table 6 presents an illustrative case vignette for this organization, which will be referred to as TakeCare or Hospital X.

Even though a single-case design limits the power of generalization – or external validity – of a study (Tsang, 2014), the uniqueness of a case’s context understood in depth may allow for unique insights (Flyvbjerg, 2006; Siggelkow, 2007). The case analyzed in this thesis is a source of inspiration and illustration of a more profound conceptual argument (Siggelkow, 2007). Hence, it is relevant for evolving theory in the field despite the limitations of a single case study.

Table 6 - Case vignette

TakeCare is a significant player in the Brazilian health sector, with over 13,000 employees. Its central business unit is a non-profit private hospital; other business units include a research center, public partnerships, and a tertiary school offering undergraduate, graduate, and short-term health sciences and healthcare management programs. Throughout its almost 60 years of history, TakeCare has been a nationwide pioneer in technology adoption, but it did not have the competencies to develop technological solutions internally. Aiming to fill this gap and face an imminent Digital Transformation, the organization instituted an innovation division in 2014. A former entrepreneur from outside the health sector was hired to found and direct this new division. Since the organization was not originally innovation-savvy, the central strategy to disseminate an innovation culture and provide innovation-supporting structures was to institute a Design Thinking workshop program to which any employee could apply. In the workshops, participants were split into groups, defined a specific problem they would investigate, and proposed one or more solutions to it along with the 4-6 sessions of the program. The solutions that emerged from the workshops gave the innovation division momentum to leverage other initiatives and develop capabilities that were pulled by the workshop participants (e.g., prototyping capabilities, innovation-related funding, legal and project management capabilities); moreover, the excellent reception of the workshop outcomes enabled the innovation division to seek board support for other initiatives that could bring good results, such as the institution of a national conference for health innovation and a health tech-focused startup incubator – developing capabilities related to strengthening ties with the ecosystem.

3.3.2. Data collection

The research data pool consists of primary and secondary pieces of data. The data collection process was the same for *Paper 3, Paper 4,* and *Paper 5*. The approach to data collection counted with multiple sources of evidence, which were documented and triangulated to ensure internal validity and convergent findings (Eisenhardt, 1989; Voss et al., 2002). Table 7 summarizes our data sources.

Table 7 - Summary of data sources

Data types	Volume	Collection date	Key information gathered
<u>Primary data</u>			
Interviews			
IO personnel; position of interviewees: Innovation Specialists, Design Thinking Analyst, Digital Transformation Manager, Innovation Manager, Innovation Medical Consultant, Innovation Director	Six semi-structured interviews (4 recorded) Four open interviews (none recorded)	10/2019-01/2020	Context Innovation structures and challenges Design Thinking Workshop evolution Design Thinking as mindset, culture driver, and mental model Limitations of Design Thinking Emblematic cases Productization of Design Thinking Digital Transformation Inward and outward-focused innovation Specificities of medical innovation
Workshop attendees; position of interviewees: Nurse, HR Analyst, Facilities Supervisors, Big Data Manager, Innovation IT Analyst, Innovation Specialist	Six semi-structured interviews (6 recorded)	01/2020	Perceptions of innovation culture Workshop highlights Critiques of the workshop Description of solution development in the workshop After the workshop: application of Design Thinking in daily activities
Spin-offs and startups; position of interviewees: Design Technical Leader, Chief of Operations Office	Two semi-structured interviews (2 recorded)	10/2020	Motivation for joining the ecosystem Ties with the mainstream organization
Participant observation			
Support to workshop teams	16h in lectures 4h work meetings	04/2020-05/2020	Design Thinking workshop format Attendee reaction and evolution
<u>Secondary data</u>			
Institutional and open press			
Videos (2013-2020)	12	06/2020	Cross-validation Information about spin-offs
News and blog articles (2008-2020)	15	06/2020	Cross-validation Information about spin-offs
Internal document analysis			
List of workshop participants (2014-2020)	Spreadsheet (1)	01/2020	Dimension of Design Thinking in the organization
List of projects developed in the workshop (2014-2020)	Spreadsheet (1)	01/2020	Nature of Design Thinking projects in the organization
IO internal performance evaluation presentations (2019)	Powerpoint presentations (limited)	01/2020	Evolution of Design Thinking inside the organization Design Thinking as a B2B service
Presentations used in the Design Thinking workshops (2015-2020)	Powerpoint presentations (several)	10/2019-05/2020	Evolution of the contents presented in the Design Thinking workshops
Product requirement and assessment documents (2016-2019)	Powerpoint presentations (several) Survey data (20 responses)	01/2021-06/2021	Exploration of NPD process using Design Thinking
Prototypes (2016-2019)	5	01/2021-06/2021	Exploration of NPD process using Design Thinking

On the primary side, semi-structured interviews were performed with members of TakeCare’s innovation division, other departments involved in innovation-related activities, and external actors engaged in TakeCare’s innovation ecosystem. The interviews aimed to map the innovation division’s internal structure and identify the effects of the innovation division initiatives on the mainstream organization and the ecosystem from the perspective of individuals in various contexts. The first three interviewees were selected based on our previous knowledge of the case, and the remainder were chosen through snowballing. All but three semi-structured interviews were recorded, transcribed, and coded; 4 non-recorded open interviews were held to confirm specific information. Interview protocols were refined throughout the data collection. These semi-structured interviews were complemented with open interviews to address or clarify particular issues that arose during the semi-structured interviews. This data collection stage took place in two rounds: the first was between October 2019 and January 2020, and the second was in October 2020.

Moreover, the author participated in one edition of the Design Thinking workshop as a volunteer engineering consultant in 2020. In the research group in which this thesis was developed, one researcher was the coordinator of a cooperation agreement for NPD between TakeCare and USP between 2014 and 2017, and another researcher was the idealizer of the Design Thinking workshop program and acted as its principal lecturer between 2015 and 2018. The study had access to their retrospective materials from these initiatives. Hence, collectively, the study is composed of both longitudinal and retrospective data, as it could count on previous experiences with TakeCare.

As for the secondary data, if a document were mentioned during the interviews, the interviewers would ask permission to access it. Some of these documents were shared integrally, partially, and denied due to confidentiality issues. Further, an extensive search of the press was undertaken to see how the case was presented in the media.

3.3.3. Data analysis

3.3.3.1. Data analysis for *Paper 3*

This part of the data analysis followed Bazzano et al.'s (2020) guidelines for reporting health research. Since *Paper 3* aims to answer *RQ2-B*[15] by shedding light on how Design Thinking is employed within a project in healthcare, a narrative and timeline of the case of a three-year NPD project were created, providing an overview of the product development macrophases and activities within the phases.

3.3.3.2. Data analysis for *Paper 4* and *Paper 5*

This data analysis followed Gioia's methodology (Gioia, 2019; Gioia et al., 2013). As recommended by the method, data analysis departed from a guiding RQ of exploring "How Design Thinking is adopted at an organizational level?" which you have not seen as an RQ presented in this thesis. Throughout the interactions of data analysis and data collection, the lenses for analysis of Study B evolved along with the RQs. The following paragraphs present the analysis process and the evolution of the RQs.

In possession of personal notes, interview transcripts, and supplied documents, a first-level coding of recurring themes in the interview was conducted. The codes were defined freely, based on the authors' previous knowledge of the field, but attempted to have a naïve mind to respond to any new patterns emerging from the data. Then, these first-level codes were grouped into second-level themes that related to one or more first-level codes. Following this procedure, a narrative and a timeline of the case were created, with

[15] *How is Design Thinking adopted as an approach for innovation within a project in a healthcare organization?*

appended confirmatory statements extracted from the transcripts. The next step was the analysis of public documents and press articles to cross-validate narrative facts (e.g., dates, open calls, events) and sources for events that were not mentioned in the interviews; following this stage, additional interviews were conducted to investigate underexplored topics and confirm details of the case. Finally, after a complete understanding of the case, a targeted literature search was undertaken to ground case data in established theory.

Following these procedures and combining the narrative of the case and the Gioia coding tree, two lenses for analysis were employed to shed light on novel aspects that emerged from the data and enriched theory on the field. First, it was possible to perceive that Design Thinking was employed in specific parts of the innovation process, and it had an entrenched interplay with other innovation management strategies; from this lens of analysis, *RQ3*[16] was developed and resulted in *Paper 4*. Second, it was evident that even if not intentionally, Design Thinking was employed as a strategy for developing capabilities in the workforce and that those capabilities became enablers of Digital Transformation in the organization; this lens of analysis derived *RQ4*[17], which drove the conceptualization of *Paper 5*.

[16] *How can Design Thinking be institutionally adopted, and how does it relate to innovation management in healthcare organizations?*

[17] *How does Design Thinking relate to capability building for Digital Transformation in healthcare organizations?*

4. Summary of results, findings, and contributions

This section presents a summary of the findings and results from the thesis. Table 8 resumes the content previously shown in Figure 1 to remind readers of the research design and provide better readability of each paper's results, findings, and contributions.

Table 8 - Summary of studies and associated papers

Study	Methods and design	RQ	Paper	Main content
A	SLR – Design Thinking construct	1	1	Proposed construct for Design Thinking
	SLR – Design Thinking adoption	2A	2	Assessment of scholarly reports on the conduction of Design Thinking projects.
B	Case study – project level	2B	3	Empirical assessment of the conduction of a Design Thinking project
	Case study – organization level	3	4	Empirically derived model of an innovation process employing Design Thinking
	Case study – organization level	4	5	Empirically derived capability model for Digital Transformation driven by Design Thinking

The following sections present a summary of the results, findings, and contributions related to each paper, and each section finishes with a table that summarizes the main findings related to the RQ associated with that paper. Please note that each paper is associated with only one RQ, but in the findings tables, several papers sometimes contribute to the same RQ. Even though each paper had its unique driving RQ, since their themes are highly intertwined when collectively analyzed, it is possible to cross-pollinate previously unrelated findings and RQs.

4.1. *Paper 1*: Unveiling the Construct of Design Thinking: An Exploratory Study[18]

The variety of definitions and characteristics attributed to Design Thinking puts its concept at the risk of becoming an “umbrella construct” with a loose meaning that might delay or even collapse its theory development due to the lack of an artificial language[19] to denote standard definitions (Micheli et al., 2019). This paper aims to propose a comprehensive construct of Design Thinking to be employed in this thesis upfront to enable the decoupling of the discussion on the definition, implementation, and outcomes of Design Thinking.

Even though a setpoint must be taken for theory development, the author shares Johansson-Sköldberg et al.’s (2013) belief that a search for a definite unique definition is counterproductive: Design Thinking is a context-dependent practice and, hence, will inherently assume different meanings to different individuals and organizations. As long as these meanings and contexts are identified, these multiple academic perspectives should be understood as a sign of maturity rather than weakness (Johansson-Sköldberg et al., 2013). Respecting the context-dependence of Design Thinking, *Paper 1* proposes a formal definition as follows: “Design Thinking is an abductive, human-centered approach for problem-solving”; each word of the formal definition holds its own set of associated properties that accommodate the multivalence of the construct (see *Paper 1* for the elaboration and justification of the construct). Figure 5 presents the construct and its associated properties. The definition was deductively built, departing from a dialogue with previous depictions of Design Thinking in scholarship.

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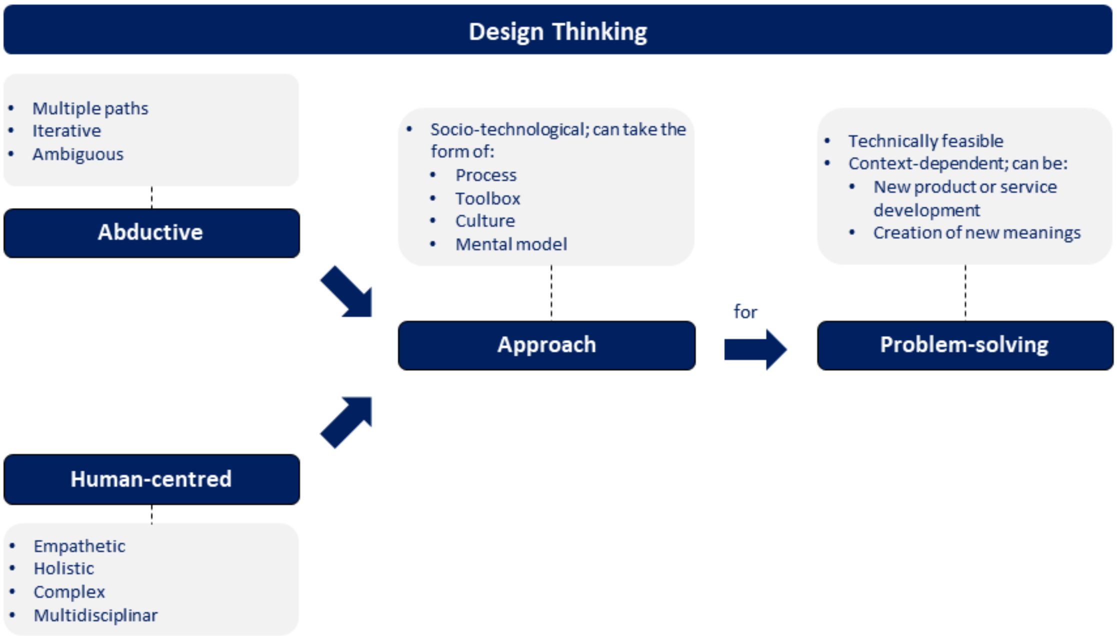
18 This section summarizes Paper 1. For an extended version of the discussion presented here, please refer to the original article in Appendix A.

19 For a discussion on the importance of construct validity and artificial languages for theory development, please refer to Wacker (2004)

Figure 5 - Design Thinking construct



Paper 1 contributes by proposing a comprehensive construct to Design Thinking, respecting the multivalence of its enactment depending on the context in which it is inserted. This understanding enables the analysis of Design Thinking as a structured process employed in project management and as an organizational approach to innovation and change within an organization.

Table 9 consolidates the findings related to *RQ1: What is the construct of Design Thinking?* The findings build on the understanding of Design Thinking as a summary of dynamic, contextual-dependent attributes rather than static and normative definitions.

Table 9 – Findings for RQ1

RQ	Main findings and results	Paper
RQ1[20]	Establish a normalized comprehensive construct of the term Design Thinking, avoiding speculation.	1
	Proposed construct: Design Thinking is an abductive, human-centered approach to problem-solving (presented in Figure 5)	1
	Abductive property: involves multiple paths, is iterative and ambiguous.	1, 3
	Human-centered property: the approach is empathetic to the user for which the solution is being developed and to the individual involved in the design process. To do so, it seeks a holistic view of complex scenarios by involving multidisciplinary individuals.	1, 3, 5
	Approach property: socio-technological character, as the approach can take the form of a process, a toolbox, a culture, and a mental model	1, 4, 5
	Problem-solving property: must be technically feasible and is context-dependent	1, 3

4.2. *Paper 2*: Design Thinking as an approach for innovation in healthcare: systematic review and research avenues[21]

Previous works have analyzed the impacts of solutions developed using a Design Thinking approach on health outcomes both in broad (Bazzano et al., 2017) and deep (Altman et al., 2018) accounts. Rigorous evaluations on how Design Thinking is operationalized in the health sector from a process perspective remain an opportunity for further integrating design knowledge into health research (Bazzano et al., 2017). In response to this gap, *Paper 2* assesses the enactment of Design Thinking in healthcare projects based on an SLR.

In the SLR conducted in *Paper 2*, 32 articles were selected for full-text review. They reported clinical and managerial healthcare-related interventions covering a variety of contexts, from developing surgical equipment to leveraging the income of vulnerable populations to improve public health. *Paper 2* discusses extensively several attributes in the sample of documents reviewed, such as the design tools adopted, the status of the

[20] *What is the construct of Design Thinking?*
[21] This section summarizes Paper 2. For an extended version of the discussion presented here, please refer to the original article in Appendix B.

solution, the disciplines involved, the timeframe of the project, and many others (see *Paper 2* for a deeper analysis). It was identified that most of the solutions described were related to developing digital or software solutions; *Paper 5* dives deeper into the relationship between Design Thinking, Digital Transformation, and digital solutions.

Paper 2 contributes with an assessment of how Design Thinking and its tools are applied in scholarly literature and by identifying avenues for research: a) creation of platforms and groups for leveraging the integration of individuals in health innovation projects, b) increased focus on the inspiration stage, c) e-health focused user research and d) lead user involvement.

The identified avenues for research incited a reflection on the relevance of advancing Design Thinking understanding beyond project efforts. Dominating Design Thinking as a structured step-by-step approach to project management is relevant. Still, most of the projects analyzed in the SLR did not present positive prospects of launching and enabling value capture. This acknowledgment provoked an angle switch from a project level towards an organizational level, based on the assumption that if a known case is considered successful in the adoption of Design Thinking, this case would be worth exploring to understand what their organizational and project practices that make use of Design Thinking and why they are successful. This reflection drove *Study B* towards exploring how organizations may employ Design Thinking to leverage the integration of individuals in health innovation projects in the era of Digital Transformation.

Table 10 groups the main findings for *RQ2-A: How is the application of Design Thinking in healthcare projects reported in scholarly literature?* The findings provide a thorough view of how Design Thinking is employed in healthcare contexts at a project level.

Table 10 – Findings for RQ2-A

RQ	Main findings and results	Paper
RQ2-A[22]	Assessment of Design Thinking processes and tools applied in healthcare projects based on multiple case reports.	2
	Design Thinking provides a frame for developing healthcare innovation by balancing contextual factors (e.g., users, stakeholders, resources) and clinical evidence.	2, 3, 4, 5
	Design thinking is an ally for starting up solutions with low-resource deployment.	2, 4
	Opportunities for further research include (a) the creation of platforms and groups for leveraging the integration of individuals in health innovation projects, (b) increased focus on the inspiration stage, (c) e-health-focused user research, and (d) lead user involvement.	2, 4, 5

4.3. *Paper 3*: Design and early evaluation of a device to improve the sharp count process in operating rooms[23]

Extending the knowledge of the state of the practice of the use of Design Thinking in healthcare projects initiated in *Paper 2*, *Paper 3* conducts an empirical investigation of how Design Thinking was adopted in the conduction of a project for improving the surgical sharp count process in operating rooms. The project was a partnership between TakeCare and USP's research group and was analyzed in the context of Study B.

The paper details the need-finding, concept generation, concept validation, concept development, and market analysis phases for prototyping a device to improve sharp count procedures that took place throughout three years (see Paper 3 for a more thorough description). Compared to the reports of Design Thinking projects analyzed in *Paper 2*, the empirical assessment conducted in *Paper 3* encountered a far more extensive use of tools for sensemaking of user data (e.g., personas, user journey mapping), acquiring expert knowledge (e.g., literature review, involvement of experts) and go to market.

[22] *How is the application of Design Thinking in healthcare projects reported in scholarly literature?*
[23] This section summarizes *Paper 3*. For an extended version of the discussion presented here, please refer to the original article in Appendix C.

Paper 3 contributes by enriching the assessment of the current adoption of Design Thinking in healthcare projects, evidencing that, on average, scholar reports neglect the reporting of tools employed in the inspiration phase. Since the study is conducted at TakeCare, it also provides an in-depth view of the enactment of Design Thinking in a project developed in close collaboration with the organization, providing context for analyzing Design Thinking at an organizational level.

In addition to its contributions, the publishing process of *Paper 3* drove a reflection: even if the published version of *Paper 3* has a more extensive explanation of the development process than the average reports on the field, peer review and editorial adjustments caused the development process sections of *Paper 3* to shrink when compared to the initial manuscript. The published version of *Paper 3* dives extensively into the functional requirements, technical aspects, and testing of the final solutions.

Table 11 groups the main findings and results for *RQ2-B: How is Design Thinking adopted as an approach for innovation within a project?*

Table 11 - Findings for RQ2-B

RQ	**Main findings and results**	**Paper**
RQ2-B[24]	Empirical assessment of design tools applied throughout the Design Thinking approach empirically, as well as when and how each stakeholder was involved in the process.	3
	Providing an in-depth view of the inspiration and evaluation phases.	3

Please note that Table 10 and Table 11 combined answer *RQ2: How is Design Thinking currently applied as an approach for innovation in the healthcare sector?*

[24] *How is Design Thinking adopted as an approach for innovation within a project?*

4.4. *Paper 4*: Hospital innovation process and organization evolution: from Design Thinking workshops to innovation outcomes[25]

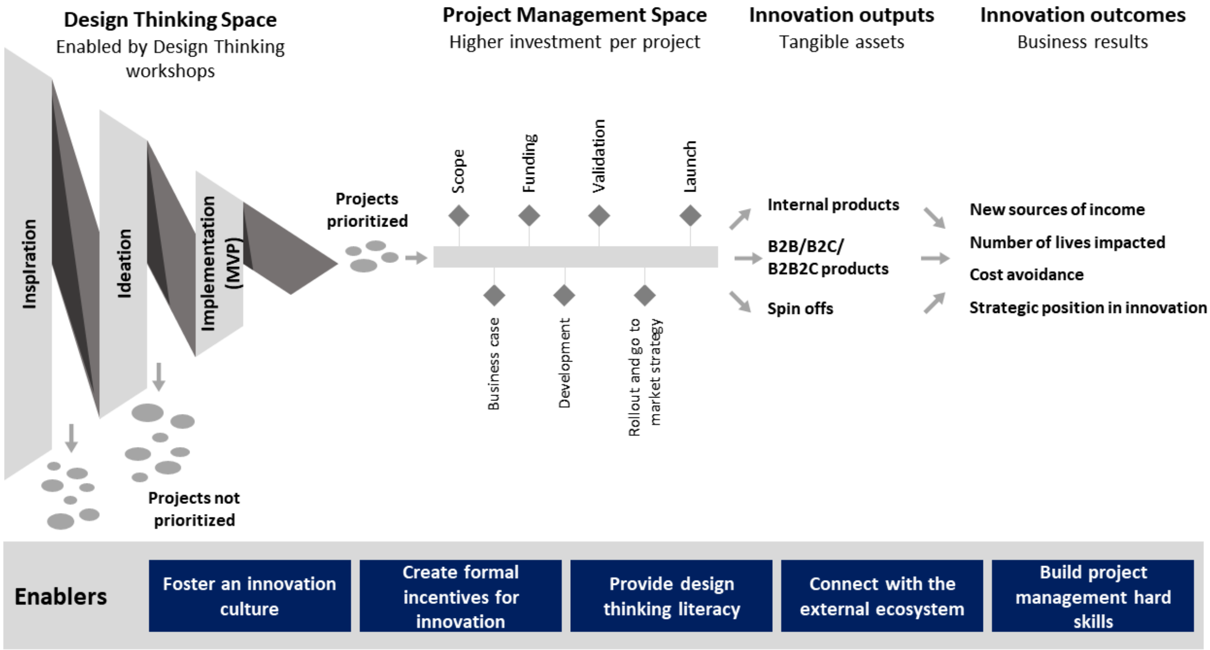
Design Thinking is acknowledged as a promising approach to innovation in healthcare, with positive reports on the clinical (Altman et al., 2018a) and managerial (Martinez Ibañez et al., 2022) outcomes of healthcare interventions that claim to have employed it. Additionally, Design Thinking tools have been used to promote better communication in healthcare by addressing interprofessional work (Cleckley et al., 2021) and conversations with patients (Annweiler et al., 2023; Casarett et al., 2023). Despite these recognized benefits, studies on how to build a Design Thinking culture and its structured adoption to promote innovation within healthcare organizations are scarce (Eines & Vatne, 2018a). *Paper 4* narrows this gap by conducting a case study within a healthcare organization that has employed Design Thinking at the organizational level for over six years, exploring how the approach evolved and relates to other innovation management approaches that coexist in the organization.

Paper 4 presents that the central strategy for disseminating Design Thinking in the organization was the creation of a 40h workshop program in which over 600 employees were trained, in addition to over 700 having participated in Design Thinking satellite events with shorter programs; this broad diffusion of Design Thinking formed a body of knowledgeable agents that, as stated by one of the interviewees, acted as “nucleators” of Design Thinking within their departments. After this initial diffusion, Design Thinking assumed a role at the forefront of innovation within TakeCare, as presented in Figure 6. The initiatives within the Design Thinking space are conducted with little to no support from formal structures, requiring very little investment. They may be submitted to a

[25] This section summarizes *Paper 4*. For an extended version of the discussion presented here, please refer to the original article in Appendix D.

committee and advanced to the project management space, which is concerned with accelerating initiatives to become scalable and self-sustainable until they can be launched and their deliverables become innovation outputs, which are expected to generate business results. The paper also identifies enablers antecessors to this model, as presented in Figure 6. For further elaboration on the Design Thinking workshops and the hospital innovation process model, see *Paper 4*.

Figure 6 - Hospital innovation process model



Paper 4 contributes by presenting a longitudinal study on how Design Thinking supports building innovation within a healthcare organization, unpacking the role of time in the dynamics of implementing Design Thinking at an organizational level. It also provides a detailed account of Design Thinking's interactions with enabling capabilities and other innovation management approaches. Finally, it positions Design Thinking at the forefront of innovation, addressing a known gap in the literature regarding where and in which phases in innovation management Design Thinking should be adopted (Liedtka & Locatelli, 2023; Magistretti, Ardito, et al., 2021).

Table 12 consolidates the findings and results related to *RQ3: How can Design Thinking be institutionally adopted, and how does it relate to innovation management in healthcare organizations?* The findings advance the understanding of how Design Thinking can be integrated within organizations and evidence the research opportunity for exploring the interconnections between Design Thinking, innovation, and Digital Transformation.

Table 12 - Findings and results for RQ3

RQ	**Main findings and results**	**Paper**
RQ3[26]	Proposition of a model for integrating Design Thinking within an organizational innovation program	4
	Providing a longitudinal analysis of how Design Thinking supports organizational change towards innovation.	4, 5
	Exploring Design Thinking's interplay with traditional innovation management approaches.	4
	Exploring the role of time in Design Thinking adoption.	4, 5

The conduction of the research for *Paper 4* also inspired some reflections: several of the informants kept mentioning that the innovation division in which the study was being conducted was absorbing the Digital Transformation mandate within the organization. When investigating the relationship between the innovation division and Digital Transformation, it was evident that Design Thinking played a role in developing capabilities for Digital Transformation. *Paper 5* unveils this relationship.

[26] *How can Design Thinking be institutionally adopted, and how does it relate to innovation management in healthcare organizations?*

4.5. *Paper 5*: Capability building for Digital Transformation through Design Thinking[27]

There is an opportunity for analyzing Design Thinking from a dynamic capability lens. Building on data collected from knowledgeable interviewees in *Study B* and advancing the work that began in *Paper 4*, *Paper 5* investigates how Design Thinking relates to capability building for Digital Transformation. In the digital era, innovation is highly connected to digital technologies and Digital Transformation as they have disrupted the configurations of products, business models, and even entire markets. Corroborating this understanding, most health solutions developed using Design Thinking identified in *Paper 2* are software or digital solutions. Hence, enabling capabilities for Digital Transformation allows the development of innovative offers in the digital era.

The paper identifies that Design Thinking drives capabilities for Digital Transformation related to creating a risk-agreeable safe space and enabling an innovative workforce. It explores how these capabilities are developed through time and their interaction with other capabilities that must be developed in the strategic management domain. Figure 7 presents each capability identified and the period they were created. Besides discussing each capability individually, the reported mechanisms by which these capabilities are enacted in the case, and evidence of their outcomes, the paper also unfolds how Design Thinking drives these capabilities, discusses organizational readiness for their development, and presents Design Thinking's limitations.

Paper 5 has three main contributions: first, it details the mechanisms by which the dynamic capabilities for Digital Transformation are driven by Design Thinking. Second,

[27] This section summarizes *Paper 5*. For an extended version of the discussion presented here, please refer to the original article in Appendix E.

it discusses the organization's readiness for an ecosystem where these capabilities can be developed and continuously deployed, consistently generating value throughout the years. Third, it discusses the limitations of Design Thinking in building capabilities for Digital Transformation and how they may be overcome.

Figure 7 - Process for developing the enabling capabilities for Digital Transformation

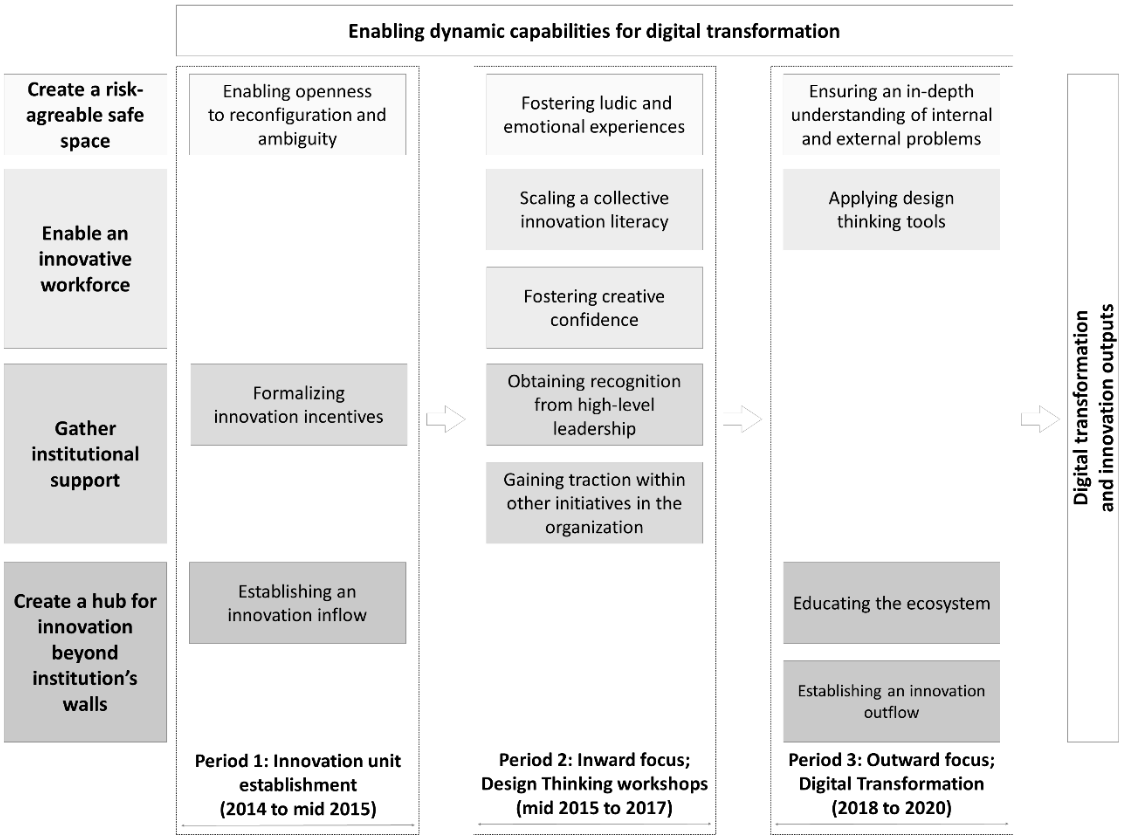


Table 13 groups the findings related to *RQ4: How does Design Thinking relate to capability building for Digital Transformation in healthcare organizations?*

Table 13 - Findings and results for RQ4

RQ	Main findings and results	Paper
RQ4[28]	Providing a model for developing enabling capabilities of Digital Transformation, using Design Thinking and addressing how the capabilities are formed, organizational readiness for this development, and Design Thinking's limitations.	5
	Extend the understanding of building capabilities for Digital Transformation.	5
	Unveil how Design Thinking actively sources dynamic capabilities for Digital Transformation at an organizational level.	5
	Enrich the theoretical underpinnings of Design Thinking by connecting it with the dynamic capability literature.	5
	Explore the adoption, implementation, and outcomes of Design Thinking as an organization-wide approach to innovation.	5

[28] *How does Design Thinking relate to capability building for Digital Transformation in healthcare organizations?*

5. Discussion

This section discusses the findings from the appended papers and the literature. The purpose of the research guides the discussion: "*To explore the adoption of Design Thinking in healthcare contexts and its relationship to capability building for innovation in the era of Digital Transformation at an organizational level.*" Section 5.1 explores the current adoption of Design Thinking in healthcare projects based on theoretical and empirical evidence. Section 5.2 discusses how to integrate Design Thinking into an organizational innovation process and its relationship to capability building. Section 5.3 sheds light on enablers that precede the adoption of Design Thinking as an organizational approach for innovation. Section 5.4 wraps the discussion section by counterpointing the view of Design Thinking in the managerial discourse adopted in this thesis and the ontology of the design discipline.

5.1. Exploring the current adoption of Design Thinking in healthcare projects

Even if undertheorized in scholarly literature, Design Thinking has been employed in industry and academic settings for at least a few decades. Hence, it is essential to shed light on the state of its practice before attempting to promote any theoretical advancements in the field. This section explores and discusses the current adoption of Design Thinking in healthcare projects in two parts: Section 5.1.1 elaborates on the enactment of Design Thinking in healthcare projects. Then, section 5.1.1.2 discusses opportunities for evolving the understanding of Design Thinking adoption in healthcare beyond the project level.

5.1.1. Assessing the enactment of Design Thinking, associated tools and attributes in healthcare projects

Both *Paper 2* and *Paper 3* portray the enactment of Design Thinking as a somewhat structured process to enable the development of a solution. Overall, scholars who report on the development of Design Thinking solutions often neglect reporting methodology, results, and the impact of their solutions and their effects on health outcomes (Bazzano et al., 2017a). Reporting guidelines for improving written studies of design-related solutions in healthcare contexts have been proposed recently (Bazzano et al., 2020a). The following sections will elaborate on the state of the practice of each phase of Design Thinking.

5.1.1.1. Inspiration phase: need-finding

Analyzing *Paper 2* and *Paper 3* in detail, it is easy to perceive that reports of the adoption of Design Thinking in the literature tend to rush in their reports of the inspiration phase without detailing the tools they used for sensemaking of data acquired during their field and desk research when compared to what was seen in the empirical setting assessed in *Paper 3*. Tools for sensemaking reported include the persona tool, user journey mapping, and the breakdown of user needs, and are highly relevant to communicating with stakeholders and users. In addition, acquiring expert knowledge in the area of expertise of the project is also a necessary step for sensemaking, as reported in *Paper 3*, enabling the balancing of contextual factors and evidence; the acquisition of this knowledge can happen either through desk research or through the involvement of specialists. In *Paper 2*, it was noted that solutions in more advanced stages of development often failed to report the tools employed in the inspiration stage or lacked detail about this stage.

This “setting aside” of the initial development stage may be counterproductive for replicating Design Thinking: the engagement and understanding of the final user are essential for developing appropriate solutions (Thies, 2015a). There is evidence that it is more crucial that users and stakeholders are involved in the early stages compared to the late stages of the innovation process, as they can incorporate their knowledge into the solution (Noktehdan et al., 2019a; Shah & Robinson, 2007a). Overlooking reporting at this stage may cause professionals in projects employing the Design Thinking approach to neglect the information collected and propose solutions that do not fulfill the user's needs (Greenhalgh et al., 2010a; J. L. Martin & Barnett, 2012a). Interviews with users reported in *Paper 4* and *Paper 5* reinforce that individuals involved in Design Thinking perceive that close interaction with users and stakeholders positively influences the conduction of the inspiration phase and the entire Design Thinking process.

Although there are some exhibits from the literature present a systematization of how to incorporate the results of the inspiration phase and user-centered research throughout the development process (e.g. LeRouge et al., 2013a; J. L. Martin et al., 2012a), further studies that formalize the incorporation of inspiration phase data throughout development would be beneficial to the theory and practice of health research involving design, enrichening the repertoire of research that follows guidelines for reporting health research involving design (Bazzano et al., 2020a).

Opportunities for integrating lead users

Von Hippel (1986a) introduced the concept of lead users as users who face a need before the bulk of a marketplace and are highly motivated to seek a solution. They are willing to take an active role in the development process beyond the passive role implied by expert-driven user-centered practices, such as interviews, personas, and journey mapping.

There is evidence of the potential benefits of involving lead users in the co-creation and development of solutions in healthcare (Shah & Robinson, 2007a). Involving these users could increase development rates and boost commercial performance. Consequently, it could increase manufacturers' profits by reducing time to market and development costs (Shah & Robinson, 2007a). On top of this, the complexity of concurrent potential users in healthcare solutions – the patient, the healthcare professional, or the healthcare provider, to name a few – poses an avenue for research on if and how Design Thinking is a suitable approach to managing these user layers from the inspiration stage.

Even though there are generic suggestions in the literature on retaining these lead users (Rahimi & Ibarra, 2014a), further research on identifying lead users in healthcare and whether Design Thinking may be adopted to identify or retain these users may benefit future development projects.

5.1.1.2. Ideation phase: concept generation and concept validation

More than half of the solutions identified in the SLR in *Paper 2* were at the ideation phase, having either a visual prototype, a design concept, or, in most cases, a functional prototype finalized. Design Thinking postulates that prototyping helps the design team perceive their solution's strengths and weaknesses early in the design process and even get feedback from the users. Using props or mockups serves as a tool to help users conceptualize feature examples during interviews (Fearis & Petrie, 2017), leveraging the adoption of prototype visualization strategies and as boundary objects that are plastic enough to conform to specific needs yet robust enough to maintain its core features to communicate the same meanings to different audiences (Carlgren et al., 2016a; Magistretti et al., 2023).

Anchoring the conceptualization activities in low-fidelity prototypes promotes a quick escalation in the concept's attributes and intelligent allocation of resources in ideas worth pursuing. In fact, out of the five prototypes developed in the case reported in *Paper*

3, the first three were built throughout the ideation phase to prove a critical function or communicate with stakeholders, and only from the fourth prototype onward were the prototypes built to provide an effective use in real-world conditions (e Silva & Zancul, 2023).

During the ideation phase, the modus of delivery for the solution is selected. In *Paper 2*, most of the papers in the sample report interventions in the form of software tools, only six of the papers report the development of medical devices, and isolated papers report the creation of events, timetables, toolkits, and decision support systems. While developing software and service solutions may have seemingly lower entrance barriers and time to market compared to the development of medical devices, developing functional and usable digital applications is not trivial, as there is a need to create an in-depth understanding of the user's needs, desires, limitations, preferences, attitudes, and behaviors (LeRouge et al., 2013a).

Capturing these psychological and psycho-social nuances is not trivial with the "traditional" application of user-centered methods like user profiles and personas, as they tend to rely on demographic data and shallow caricatures of user groups (LeRouge et al., 2013a). Not employing the rigor, time, and collective sense of the importance of user research may doom it to become unactionable or overlooked work (e.g. Greenhalgh et al., 2010a; J. L. Martin & Barnett, 2012a). Firms willing to continuously develop digital solutions must empower employees to envision and execute them. *Paper 5* extends the understanding of the capabilities firms need to develop in their managers and employees to adopt digital technologies and conduct a Digital Transformation successfully.

5.1.1.3. Implementation phase: concept development and market analysis

The implementation phase, which aims to refine the ideated concept into a viable solution, was the least reported among *Paper 2*'s sample, as a significant portion of the articles did not report reaching this phase. Some of those who had reached it focused their reports on assessing the intervention and not describing their development process and a couple of articles reported that they would not disclose their resulting solutions due to commercial confidentiality. Only three articles in the sample reported commercial analysis. If the solution is meant to be commercially viable, this aspect must be addressed diligently.

The empirical evaluation of the implementation phase in *Paper 3* comprehended a device in a pretty advanced development phase, having been submitted to empirical testing and quality analysis in a real-world setting and undergoing a commercial negotiation for scale fabrication. Nevertheless, even though the prototype successfully created value for the targeted process, the project was demobilized after product valuation and commercial proposal as a part of the market analysis since the balance between development efforts and value capture potential was unfavorable (e Silva & Zancul, 2023). Silva and Zancul (2023) state that value capture is not a direct outcome of Design Thinking but a necessary asset for successful innovation projects; hence, Design Thinking must be complemented with business-oriented approaches to enable value capture.

5.1.2. Beyond projects: evolving the adoption of Design Thinking in healthcare

Paper 2 and *Paper 3* elaborate on the current adoption of Design Thinking in healthcare projects using two different analysis methods. While the project focus lens has been, so far, the primary unit of analysis for the Design Thinking approach, this same lens makes it evident that looking solely at the project level will not ensure the effective integration of Design Thinking into an ongoing stream of valuable and financially sustainable innovations. Hence, there is an opportunity to explore the potential of adopting Design Thinking from an innovation management process perspective.

According to the findings of *Paper 2,* reports on effectively connecting individuals to develop innovative healthcare solutions are scarce. While these reports evidenced the benefits of innovative solution development by connecting individuals from multiple backgrounds and synergies and reducing development time, they did not explore how to make these connections happen. A practical model for leveraging the integration of individuals around healthcare innovation in the digital era and an analysis of this model within an organization and the healthcare ecosystem are relevant contributions to evolving the adoption of Design Thinking in healthcare. This opportunity is the setpoint for the elaboration of *Paper 4*.

5.2. Integrating Design Thinking in an organizational innovation process

Innovation processes are typically created with strong C-level support; however, their outcomes and impact on the cultural shift towards innovation make them endure throughout the years. If employees are well trained, Design Thinking can become an institutional resource through which employees across all institution levels can relate, and it can be used to address tactical and strategic demands. Section 5.2.1 discusses the hospital innovation process model and why Design Thinking is positioned at the front end of innovation. Then, in the same context of the hospital innovation process model, section 5.2.2 discusses the capacity of Design Thinking to generate value beyond the solutions originating from its application at a project level; instead, it focuses on the role of Design Thinking's social technology in developing capabilities in the workforce.

5.2.1. Positioning Design Thinking in the hospital innovation process model

The innovation process proposed in *Paper 4* states that the innovation process starts in the Design Thinking space, which ensures an ongoing pipeline of innovation initiatives in the organization at a small cost because the initiatives in this phase are proposed and conducted by trained employees who may or may not find innovation opportunities within their daily activities. As stated by one of the informants, this approach relies on "*laissez-faire… and if it works, sell it to me."* This space operationalizes the promotion of active experimentation and generates positive encouragement and confidence, which have been identified as enablers to promote the involvement of nurses in innovation activities (Zuber & Moody, 2018).

The following phase is project management space, which requires more investment per initiative in employing human capital or investing financial capital. As expected, fewer initiatives reach the project management space portfolio, and it is assumed that a reasonable proportion of them are expected to be successful. This is quite the opposite of the Design Thinking space, in which one would expect that most of the initiatives would be rejected before moving into the next phase.

This division between spaces was an evolution of the model over the years. The innovation management perceived that the benefits of engaging and empowering the workshop outweighed the role of Design Thinking initiatives in effectively developing and deploying products and services since the latter required more structured management processes than the practice of Design Thinking could effectively provide. Hence, the activities related to generative, design-thinking fuzzy innovation front-end (Design Thinking space) and hard skills in project management (project management space) were split into two separate structures within the innovation unit. This situation prevented them from cannibalizing one another.

The generative Design Thinking activities ensure the outputs of innovation in terms of new products, services, or processes. Typically, these outputs are in their infancy and require further investment before they can produce business outcomes. Furthermore, these outputs are formally assessed by innovation and entrepreneurship committees, where executives analyze them based on their potential. If selected, these outputs are tunneled into a project management pipeline separated from the generative Design Thinking activities; this pipeline strives to embed these solutions further to ensure that the outputs generate business outcomes regarding financial success, customer base, or other specific business goals. Design thinking does not provide the structure to drive the validation and launch of elaborated products or services within a regulated market. Thus, more rigid approaches to project management are needed to complete these stages.

As identified in *Paper 4* and *Paper 5*, separating the structures responsible for generative Design Thinking initiatives and hard skills related to Digital Transformation and innovation management is beneficial in achieving the outputs and outcomes of innovation and Digital Transformation.

5.2.2. Exploring the building of capabilities for Digital Transformation through Design Thinking

The relationship between Design Thinking and Digital Transformation is underexplored. *Paper 5* extends the understanding of the relationship between Design Thinking and Digital Transformation, building on the innovation process model presented in *Paper 4*.

At Takecare, Digital Tranformation was an intentional inquiry targeting multiple streams: adopting new technologies to modify the properties of their service offerings – for example, through the creation and implementation of telemedicine services –, digitalization of operational processes – for example, through the creation, implementation and commercialization of a software for managing allocation timetables –, and digitalization of tools related to improving health offers – for example, through the creation, implementation and commercialization of a software to aid genomics data processing and analysis. In addition, the organization was conducting an ongoing initiative to revision their internal processes in face of the new digital technologies available, and using design thinking as a foundation for driving the mindset and actions to reassess these processes. Takecare is generating change in its properties and regular offerings through the use of technology; hence, they are counducting a Digital Transformation according to Vial’s (2019) definition of term.

The study identifies enabling capabilities for Digital Transformation that firms should mobilize to develop before executing a digital strategy. This aims to ensure the organization is sufficiently mature to implement this strategy. Digital Transformation is a lengthy endeavor, and launching ambitious initiatives without organizational readiness may hinder the innovation-driven enhancement of business (Zhen et al., 2021). A relevant finding is that several of these capabilities are enabled by Design Thinking literacy, corroborating Marx’s (2022) proposition. Since the organization analyzed in *Paper 5* had a contingent of over 600 employees trained in Design Thinking and was actively conducting a Digital Transformation, the unanticipated effects of Design Thinking on capability development for Digital Transformation were brought to discussion by several informants.

While previous studies contributed to consolidating the microfoundations of capabilities required for an organization’s Digital Transformation (Warner & Wäger, 2019), the mediating roles of digital capabilities and firm digital performance (Sousa-Zomer et al., 2020) and enlightening how Design Thinking may foster capabilities in discovering digital technology opportunities at a project level (Magistretti, Tu, et al., 2021), no previous study has empirically examined how organizations can adopt Design Thinking to drive enabling capabilities for Digital Transformation over time.

Even more recently, through an empirical study, Sahakian & BenMahmoud Jouini (2023) characterize design as an operational capability related to designing, spreading and managing design, as well as posing a renewing and regenerative dimension that fosters continuous learning revolving design; this model of ongoing feedback between the operational and regenerative capabilities enables the portray of design as a dynamic capability. While their model is focused on the integration of the design discipline within an organization, they acknowledge Design Thinking as an asset to: a) enhance customer relationship processes by training front-line employees in Design Thinking, and b) expand the conduction of design activities among non-designers.

Tapering the gap on exploring the use of Design Thinking for developing capabilities in a widespread manner withi an organization, *Paper 5* proposes a model for developing enabling capabilities for Digital Transformation. The focus here is not on the technical capabilities necessary for Digital Transformation but on analyzing the managerial capabilities of individuals exposed to Digital Transformation.

The enabling capabilities are split into the Design Thinking domain and the strategic management domain; unlike the hospital innovation process terminology, these Design Thinking capabilities are not necessarily developed or employed solely in the fuzzy front-end of innovation, as these capabilities are dynamic and are employed on a contextual basis. Capabilities in the Design Thinking domain are related to creating a risk-agreeable safe space and enabling an innovative workforce. Capabilities in the strategic management domain are related to gathering institutional support and creating a hub for innovation beyond the institution’s walls. Section 5.2.2.1 discusses the dynamic capabilities for Digital Transformation in the Design Thinking domain fostered by Design Thinking. Section 5.2.2.2 discusses the dynamic capabilities for Digital Transformation in the strategic management domain developed within the hospital innovation process model but not directly fostered by Design Thinking.

5.2.2.1. Capabilities for Digital Transformation in the Design Thinking domain

Enabling openness to reconfiguration and failure. At first, the innovation unit had the resources for conducting the Design Thinking workshops, and the Digital Transformation mandate was allocated within the IT unit of the organization. Eventually, after several rounds of reconfiguration to incorporate new mandates and initiatives related to innovation, the innovation unit received the mandate for Digital Transformation strategy because of its proven capacity for enabling openness to reconfiguration and ambiguity throughout the years, which was highly valuable within the risk-averse environment. Design Thinking was institutionally acknowledged as a cultural foundation for Digital Transformation, as stated by a few informants. Hence, the case corroborates Warner and Wäger’s (2019) proposition that strategic agility and internal structure redesign the enabling capabilities for Digital Transformation.

Fostering ludic and emotional experiences. This capability is put into practice through the creation and engagement with prototypes, allowing for the reinterpretation of what was previously perceived as a failure as a teaching opportunity. Prototyping enables individuals to understand that failure is an expected and perhaps necessary part of developing products or services, as Gerber and Carrol (2012) assert. It enables people to break away from the risk-averseness typical of the healthcare sector and prepares them to engage in and have a mindset for rapid prototyping actively. This aspect has been presented as a capability required for Digital Transformation (Warner & Wäger, 2019).

Scaling a collective innovation literacy. Training hundreds of employees in Design Thinking workshops and making them the ambassadors of Design Thinking within the organization crafted a shared digital mindset and digital-savvy workforce. Warner and Wäger (2019), Solberg et al. (2020), and Souza-Zomer et al. (2020) identify these capabilities as requisites for Digital Transformation.

Fostering creative confidence. Magistretti et al. (2021) define individual creative confidence as “a sense of belonging and willingness to contribute to the organization’s innovativeness by creatively proposing opportunities.” It can be fueled through coaching and experience (Kelley & Kelley, 2013). In Design Thinking workshops, individuals were encouraged to connect their technical abilities with their creative potential. The workshops focused on the learner’s experience and fostered the individual’s sensibility and reflection, typically absent in managerial cultures (Rylander Eklund et al., 2022). Those involved in Digital Transformation initiatives are constantly challenged with the unknown and must be resilient and self-aware of their work (Cavalcanti et al., 2022). Hence, creative confidence is an ability that can positively contribute to Digital Transformation efforts and must be supported by organizations willing to carry out effective Digital Transformation.

Ensuring in-depth understanding of internal and external problems. Design thinking has helped the organization frame and reframe existing problems. Magistretti et al. (2021) proposed that Digital Transformation goes beyond the digitalization of previous analogical processes, products, or services and necessitates the capability to expand the knowledge base after considering how technology can improve a previous analogical interaction. In departing from this understanding, one can deduce that this capability, fostered by Design Thinking, directly contributes to Digital Transformation.

Applying Design Thinking tools. Design thinking’s attributes, such as interdisciplinary collaboration and user-centeredness, can relate to how individuals overcome challenges and learn (de Paula et al., 2023; Dell’Era et al., 2020; Marx, 2022). In the Design Thinking workshops, employees learn how to autonomously apply Design Thinking tools and methods in a replicable manner. Thus, they learn how to use Design Thinking as a social technology that could be reconfigured for given purposes on demand – a construct introduced by Liedtka (2020). This ability to continuously reconfigure their toolbox to overcome new challenges helps organizations achieve integration and innovation in their Digital Transformation endeavors (Guo et al., 2023; Hanelt et al., 2021; Usai et al., 2021).

5.2.2.2. Capabilities for Digital Transformation in the strategic management domain

Formalizing innovation incentives. The existence of incentives makes employees voluntarily seek initiatives driven by the innovation unit. In the past, it provided the unit feedstock to develop solutions that eventually increased the innovation unit's social and political capital within the organization. Through such volunteer involvement, employees will willingly use their idle time to pursue innovation activities, thereby contributing to organizational ambidexterity. The existence of innovation-oriented financial incentives positively moderates ambidexterity within organizations (Ardito et al., 2019). Ambidexterity is necessary for competitive firms in the digital world (Vial, 2019).

Establishing an innovation inflow. The innovation unit demonstrated to the middle and top management that they could better use new technology, business models, and solutions to provide enhanced care and operational efficiency. The unit started with the connection of internal sectors to health-tech startups in 2014, which ignited digital savviness within management, catalyzing their future involvement in Design Thinking and Digital Transformation initiatives. Digital savviness is a capability required for Digital Transformation (Sousa-Zomer et al., 2020). In the current case, this capability was fostered by the exposure of risk-averse management to the potential benefits of importing existing innovation solutions by connecting with external partners.

Obtaining recognition from high-level leadership. Obtained executive support and respect through Design Thinking initiatives, extensive portfolios, and their outcomes. This fact is evidenced in the executives' requests for the involvement of the innovation unit in their projects. Executive support is seen as an enabler of Digital Transformation (Sousa-Zomer et al., 2020; Warner & Wäger, 2019).

Lifting traction within other initiatives in the organization. By enabling employees and managers to solve problems of their departments in the Design Thinking workshops, the unit helped solve latent problems in clinical and non-clinical areas of TakeCare. The case confirms the findings of Björklund et al. (2020), who posited that design-related interventions, such as Design Thinking, benefit from connecting to organizations' ongoing transformation initiatives as a strategy for legitimization.

Educating the ecosystem. The firm in this case positioned itself as a focal firm within the ecosystem, providing a hub for actors to meet and interact. It also offered resources to elevate the plateau of the ecosystem in terms of innovation, such as creating partnerships with universities and other companies and offering consulting services. By capacitating the ecosystem, the organization benefited from co-creation and coopetition initiatives with other actors. As Warner and Wäger (2019) propose, such actions directly enable the capability for Digital Transformation to navigate the digital ecosystem.

Establishing an innovation outflow. As a consequence of the Design Thinking generative initiatives, more internal projects showed positive results and demanded the creation of new paths to market and funding. This led the organization to create spin-offs, license internally developed technologies, and establish open innovation partnerships. As Warner and Wäger (2019) emphasize, navigating digital ecosystems, which entails establishing collaboration initiatives with external partners, is a dynamic capability for Digital Transformation.

5.3. Antecessors and enabling capabilities for Design Thinking adoption and developing capabilities for Digital Transformation

Paper 4 and *Paper 5* analyze the same case, the first seeking to explore the process by which innovation unfolds in the organization along with its interactions with Design Thinking, generating innovation outputs. The latter explores how adopting Design Thinking within this same innovation process enables the construction of dynamic capabilities for Digital Transformation. In both of these, the enactment of Design Thinking outputs and outcomes either in terms of solutions or capabilities does not unfold in a vacuum, and organizations must develop enabling capabilities that antecede the value capture of Design Thinking either in solutions or capabilities; note that, in the case of *Paper 5*, the enabling capabilities are the ones that are developed in the first period presented in the capability model.

The first enabler is *fostering an innovation culture*: especially in healthcare, where there is an inherent mandate for safety, quality, and replicability in every practice, it is challenging to invite individuals to feel comfortable innovating. Instituting an open and supportive culture (Thijssen et al., 2023), group cohesiveness (Weintraub & McKee, 2019), and even an energizing (Palumbo, 2021) or supportive environment (Barnett et al., 2011) have been identified as antecessors of employee engagement (Palumbo, 2021) and innovation implementation success (Thijssen et al., 2023). Several works refer to the need for having a leadership and an executive team supportive of innovation activities to make sure this innovation culture endures (Glover et al., 2020; Hyrkäs et al., 2020; Palm & Fischier, 2022; Palumbo, 2021; van den Hoed et al., 2022; Weintraub & McKee, 2019), and healthcare leaders have reckoned that the organizational structure must follow this ambition at the risk of letting managers with no other options than to refrain for working with innovation activities due to lack of resources (Palm & Fischier, 2022).

The second enabler is the *creation of formal incentives* for engaging in innovation activities. Individual job autonomy intrinsic to healthcare professions (Schultz et al., 2012a) and diversified workforce experience across several disciplines (Baig et al., 2022) makes health professionals' engagement a fundamental ingredient for innovation (Palumbo, 2021). Human resource management is a critical enabling factor in idea generation and moving from idea generation to innovation implementation (Thijssen et al., 2023), all stages presented in the hospital innovation process. Labitzke, Svoboda, and Schultz (2014a) suggest that formal control mechanisms may encourage proactive innovation-related behavior in hospital employees. The existence of innovation-oriented financial incentives positively moderates ambidexterity within organizations (Ardito et al., 2019). Ambidexterity is necessary for competitive firms in the digital world (Vial, 2019).

The third enabler is *providing Design Thinking literacy* through training. Design Thinking and human-centered design have been extensively employed in healthcare projects (see Bazzano et al., 2017a; Oliveira et al., 2021 for reviews) and have been pointed out as a competency domain for healthcare leaders (van den Hoed et al., 2022). Providing a structured approach to Design Thinking promotes psychological safety within teams novice to innovation and enables these teams to drive idea generation (Liedtka, 2020). Due to differences between achieving innovation in healthcare compared to other sectors, involving the non-obvious relationship between the complexity of the innovation initiative, the level of individual autonomy, and innovation initiative success, structured approaches to Design Thinking in healthcare have been tailored to guarantee cohesiveness (Glover et al., 2020). Instituting such an approach organization-wide refrains the organization from facing known barriers to adherence to innovation programs, such as the lack of applicants, underdeveloped innovation ideas, and the need for training innovators (Hunter et al., 2021).

The fourth enabler is *connecting with the external ecosystem* to identify opportunities to establish innovation inflows and outflows and educate the ecosystem. Promoting links between organizations enables the exchange of capabilities and knowledge between them (van den Hoed et al., 2022) as long as both parties are engaged and know what is expected of them (Hyrkäs et al., 2020). The organization started this connection by establishing an innovation inflow, through which the innovation unit demonstrated to the middle and top management that they could better use new technology, business models, and solutions to provide enhanced care and operational efficiency. It started with the connection of internal sectors to health-tech startups in 2014. It ignited digital-savviness within management, catalyzing their future involvement in Design Thinking and Digital Transformation initiatives. This capability was fostered by risk-averse managers seeking to capture the potential benefits of importing existing innovation solutions by connecting with external partners.

The fifth and final enabler is *developing complementary skills to Design Thinking* to certify that the portfolio of initiatives selected for further investment is aligned with the strategic planning and that they can exist autonomously beyond their minimal viable products; the generative initiatives will typically be underexplored if the organization does not have this capability. These complementary skills will be enacted in the project management space in the hospital innovation process model; hence, there is a separation between generative innovation expertise and project management innovation expertise to avoid cannibalization between these scopes and counterbalance their potentials and limitations. The complementary skills to Design Thinking identified are:

i) Creating gateways with high-level executives to assess innovation projects. Combined with the Design Thinking workshops, this approach balances the need for generating an ongoing pipeline of ideas coming from employees by promoting innovative work behavior (as recommended by Baig et al., 2022) while promoting a control mechanism on what will be prioritized and invested in in terms of innovation (as recommended by Glover et al., 2020) later the process. This strategy ensures both bottom-up engagement and top-down support for innovation projects, avoiding a lack of efficiency in addressing hierarchical and heterarchical constraints in managing innovation projects (Atkinson & Singer, 2021).

ii) Developing management, financial, and legal project skills to enable selected innovation projects to streamline towards launch phases (a similar approach for this phase is presented by Hunter et al., 2021).

iii) Fostering an entrepreneurial education for employees to enable the creation of spin-offs as possible exits for innovation projects.

5.4. Providing another point of view: a critique to the adoption of Design Thinking as a driver of capabilities

The heart of this thesis relies on exploring the adoption of Design Thinking in healthcare contexts, both at the project and organizational levels, and elaborating on it to leverage its adoption to generate better outcomes by developing new solutions or capabilities. While this research is necessary for enabling a more effective adoption of Design Thinking within organizations, its outcomes must be reflected from an ontological perspective.

Hargraves (2018) poses a thorough discussion on how the value of human-centered design has been portrayed over the years in the context of healthcare; while human-centered design and Design Thinking ontologically are concerned about caring for people, they are often presented as a capacity for problem-solving. The author presents that, in healthcare, human-centered design interventions often claim their success based on efficiency gains, solutions development, or capabilities development, for example. Nevertheless, suppose one were to consider the roots of HCD and Design Thinking and the enactment of other professions that act in the healthcare context. In that case, the goal of a design intervention should ultimately be the better care of a human being.

Similarly, management reports on Design Thinking present the individuals involved in it as a "bundle of capacities" driven by a replicable toolkit of activities originated in the way professional designers think and work, in which design is seen as a means to develop this bundle of capacities. Still, design output is sometimes portrayed as of little importance (Lee, 2021), and they mostly neglect the aesthetics and reflexive dimension of Design (Tonkinwise, 2011).

Besides that, while the Design Thinking prescriptive models might be positive for popularizing designerly techniques, these managerial, mechanical ways of acquiring knowledge using prescriptive methods of Design Thinking to produce outputs that may not be in the form of products cannot refrain organizations from the reflective ways of developing expertise and making desirable change that is on the core of design. The dynamics for enabling this kind of expertise and thus enabling design-driven innovation are very different and more time-consuming than those for enabling human-centered innovation.

Human-centered innovation, by definition, will focus on the explicit needs presented by users, which will invariably be rooted in known and current products, services, or experiences and hence tends to produce incremental innovation (D. A. Norman & Verganti, 2014; Verganti, 2008). Nevertheless, firms need to develop capabilities for enabling the development of radical innovation through design-driven research to enable market breakthroughs through the creation of new meanings through design (D. A. Norman & Verganti, 2014; Roberto Verganti, 2011; Verganti, 2008).

The discussion section ends with the acknowledgment that Design Thinking is a powerful and effective tool for diffusing design knowledge, even superficially, and enabling a collective body of an organization to share the same human-centered principles that enable a collective mindset prone to Digital Transformation. Nevertheless, with Design Thinking, “Management has not moved closer to design. Design moved closer to management.” Organizations must be actively cautious in separating the scopes and evaluations of initiatives, practices, and limitations related to Design Thinking from those related to the design discipline, protecting one another from their sometimes conflicting approaches.

6. Conclusion

This doctoral research was driven by the motivation to understand the enactment and the potential of adopting Design Thinking in healthcare contexts, unveiling its relationship to capability building at an organizational level. The research was motivated by two foundational gaps:

a) *Lack of standardization on what is labeled as Design Thinking hinders theory development.*

b) *Lack of understanding of if and how Design Thinking contributes to developing capabilities for innovation at the organizational level in the Digital Transformation era.*

Study A and *Study B* were designed to fill these gaps. *Study A* addresses *RQ1* (*What is the construct of Design Thinking*) and *RQ2-A (How is the application of Design Thinking in healthcare projects reported in the scholarly literature?)* through two literature reviews. *RQ1* is addressed through a review of the literature on Design Thinking in management publications and making sense of the findings by proposing a comprehensive construct for Design Thinking. *RQ2-A* is also addressed through a literature review, but this one focuses on enacting Design Thinking in healthcare projects. The sample was classified into several attributes, and the articles were explored for a cross-content analysis, which guided to the elaboration of a model presenting the most prevalent Design Thinking tools reported in each phase and the reflection upon four research avenues in the field.

Next, *Study B* addresses *RQ2-B (How is Design Thinking adopted as an approach for innovation within a project in a healthcare organization?), RQ3 (How can Design Thinking be institutionally adopted, and how does it relate to innovation management in healthcare organizations?)* and *RQ4 (How does Design Thinking relate to capability* *building for Digital Transformation in healthcare organizations?).* The RQs are addressed through a longitudinal single case study of a healthcare organization. *RQ2-B* is tackled by the in-depth analysis of a project that employed Design Thinking, exploring the activities performed within each phase, the innovation outputs related to the project, and the testing and go-to-market activities employed. Within the same case, following the collection and sensemaking of primary and secondary data summing up six years, *RQ3* is addressed by exploring the strategies for adopting Design Thinking and its subsequent enactment. Design Thinking assumed a role in the front end of the innovation process, and a hospital innovation process model for better integrating Design Thinking is proposed. Departing from the same study, *RQ4* is answered by diving deeper into the unveiling of Design Thinking across time and its role in sourcing dynamic capabilities for Digital Transformation.

As a direct product of answering the aforementioned *RQ*s, three original artifacts were produced as a result of the thesis:

i. *A comprehensive construct for Design Thinking, accommodating the nuances and contextual dependencies of the approach (*Figure 5*).*
ii. *A hospital innovation process model integrating Design Thinking with project management approaches (*Figure 6*).*
iii. *A model for developing capabilities for Digital Transformation through Design Thinking (*Figure 7*).*

Hence, the collection of the discussions presented in this thesis and their resulting artifacts comprehend a holistic analysis of the papers elaborated throughout the doctoral program, helping to advance knowledge in the field in several ways.

6.1. Implications for theory

This thesis provides a thorough articulation regarding Design Thinking and its enactment in healthcare. Its contributions to theory are consolidated in the following paragraphs.

First, this work contributes to the Design Thinking literature by providing a comprehensive construct. This provides a baseline foundation for theory building, avoiding tautological, unclear, and insufficient definitions, and enhancing construct clarity, as recommended by Auernhammer & Roth (2021). The properties associated with the proposed construct are valuable to enable the construction of research instruments for empirical studies on assessing the adoption of Design Thinking, a need previously presented in related research (Elsbach & Stigliani, 2018; Micheli et al., 2019). This construct of Design Thinking was used as a theoretical foundation and enabled exploring the intersection of Design Thinking, Dynamic Capabilities, and Digital Transformation in this thesis.

Second, this thesis shows evidence of Design Thinking's application in projects in clinical and managerial scenarios in healthcare, fundamented by theoretical and empirical research methods. The findings endorse that Design Thinking provides a frame for addressing the development of innovation in healthcare by balancing contextual factors and clinical evidence. Hence, the thesis contributes to understanding the enactment of Design Thinking in specific industries and contexts with alternative thought logics, responding to previous calls for research (Elsbach & Stigliani, 2018; Micheli et al., 2019), adding an analysis of the adoption of Design Thinking in the healthcare sector to the repertoire of analysis in other industries (e.g. Bertão et al., 2023; Magistretti et al., 2023). The work presented here explores how Design Thinking may be adopted in industries that have historically valued perfectionism and siloed specialization, and how the adoption of Design Thinking can surpass the project level towards the organizational level.

Third, at an organizational level, this thesis provides a systematic analysis of the adoption, implementation, and outcomes of Design Thinking, in response to Micheli et al.'s (2019a) call. This work sheds light on the trajectory of change within an organization that adopts Design Thinking as a practice, exploring its limitations, the challenges in its adoption, and ways in which these challenges may be overcome, complementing Carlgren & BenMahmoud-Jouini's (2022) cross-case study on the cultural challenges of Design Thinking implementation. The hospital innovation process model positions Design Thinking at the forefront of organizational innovation, filling a previous gap in the literature questioning where at the innovation process Design Thinking should be adopted (Liedtka & Locatelli, 2023; Magistretti, Bianchi, et al., 2021). The thesis provides a detailed account of how Design Thinking interacts with enabling capabilities and previously existing project management, human resources, and innovation management practices within an organization. Thus, it joins the sparse literature that explores the enablers of Design Thinking implementation (Wrigley et al., 2020).

Fourth, this thesis extends the theoretical underpinning of Design Thinking by connecting it with the Dynamic Capabilities literature, joining a recent stream of research connecting the two fields (Auernhammer & Roth, 2021; Magistretti, Ardito, et al., 2021). The research unpacks how Design Thinking sources capabilities for Digital Transformation at an organizational level, complementing previous research that has explored the potential of Design Thinking powering capabilities for Digital Transformation at a project level (Magistretti, Tu, et al., 2021), Design Thinking's relationship to digital capabilities in light of venture performance (Kamble et al., 2023), and its acknowledgment as a process embedded in the Digital Transformation at an organization (Correani et al., 2020). This work is the first to explain the mechanisms by which Design Thinking drives Dynamic Capabilities for Digital Transformation, filling two known research opportunities: exploring the changing dynamics of managing Digital Transformation (pointed out by Appio et al., 2021; Warner & Wäger, 2019) and examining the role of time in building capabilities and producing business outcomes (pointed by Sousa-Zomer et al., 2020; Warner & Wäger, 2019).

6.2. Implications for practice

This research has also made contributions to a practitioner audience. First, it portrays a replicable structured approach for implementing a Design Thinking workshop in healthcare contexts, which can be reused in several settings in public and private health, either at the project level or organizational level.

Second, it proposes the hospital innovation process model that integrates Design Thinking with project management approaches, presenting strategies for formulating an innovation portfolio with clear gateways and an ongoing stream of new projects. This serves as a reference for managers willing to adopt Design Thinking at the organizational level.

Third, this thesis presents a model for developing capabilities for Digital Transformation and discusses the mechanisms by which they were developed, which can act as a reference for managers facing Digital Transformation challenges in risk-averse industries.

Finally, this work unveils the antecessors of implementing the hospital innovation process model, shedding light for managers seeking organizational readiness for innovation and Digital Transformation.

6.3. Limitations

Despite the contributions, like any other research, this thesis has its limitations. The most relevant limitations are highlighted in this section.

First, the findings presented here could not be empirically tested for external validity through strategies such as surveys or sort carding exercises, for example. External validity was sought by comparing the findings with similar cases from the literature. In addition, in the empirical part of the thesis, the analysis of a single case study limits the generalization of the findings.

Second, business outcomes related to projects that employed Design Thinking could not be assessed due to a lack of data reported both in empirical and theoretical analysis and to long innovation lead times in the healthcare sector. Hence, the study explores the adoption of Design Thinking in healthcare projects and organizations without actually being able to assess the final outcomes for the organizations. As a consequence, critical success paths for Design Thinking's adoption within projects or organizations cannot be coined.

Finally, in the proposed capability model, isolating each capability's effects on the generation of Digital Transformation and innovation outputs and outcomes was not possible. Hence, it is not possible to empirically postulate the direct effects of Design Thinking on business and innovation outcomes based on the findings of this research.

6.4. Future research

Design Thinking has been discussed in management for over 15 years. This work has helped to unpack the conceptualization and dynamics of the approach in the context of healthcare and in light of the phenomenon of Digital Transformation. The impacts of the adoption of Design Thinking over the first 15 years of adoption will continue to endure. Looking forward to addressing the limitations identified in this thesis, extending its findings, and enabling the academic literature to keep the pace of the unveiling of Design Thinking in practice, a few guiding RQs are proposed for future research:

- Understanding that Design Thinking is composed of attributes, is there an optimal configuration of attributes that will enable better outcomes for Design Thinking projects?
- Do solutions developed employing Design Thinking contribute to better health outcomes?
- Do solutions developed employing Design Thinking contribute to better business outcomes?
- Do organizations that intentionally adopt Design Thinking as an approach for innovation or Digital Transformation deliver better business outcomes?
- Does Design Thinking mediate the effective adoption of emerging management approaches, such as agile management and the construction of ecosystems?

This work has unpacked the enactment of Design Thinking in healthcare contexts. The evidence presented here shows that Design and Design Thinking are assets for enabling people to provide better care for people in all stages that involve this care – whether this meand developing a device for preventing retained surgical items, creating a new checkup routine, building a staff timetable software, or any clinical or managerial activity that are crucial for delivering care. As a consequence, Design and Design Thinking drive better outcomes for organizations that care for people. Hopefully, this thesis has made these connections clearer and inspired academics and practitioners to reflect upon their work in light of Design Thinking.

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Appendix A

Paper 1

Unveiling the Construct of Design Thinking: An Exploratory Study

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DESIGN 2022

Unveiling the Construct of Design Thinking: An Exploratory Study

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Abstract
Design thinking does not have a consensually defined construct in the academic literature. This foundational fragility hinders theory building in the field. This study addresses this gap by providing a construct of design thinking following guidelines for developing theory-building instruments. We propose a non-normative, comprehensive construct composed of a conceptual definition and a subset of properties that portray tangible design thinking expressions. The proposed construct aims to provide a grounded foundation to support the advancement of design thinking theory building and testing.

Keywords: design thinking, construct, theory building, design theory, human-centred design

1. Introduction

Design Thinking is a widely known approach to innovation among management practitioners. It has been extensively adopted, even though it lacked a clear-cut unique definition (Johansson-Sköldberg et al., 2013). In a broad sense, design thinking was introduced as "*a discipline that uses the designer's sensibility and methods to match people's needs with what is technologically feasible and what a viable business strategy can convert into customer value and market opportunity*" (Brown, 2008, p. 2).

Throughout the years, many authors have incorporated addendums into the concept of design thinking. Design thinking has been portrayed as a distinctive and strategic approach to problem-solving that may be applied to virtually any business problem (Brown and Katz, 2011; Carr *et al.*, 2010; Liedtka, 2015) that drives multidisciplinary teams (Seidel and Fixson, 2013) in a user-centred (Verganti, 2008), empathetic and collaborative (Brown and Katz, 2011; Liedtka, 2015) quest to innovation (Liedtka, 2020). It was proposed as a balance between analytical and intuitive thinking (Martin, 2009), making use of an abductive logic for value creation (Dorst, 2010, 2011). Design thinking was described as both an organisational resource for innovation (Kimbell, 2011) and a contingent set of routine practices inspired by professional designers (Kimbell, 2012).

The variety of definitions and characteristics attributed to design thinking puts its concept at risk of becoming an "umbrella construct" with a loose meaning that might delay or even collapse design thinking theory development (Micheli et al., 2019). Even though a setpoint must be taken for theory development, we share Johansson-Sköldberg et al.'s (2013) belief that a search for a unique, normative definition of design thinking is counterproductive: design thinking is a context-dependent practice, and hence will inherently assume different meanings to different individuals and organisations. However, we believe that a non-normative, comprehensive construct is needed to advance theory development in the field of design thinking.

Abstract

Design thinking does not have a consensually defined construct in the academic literature. This foundational fragility hinders theory building in the field. This study addresses this gap by providing a construct of design thinking following guidelines for developing theory-building instruments. We propose a non-normative, comprehensive construct composed of a conceptual definition and a subset of properties that portray tangible design thinking expressions. The proposed construct aims to provide a grounded foundation to support the advancement of design thinking theory building and testing.

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However, we believe that a non-normative, comprehensive construct is needed to advance theory development in the field of design thinking.

This work aims to contribute to the theory by providing a comprehensive construct of design thinking, along with other works that have contributed to construct clarity in design thinking (e.g. Auernhammer and Roth, 2021). We highlight that the term design thinking is employed here from a managerial perspective, differing from Johansson-Sköldberg et al.'s (2013) construct of designerly thinking which refers to the study of how professional designers think and work. Our proposed construct provides a setpoint for theory development, as it presents a general definition of design thinking and its characteristics; a valid construct provides scholarship with a generalisable start point and measurable parameters to conduct long required empirical studies in topics such as: how does design thinking drives organisational change (Elsbach and Stigliani, 2018), its effectiveness and applicability (Micheli *et al.*, 2019) and its influence on overall project performance (Magistretti, Ardito, *et al.*, 2021). Our definition is careful not to undermine the inherent ambiguity of design thinking, a risk that was pointed in previous research (Johansson-Sköldberg *et al.*, 2013).

The remainder of this paper is structured as follows: Section 2 presents the theoretical background discussing previous works that have begun a conversation about the design thinking construct. Section 3 details the study design. Section 4 discusses our proposed construct of design thinking and a thorough argument justifying its theoretical validation, as well as its relation to how design thinking is adopted in management professional practice. Finally, Section 5 presents the concluding remarks and recommendations for future works.

2. Theoretical background

From the early 2000s, when design thinking became popular among practitioners, many toolkits (IDEO, 2011, 2015) and practical guides (D.school, 2018) presenting prescriptive phased design thinking processes have been published. In their core, they follow the same overall logic on the pace of phases for problem-solving, even if they use different terms to describe these phases - which consist of need-finding, solution ideation, and solution implementation (Fleury *et al.*, 2016; Johansson-Sköldberg *et al.*, 2013; Micheli *et al.*, 2019; Oliveira *et al.*, 2021; Seidel and Fixson, 2013). We do not believe that design thinking might be reduced to this processual method, but we reckon that the process perspective has a pedagogical character and contributes to popularising the design thinking approach. Our understanding is that design thinking is a context-dependent approach and may be portrayed "*as a process, or as methods, a toolbox, a mental approach, a culture or a mix thereof*" (Carlgren, Rauth, *et al.*, 2016, p. 49).

Aiming to contribute to establishing common definitions on design thinking scholarship, while not overlooking the inherent ambiguity within the concept – we understand design thinking as a summary of dynamic, contextual-dependent attributes rather than static and normative definitions, similarly to previous works in the design thinking literature (Carlgren, Rauth, *et al.*, 2016; Dell'Era *et al.*, 2020; Liedtka, 2020; Micheli *et al.*, 2019).

Carlgren et al. (2016) state that design thinking is composed of both the idea of design thinking and the enactment of this idea. Following an empirical study, the authors propose a framework structure for design thinking based on five main themes - user focus, problem framing, visualisation, experimentation, and diversity -, which in turn are deployed in principles, practices, and techniques. This framework cherishes for concept flexibility and contextually understanding of design thinking "*as a process, or as methods, a toolbox, a mental approach, a culture or a mix thereof*" (Carlgren, Rauth, *et* *al.*, 2016, p. 49). Similarly, Micheli et al. (2019) sweep the literature on design thinking in search of commonalities within the different uses of the term design thinking in academia. After the analysis and codification of 104 papers, the authors came to a validated summary of 11 attributes that represent, on an aggregate level, the different nuances of design thinking. Table 1 presents a summary of attributes and principles that are transversal to design thinking.

Table 1 - Attributes and principles constituting of design thinking; adapted from Carlgren, Rauth, et al. (2016) and Micheli et al. (2019)

Attributes/Themes	**Patterned principles**
Creativity and innovation	Innovation; creativity; idea creation; discovery opportunities
User centeredness and involvement	User/customer involvement; human-centredness; working with extreme users; end-user profiling; empathy; non-judgment; social
Problem-solving	Problem-solving; wicked problem solving; constraints as inspiration; decision-making; challenge the norm; reframing; optimism
Iteration and experimentation	Iteration; experimentation; prototyping; reflexivity; reflective practice; curiosity; playfulness; energetic; learning-oriented
Interdisciplinary collaboration	Collaboration; stakeholder involvement; multidimensional team; conflict negotiation; interactive process; involvement of outsiders; participatory design; persuasion and communication; openness to differences in personality type and background; democratic spirit
Ability to visualise	Aesthetics; ability to visualise; elegance; style; thinking through doing; bias towards action
Gestalt view	Holistic approach; embracing complexity; integral intelligence; synthesis; systemic model; systems thinking
Abductive reasoning	Abductive reasoning; emergent; generative
Tolerance of ambiguity and failure	Acceptance of failure; ambiguity; handle uncertainty; risk-taking; tolerant of mistakes; openness to the unexpected; comfort with complexity and ambiguity
Blending rationality and intuition	Balance between declarative and modal logic; balance between exploration and exploitation; balance between intuitive and analytical thinking; balance between reliability and validity; divergent and convergent thinking; emotional and rational; integrative thinking
Design tools and methods	Ethnographic methods; personas; journey map; brainstorming; mind map; visualisation; prototyping; experiments

Building on this perspective, Dell'Era et al. (2020) define four typologies on how consulting firms provide design thinking to their customers based on a study of 47 Italian firms. Each "kind" of design thinking identified by the authors is embedded in a specific context and addresses a different challenge (Table 2). This study presents an application of how the description of design thinking in terms of attributes or themes is useful for capturing the nuances of how design thinking is observed in practice, deploying the conceptual attributes from an aggregate level to a practice level.

Table 2 - Four kinds of design thinking; adapted from Dell'Era et al. (2020)

Design Thinking Typology	**Creative Problem Solving**	**Sprint Execution**	**Creative Confidence**	**Innovation of Meaning**
Addressed challenge	Inspire insights able to lead the development of creative and original solutions that can meet emerging users' needs	Accelerate the development process and reduce market uncertainty to quickly make and launch new solutions on the market	Promote new innovation mindsets to engage employees with a new set of approaches, practices, and methodologies able to stimulate innovation and change	Create new visions that represent radical reinterpretations of the strategic direction to follow
Contextual factors	Complexity and dynamism of user behaviours; demand for more sophisticated and personalised solutions	Tension towards execution and continuous updating; digital technologies empowering different experimentation strategies	Entrepreneurial opportunities for individuals; value of work-life balance and personal purpose in the job	Easy access to innovative ideas; abundance of alternative options

More recently, a few studies have analysed the adoption and enactment of design thinking from a capability perspective. Jeanne Liedtka (2020) conducted a multi-year cross-case study on several industries analysing how the social technology of design thinking contributes to shaping an innovator's experience. Coming from this understanding, the value of applying design thinking in organisations is untangled not only in the form of new product or service offerings but also as a social technology that enables a firm to continuously build capabilities for ongoing strategical adaptation; hence, the value of design thinking is also underpinned by the fact that it gathers a set of teachable practices that allow the development of dynamic innovation skills (Liedtka, 2020; Magistretti, Ardito, et al., 2021). Jeanne Liedtka (2020, p. 54) elaborates on what is social technology as follows:

> *"Although today we associate the term “technology” with digital or physical ways of accomplishing activities, historically technology had a much broader meaning. Derived from the Greek, meaning “science of craft,” technology referred to the techniques, skills, and processes used to transform knowledge into practical outcomes. Focusing on the social technology lens cues us to innovation as a shared process and ties it to human emotions and the complex ways people intersect and solutions emerge."*

Hence, while there is a stem in the literature that cherishes for establishing clear yet flexible connotations for design thinking, these are yet to be consolidated into a formal construct. The remainder of this work aims to bridge this gap.

3. Study design

We have been engaged in several educational and corporate design thinking projects since the early 2010s and have previously published works in this field, including a recent systematic literature review on the adoption of design thinking in the healthcare sector. When trying to theoretically ground the phenomena we observe in educational and corporate practices, we often perceive a gap in the very foundation of the design thinking construct, which impairs our theory development process. Hence, we began building a construct of design thinking, aiming to set a starting point for design thinking ground theory which is valuable not only for our research but also for the design thinking scholarship.

This study followed Wacker's (2004) recommendation for developing formal conceptual definitions. Amongst the recommendation, the author presents that a construct is composed of a formal definition, which must be general and abstract to enable theory development, and specific properties (and measures) associated with this formal definition to enable theory testing. Based on a literature review of design thinking research, we apply Wacker's (2004) recommendation to establish a construct for design thinking which is composed of a formal definition and a set of associated properties.

The literature review that composes this study was an exploratory yet systematic review, with the aim to present a narrative that derives an exploratory construct. As part of other ongoing research deskwork, the authors conducted a search on Scopus database using the string '"design think*" in title, abstract and keywords, up to September 2021. Since the literature in design thinking has been growing considerably in the past years - for example, the Scopus search for studies with "design think*" in title, abstract, or keywords, up to 2018 yielded 3131 results. Only considering 2019, 2020 and 2021, the same search yielded 2439 documents -, we split our search between papers that were published before and after 2019, and selected the 100 most cited papers within each timeframe for title and abstract review. Our selection criteria included papers that contributed to design thinking theory, or to connecting design thinking with other management theories. Selection process is presented is presented on Figure 1; details are available upon request.

4. Results and discussion

Coming from an explorative search of the literature, we deductively built a design thinking construct based on previous depictions of design thinking in scholarship. Previous works have focused on attributes (Carlgren, Rauth, et al., 2016; Micheli et al., 2019), related capabilities (Liedtka, 2020; Magistretti, Tu, et al., 2021), and even the history of design thinking (Auernhammer and Roth, 2021; Johansson-Sköldberg et al., 2013); here, our intention is to provide a summarised construct of design thinking which will ground theory building and theory testing following Wacker's (2004) recommendation to assure construct validity. In summary, we present the following formal definition of design thinking: "Design thinking is an abductive, human-centred approach for problem-solving". We present the properties derived from this formal definition in Figure 2, and we give a brief explanation about each of the properties in the following paragraphs.

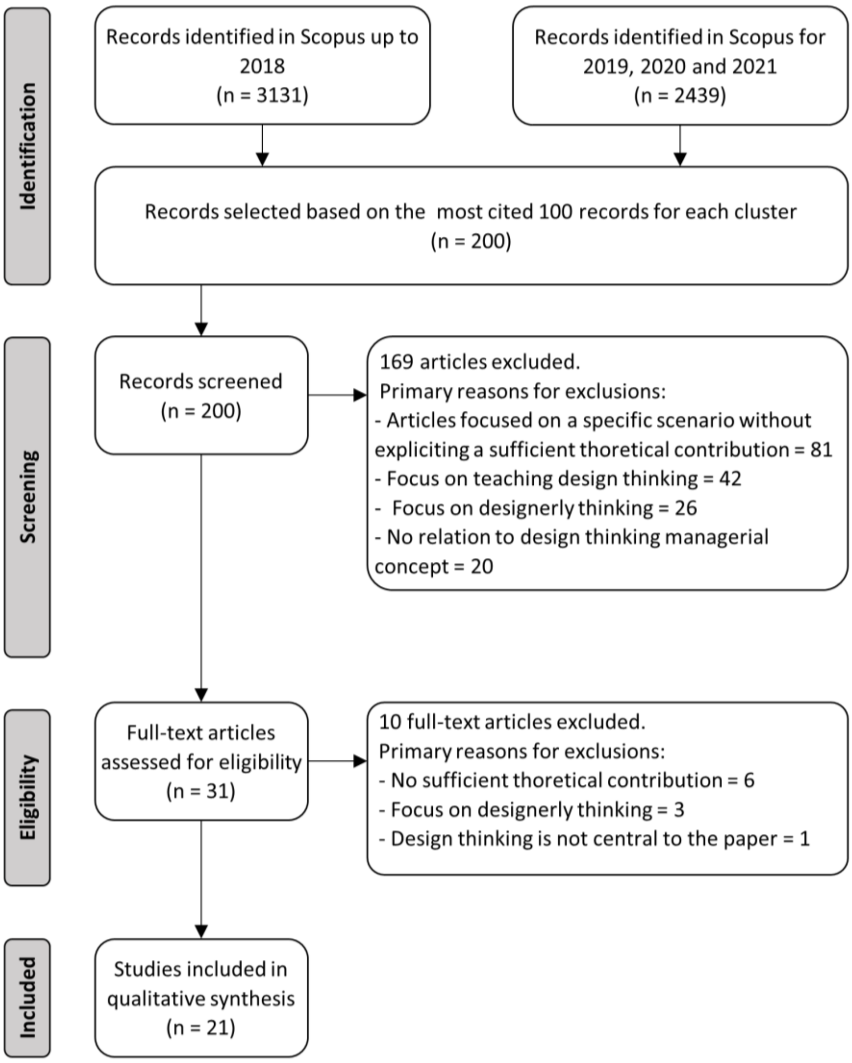

Figure 1 - Systematic review proces

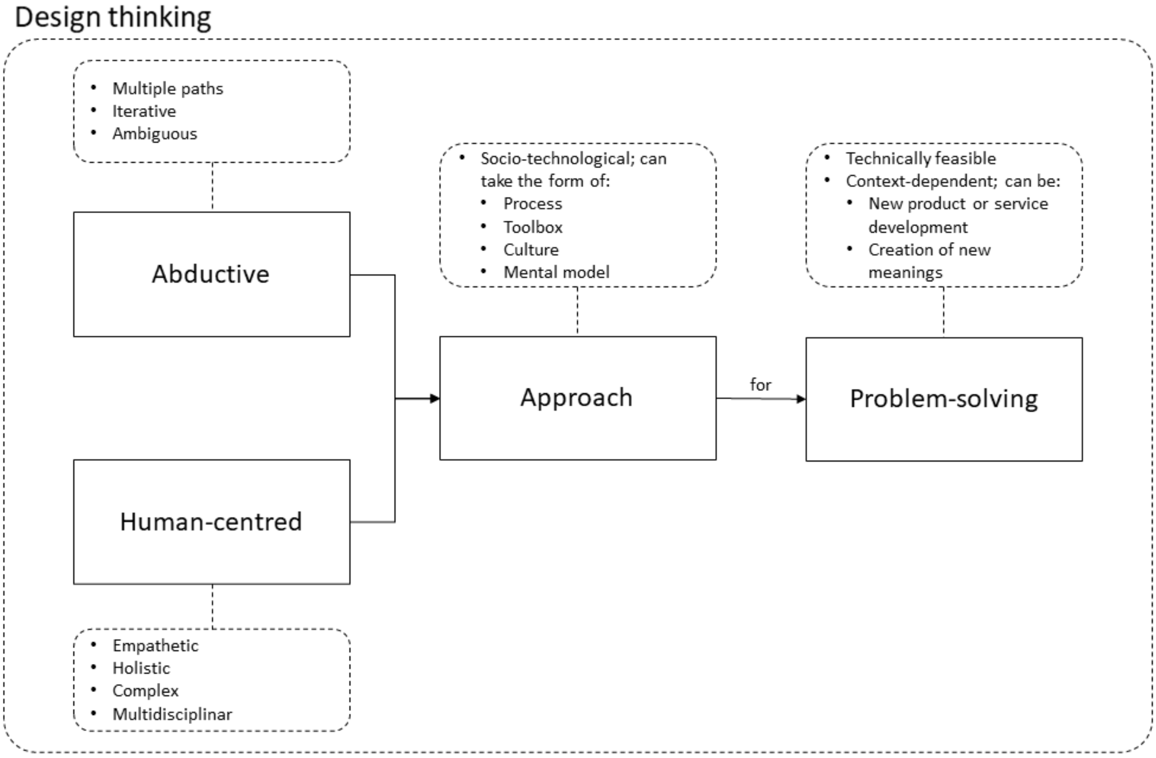

Figure 2 - Design thinking construct

Scholarship has discussed how design thinking's modus operandi is explained in formal logic terms (Dorst, 2011). Design thinking does not stem from deductive or inductive reasoning; instead, it is founded in abductive reasoning. In other words, when applying a design thinking approach, one should not try to deduce expected outcomes on the basis of what is known about the mechanism (at least not at the forefront of design thinking approach); moreover, one should not induce the definition of a possible mechanism that will drive a desirable outcome (again, at least not at the forefront of the design thinking approach). Instead, the individual must face the problem in an abductive view, i.e., focusing on understanding solely what is the desired value expected from solving this problem; once the desired value is defined, the individuals involved in the design thinking approach will adopt a human-centered view and the applicable approach to design thinking to effectively design the mechanisms through which the desired value will be delivered. In other words, design thinking departs from a creative inquiry and flows into a creation of a system (Buchanan, 2019) that delivers value - whether this value is delivered through a new product (e.g. Langell et al., 2019), a service (Uehira and Kay, 2009), a reconfiguration of existing processes (e.g. Eines & Vatne, 2018), or the very creation of a new necessity (or meaning) to the customer base (e.g. Verganti, 2008).

Human-centeredness in design thinking is twofold: first, the very inception of design thinking is rooted in deeply understanding human behaviour and desirability (Auernhammer and Roth, 2021), as the value of design thinking relies on developing solutions for actual user needs. Accordingly, the codification of design thinking as a practice introduced a set of tools and methods (e.g. journey mapping, personas, shadowing) that aim at developing this deep understanding of human behaviour (Micheli *et al.*, 2019). Secondly, it holds a ludic character for individuals involved in the design thinking initiative, which fosters the development of a psychologically safe and stimulating environment for co-creation (Liedtka, 2020; Thompson and Schonthal, 2020). On a more aggregate level, data emerging from design thinking initiatives provide substance for individuals not directly involved in the initiative to review, collaborate, stimulate and discuss how to effectively integrate the insights emerging from the data into strategic planning (Knight *et al.*, 2020).

We present design thinking as an approach due to its multivalence in the structures in which it can be adopted (Carlgren, Rauth, *et al.*, 2016; Johansson-Sköldberg *et al.*, 2013). The label of “design thinking” has been put on structured step-by-step processes, toolboxes (IDEO, 2011, 2015), organisational culture (Kimbell, 2011), a way of working (Lloyd, 2019), and as a mental model that drives individual cognition into more desirable outcomes (Liedtka, 2015). Our understanding is that, due to its socio-technological (Liedtka, 2020) and infrastructuring character (Bjögvinsson *et al.*, 2012), even though design thinking may be consolidated in a set of teachable practices, its enactment might take different shapes depending on its environment.

The target outcome of a firm that adopts design thinking is to solve one or more problems. Design thinking adoption can steer problem-solving either by gathering knowledgeable individuals who can contribute for intentionally addressing a known problem in a targeted workshop with a sequence of preconceived activities, for example, or by empowering individuals to apply a human-centred and abductive lens into emerging problems, and hence enabling them to continuously solve problems with creative confidence (Dell'Era *et al.*, 2020). We highlight the need for continuous problem-solving due to the fact that in truly complex scenarios, it is doubtful that one will ever design "the" optimal solution, since this so-called optimal solution is ingrained in one's assumptions; hence, the process of problem-solving must be a continuous and intentional attempt to bring the entire scenario to a more desirable state, building on previously designed solutions (Dorst, 2019). Organizations need to deliberately reshape their cultures and overcome barriers - as presented by Carlgren, Elmquist, *et al.* (2016) - and evolve design capabilities (Björklund *et al.*, 2020) to assure this continuous movement, at the risk of pursuing an unsustainable pathway that will not deliver design thinking's full potential (Buchanan, 2015). Sustaining the adoption of design thinking beyond the short term is a challenge for organizations (Wrigley *et al.*, 2020); a structured way to overcome this challenge is to use a learning model to guide the design thinking implementation strategy (Beckman, 2020; Beckman and Barry, 2012).

5. Conclusion

This study contributes to the literature on design thinking by providing it with a construct. We intend to provide a theoretical foundation for future studies on design thinking and its approximation with other management theories (e.g. Liedtka, 2020; Magistretti *et al.*, 2021).

As presented by Auernhammer and Roth (2021), enhancing construct clarity in design thinking aid the advancement of understanding the mechanisms by which design drives innovation. Providing a formal construct, we contribute to the body of research in design thinking by providing a baseline foundation for theory building, avoiding tautological, unclear and insufficient definitions. The properties presented in the proposed construct are of special value to long-required empirical studies in the field of design thinking, as pointed by Elsbach and Stigliani (2018) and Micheli *et al.* (2019). The properties that compose the construct portray more tangible expressions of design thinking, which are essential to advance the building of research instruments to assess the adoption of design thinking in certain scenarios and respond to unanswered questions, such as: how does design thinking drives organisational change, what is the effectiveness of design thinking, whether design thinking is more suitable for certain industries, and design thinking's impact on project performance, to mention a few.

Like any other work, this study has its own limitations. The presented scope was limited to developing and discussing the proposed construct. Future studies could provide more structured and exhaustive reviews, as well as apply content analysis techniques - e.g. natural language processing, frame semantic analysis - to systematically advance the proposed design thinking construct in the literature. We also suggest that future studies apply and assess the construct aiming for external validity. Moreover, we urge future studies to further elaborate on each of the properties in the construct as to inform the foundations for future qualitative and quantitative studies; a thorough understanding of these properties will enable the validation of the construct and, moving forward, more assertive and objective assessments of the adoption of design thinking in certain scenarios.

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Appendix B

Paper 2

Design Thinking as an approach for innovation in healthcare: systematic review and research avenues

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Review

Design thinking as an approach for innovation in healthcare: systematic review and research avenues

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ABSTRACT
Design thinking has been increasingly adopted as an approach to support innovation in healthcare. Recent publications report design thinking application to various innovation projects, across medical specialties, including paediatrics, psychiatry, radiology, gastroenterology, oncology, orthopaedics and surgery, as well as to innovation in hospital operations and healthcare management. Current literature in the area typically focuses on single case descriptions. With the recent increase in the number of cases, there is an opportunity to assess multiple cases to identify patterns and avenues for further research. This study provides a systematic review of published design thinking projects in healthcare. The aim of the study is to provide an overview of how design thinking has been applied in the healthcare sector. Data collection was based on Institute of Scientific Information (ISI) Web of Science, PubMed and Scopus databases. The systematic review followed Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines. A total of 32 original pieces of research was selected for analysis, being classified and assessed. The paper presents current status of research and practice from various perspectives, including the design thinking progression phase—inspiration, ideation, implementation—and the prevalence of design thinking tools. Avenues for further research include the need to increase focus on the inspiration phase, the opportunity for platforms for leveraging the integration of individuals in innovation projects, and the opportunity to enhance the role of lead users in healthcare innovation.

Summary box

What is already known?
- Design thinking has been adopted in healthcare innovation projects in several domains, with reports of positive outcomes.

What are the new findings?
- The research details the design thinking processes and tools applied in healthcare based on multiple case reports.
- Design thinking provides a frame for addressing the development of healthcare innovation by balancing contextual factors (eg, users, stakeholders, resources) and clinical evidence.
- Design thinking is an ally for democratising access to healthcare through innovative solutions in low-resource settings.
- Opportunities for further research include: (a) increased focus on the inspiration stage, (b) creation of platforms for leveraging the integration of individuals in health innovation projects, (c) e-health focused user research and (d) lead user involvement.

INTRODUCTION
Healthcare is increasingly applying design knowledge and competence to deal with challenges,[1] as design provides a frame for understanding and developing a subject or business and its related policies, products, resources and services.[2] As a matter of fact, innovation is required to address the changing environments (eg, ageing of the population) and guarantee the financial sustainability of health services;[3] this may be achieved by improving health outcomes at a good value, reducing cost for care or tracking health outcomes.[4] In this scenario, design thinking emerges as an approach for incorporating innovation in medical practice in public and private sectors.[5] Clinical outcomes of healthcare interventions that claim to have employed design thinking have proven to be positive.[6] Design thinking application may potentially benefit the design of new health devices, products and processes, and the implementation of evidence-based practices.[7]

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ABSTRACT

Design thinking has been increasingly adopted as an approach to support innovation in healthcare. Recent publications report design thinking application to various innovation projects, across medical specialties, including pediatrics, psychiatry, radiology, gastroenterology, oncology, orthopedics, and surgery, as well as to innovation in hospital operations and healthcare management. Current literature in the area typically focuses on single case descriptions. With the recent increase in the number of cases, there is an opportunity to assess multiple cases to identify patterns and avenues for further research. This study provides a systematic review of published design thinking projects in healthcare. The aim of the study is to provide an overview of how design thinking has been applied in the healthcare sector. Data collection was based on ISI Web of Science, PubMed, and Scopus databases. The systematic review followed PRISMA guidelines. A total of 32 original pieces of research were selected for analysis, being classified and assessed. The paper presents current status of research and practice from various perspectives, including the design thinking progression phase – inspiration, ideation, implementation -, and the prevalence of design thinking tools. Avenues for further research include the need to increase focus on the ideation phase, the opportunity for platforms for leveraging the integration of individuals in innovation projects, and the opportunity to enhance the role of lead users in healthcare innovation.

Keywords: *design thinking; healthcare; innovation.*

1. INTRODUCTION

Healthcare is increasingly applying design knowledge and competence to deal with challenges,[1] as design provides a frame for understanding and developing a subject or business and its related policies, products, resources, and services.[2] As a matter of fact, innovation is required to address the changing environments (e.g.: ageing of the population) and guarantee the financial sustainability of health services;[3] this may be achieved by improving health outcomes at a good value, reducing cost for care, or tracking health outcomes.[4] In this scenario, design thinking emerges as an approach for incorporating innovation in medical practice in public and private sectors.[5] Clinical outcomes of healthcare interventions that claim to have employed design thinking have proven to be positive.[6] Design thinking application may potentially benefit not only the design of new health devices, products, and processes, but also the implementation of evidence-based practices.[7]

Brown[8] popularized the term design thinking and promoted a significant increase in its published research literature. Despite the increase in research, there is still a lack of standardization regarding the definition and understanding of what is design thinking.[9–11] In convergence with trends in the literature, we define design thinking as a human-centered approach for solving complex problems employing attributes such as creativity, user involvement, multidisciplinary teamwork, iteration, prototyping and user centeredness.[9–11] Many toolkits[12,13] and practical guides[14] presenting design thinking processes have been published; despite of using different terms to refer to the design thinking phases, they follow the same overall logic for problem-solving.[9–11,15,16] Practically, design thinking may be portrayed in three iterative phases: inspiration, ideation, and implementation.

Inspiration is the first phase and it is based on need-finding: understanding the core issue of the problem by empathizing with the user and discovering their explicit and non-explicit needs. Users and stakeholders identification is critical for innovation success;[17,18] in healthcare, this task has an increased complexity due to the various paying systems structures.[4] Ethnographic research techniques, such as observation and interviewing, are recommended at the inspiration phase.[16] After the need is defined, data analysis and solution conceptualization start at the second phase, ideation; many strategies may be used to foster concept generation and free-of-judgement creativity at this second phase.[10] Studies acknowledge the positive effects of a visually stimulating environment on problem-solving;[19] low-fidelity prototyping is used as a source of ideas and a tool for concept validation;[15] sensemaking tools, like mind-mapping, are used to support brainstorming.[16] The aims of the third and final phase, implementation, are to refine and build the concept validated during the second phase and draw a marketing strategy for the final product. Prototyping is again required at this phase, but with higher fidelity as testing will also be required.[16]

Design thinking poses an interesting strategy for empowering professionals from diverse backgrounds into proposing innovation when tackling complex problems.[15] Employing design thinking in healthcare management, innovation, and practice is justifiable as healthcare-related problems typically fit in some or all of the following typical characteristics of complex problems: a) healthcare's inherent nature of managing life and quality of life, b) intervention in the human body, which is a complex system itself, c) complex costing and paying systems involving healthcare providers, insurances, private and public hospitals, d) strict regulatory agencies supervising health-related professions, protocols, techniques and devices.

Previous works have analyzed the impacts of solutions developed using a design thinking approach on health outcomes both in broad[1] and deep[6] accounts. However, rigorous evaluations on how design thinking is operationalized in the health sector from a process perspective remain an opportunity for further integrating design knowledge into health research.[1] This article aims to appraise not only the final results of solutions developed using design thinking in healthcare but also the course of actions and tools that took place throughout development. As the enactment of the design thinking approach is context-dependent,[10,21] the format of a systematic literature search and review are aligned with the aim of this research;[22,23] an exhaustive search allows for both an aggregate appreciation of the literature, and capturing several configurations in which design thinking is adopted.

We contribute to the literature by consolidating previous reports on how design thinking has been applied in the healthcare sector and drawing conclusions from these reports. This article is also directed to practitioners as it presents tools used when applying design thinking. We will analyze articles reporting solutions ranging from the early stages of their development to solutions that are available to the market. By reviewing articles that report developing solutions, we aim to capture perspectives on every phase in the development process and avoid publication bias. We will review and tabulate aspects of each study, such as the nature of the innovation intervention, which design thinking tools were employed, team multidisciplinarity and stakeholder involvement. Finally, we will discuss the contents of the studies analyzed and possible avenues for research. We aim to provide an overview of the best practices on design thinking in healthcare.

2. METHOD

Data collection began with a search in ISI Web of Science, PubMed and Scopus databases without start date constraint (i.e. from their inception) until October 2019; the earliest publication record found dated from February 2003. The three databases were chosen to provide a comprehensive search on journals focused on the disciplines of interest of this paper (e.g.: design, business, engineering, health sciences). The search strings used were "“design think*” or "user-cent* design" or "user cent* design" or "human-cent* design" or "human cent* design"” + “innovation” + "“health*” or “medical”” included on title, abstract or keywords. In spite of subtle differences among the terms user-centered design, human-centered design, and design thinking,[1] there is a conceptual overlap between these terms. In accordance with previous works, we will use them as synonyms.[1,6]

The systematic review followed PRISMA guidelines (see supplementary file exhibit A1).[24] Only primary peer-reviewed studies were eligible for the study. Search was restricted to papers published in English. A total of 224 articles and reviews were identified in database search, of which 150 came to be non-duplicate documents. Scopus yielded 89 unique results to our search, the WoS database yielded 32 non-duplicate results when compared to Scopus results, and the PubMed database yielded 29 non-duplicate results when compared to Scopus and WoS results.

An initial selection process was conducted aiming to filter documents that were not aligned with the research scope through title and abstract analysis, followed by a full text review of the selected articles. Our research targets articles describing experiences, perceptions, and assessment on the development of innovative health-related solutions, specifically on medical devices, products and processes following a design thinking approach. In this review, medical devices refer to hardware solutions, medical products refer to innovative treatments or service offerings solutions (e.g: mHealth solutions), and processes refer to untangible routines, whether these routines are visible to the patients or not.[20,25] Articles unrelated were discarded. Most articles discarded in title abstract review regarded pharmaceutical solutions and health aids to be used by the patients without an interface to a health professional. In full text review, the articles discarded included theoretical reports without an associated solution development, literature reviews, event descriptions, and articles used the development process as a tool to advance a other discussion that were not the solution development itself (e.g.: design theory, design teaching, testing routines).

After title and abstract review, 65 articles were selected for full-text review. This sample was submitted to bibliometric analysis to identify the main references in their cocitation network, which resulted in the addition of eight references. Finally, following a full-text review, 32 references were selected for analysis. Selection process is made available (supplementary file exhibit A2).

3. LITERATURE REVIEW RESULTS

The final 32 studies were reviewed and summarized (supplementary file exhibits A3 and A4). As design thinking has no unique coded language,[9] some of the objects of interest in this review were coded for analysis and comparison purposes (supplementary file exhibit A5 presents our codes and their correspondance with each of the papers in our sample). A few codes (e.g. prototyping) are present in more than one design thinking phase; when evaluating the papers, we took into consideration reports given by the authors to assess the maturity of the activities and whether these activities would fall into one phase or another (e.g.: cardboard prototypes were considered an ideation phase activity, while functional prototypes were considered implementation phase activities).

Solution status was classified according to what is reported in their studies; due to design thinking's iterative nature, it is possible that one intervention has performed an "implementation" phase activity, but its status is still at the ideation stage. At the time of publishing, five of the solutions were at the inspiration stage of design thinking and had finalized their need assessments,[26–29] or had study protocols established.[30] 18 of the 32 solutions were at the ideation stage, having either a visual prototype,[31] a design concept,[32–35] or a functional prototype[36–48] finalized. Regarding the implementation stage, out of eight solutions, one had a final product developed but not implemented,[3] six were fully implemented,[49–54] and one had been implemented and failed.[55] One solution was discontinued due to resource limitations.[56]

Regarding medical specialty, of the 32 studies, ten discussed initiatives to manage chronic disease,[3,32,35,37,38,40,41,46,50,55] four brought solutions for hospital management,[26,34,47,49] four on pediatrics,[43,44,51,53] three on psychiatry,[30,31,48] two on radiology,[27,39] two on geriatrics,[29,43] and single articles pulverized in multiple areas, such as addiction,[36] family health,[28] gastroenterology,[52] general practice,[42] oncology,[54] orthopedics,[33] and surgery.[45]

A noteworthy theme across our sample is the creation and use of cloud-based multi-purpose digital platforms (e.g.:[35,38,41,43,46]). This type of intervention aims to provide an actionable use of information by patients, health professionals, and providers while optimizing resource allocation (e.g.: one of the papers presents two solutions for medication management targetting at two different populations using a shared architecture for personal health record system).[43]

Four of the papers in our sample provide solutions that aim to address more than one target condition;[28,31,50,51] these works elicited from both user and desk research that these conditions were intertwined and could benefit from being treated as a whole rather than as separate parts. For example, one of the solutions developed a clinical decision support for addressing tuberculosis prevention and treatment considering the high prevalence of HIV infection amongst the local population.[50]

Another recurring theme is the systematization of stakeholder involvement across various specialties and target conditions, such as orthopedics,[33] surgical rounds,[26] and pharmacy management.[34] One of the papers even reported an increase in its engagement metrics after the refinement of the intervention based on stakeholder feedback.[48]

The vast majority of the papers in our sample report interventions in the forms of software tools. Only six of the papers report the development of medical devices; we assume this happens due to resource constraints and a longer time to market of medical devices when compared to other types of interventions (e.g.: one of the papers reported a 48-month project duration).[39] Isolated papers report the creation of events (e.g.: creation of a seasonal community market to generate income aiming to address social determinants of health inequities),[53], timetables (e.g.: collaborative creation of a timetable balancing employees preferences and nursing home needs),[49] toolkits and decision support systems. The following sections present the main elucidations resulting from the systematic review.

3.1. Tools employed

Each phase of the design thinking approach and their objectives is presented in Figure ; for each phase, we listed the five most reported tools in our sample and their prevalence rate.

As for the tools employed in the inspiration stage by the authors in our sample, they emphasize the bystander roles of the researchers or individuals when first starting a new project applying design thinking. At this stage, the designer – or any professional acting as a designer – must put aside his/her convictions about the problem addressed. Only then he/she is ready to effectively absorb relevant information regarding the context in which the solution is going to be developed. It is fundamental to consider this context as broadly as possible (considering time and resource limitations) to visualize the actors impacted, possible side-problems that could interfere, previous documentation to improve the understanding of the situation, and any other relevant information.

Interview is the most employed tool in the inspiration stage. We assume this happens because an introductory interview is easy to perform, easy to gain access to, may have multiple formats (e.g.: by telephone,[33] semi-structured,[27,28,30,34,39,40] unstructured[26]) and are greatly clarifying. Observations (e.g.:[26,29,53]) and reviews of various sorts (e.g.: clinical practice review,[28,32,54] literature review[30,51]) are also clarifying and, after the initial contact is made, require little effort from the user involved in the research. Focus groups (e.g.:[31,36,56]) and user empathy tools (e.g.: clinical immersion,[54] experience maps[31]) could bring substantial information to the project but have the downside of requiring significant time and effort from both the research team and possible users or stakeholders of the intervention. Tools that do not rely solely on spoken accounts of the users or stakeholders, such as observations, do have the advantage of allowing the research team to uncover opportunities for innovation that the user or stakeholder do not perceive as valuable or achievable; we refer to these opportunities as the user's unspoken needs.

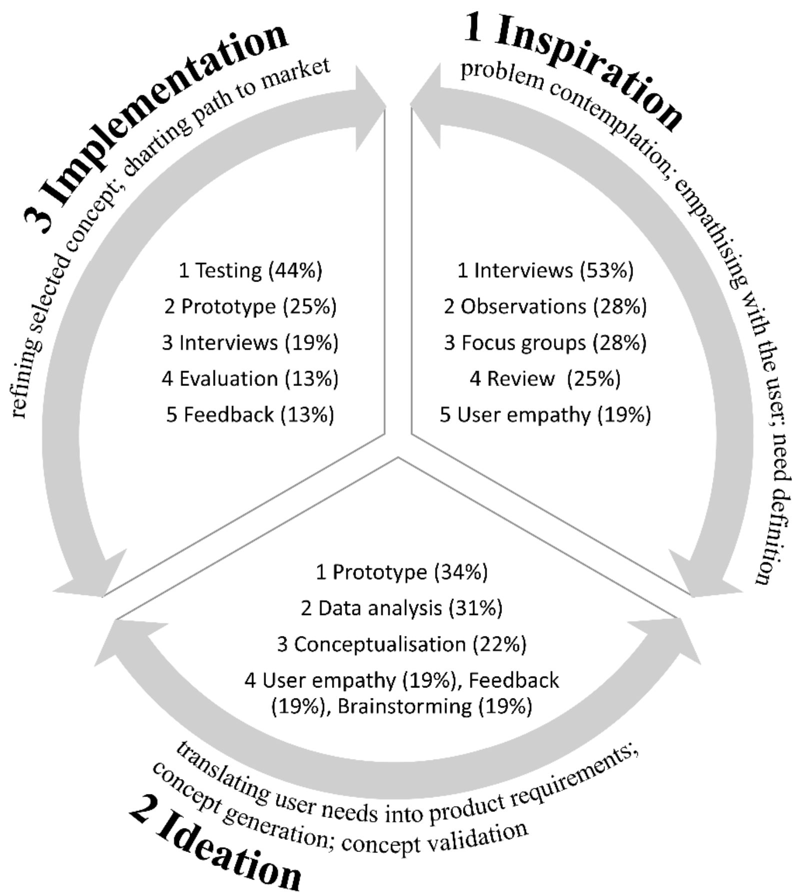

Figure 1 - Three phases of the design thinking approach, objectives for each phase and main tools employed

The ideation phase gathers data collected at the immersion phase and make sense of it by creating inputs and specifications for the solution. In other words, the users' spoken and unspoken needs will be translated into the solution's technical requirements. However, this "translation" and data analysis is not always obvious (e.g.:[34,39,50]). To initialize the design of a solution, conceptualization (e.g.:[40,43,45]) and correlated tools such as brainstorming (e.g.:[27,33,49]) are strongly recommended to keep the ideas as broad and fluid as possible. Other user empathy tools (e.g.: personas,[29,36,45] experience maps[33,47]) may be used to support this stage. After this initial wave of ideas, the most promising ones are selected for prototyping (e.g.:[36,37,40,48]), which is used as a tool for concept visualization. Design thinking postulates that prototyping helps the design team to perceive the strengths and weaknesses of their solution early in the design process and even get feedback[3,34,37,40,42,43] from the users. Anchoring the conceptualization activities in low fidelity prototypes promotes a quick escalation in the attributes of the concept and smart allocation of resources in ideas that are worth pursuing.

The implementation phase, which aims to refine the ideated concept into a viable solution, was the least reported among our sample, as a significant portion of the articles did not report reaching this phase. some of those who had reached it focused their reports on assessing the intervention and not describing their development process,[51–53] and a couple of articles reported that they would not disclose these issues due to commercial confidentiality.[27,39] Among the references that did report tools employed in the implementation stage, testing was the most mentioned tool (e.g.: user testing,[37,42,44] requirements testing[34,45]), followed by prototyping,[31,34,36,38,40,45,47,53] interviews,[33,36,42,50,54,55] solution evaluation,[36,44,46,50] and solution feedback.[3,34,38,44] It caught our attention that commercial analysis was reported by only three articles in our sample.[33,53,54] If the solution is meant to be commercially viable, this aspect must be addressed in a diligent manner.

3.2. Disciplines and Stakeholders involved

Although combining different competences and backgrounds is a best practice for design thinking,[8] more than half of the articles in our sample did not report multidisciplinarity in their design thinking teams. This is problematic as diverse teams are more likely to promote relevant innovative solutions.[10] Amongst the literature that mentioned disciplines and areas involved in their teams, the most cited were health-related disciplines,[3,27,30,32,37,38,49,50,54] design,[30,33,38,49,53,54] IT,[38,50,55,56], R&D,[32,33,37,50] and engineering.[27,32,54]

Besides congregating multiple areas of knowledge, it is necessary to gather different perspectives. Managing stakeholders in the healthcare sector is not trivial as healthcare users vary in their roles as device operators, patients, or decision-makers.[29] Understanding who the stakeholders are and their roles is a key factor for achieving relevant results and requires an understanding of the business model around the product.[29,33] A solution development focused on technical issues and neglecting stakeholders' perspectives is susceptible to barriers in implementation.[39,55] Stakeholder participation assessment tools[57] and frameworks for listening the voices of the customer, business and technology[33] are strategies to promote stakeholder effective involvement.

3.3. Regulation

Developing medical devices and products must follow regulatory requirements. In the United States, the Food and Drug Administration (FDA) is the main body of regulation for medical devices.[58]

Even though regulatory issues are inherently critical to the implementation of medical devices and products, only 12% of the articles in our sample mention the FDA or another regulator,[27,33,54,56] with only one of them stating the class their devices were fitted in.[33] Our attempt to stratify the findings in our sample according to regulation status or classification was not successful, as we found that a number of our references did not address regulatory issues. This might indicate a research lack of maturity – or even awareness – in this topic. Design thinking brings the possibility of everyone being a part of the design process to the table, but one individual must own the process and be accountable for design feasibility and regulatory issues. Additionally, two articles did not go into detail on their developments claiming commercial confidentiality.[27,39]

4. DISCUSSION AND AVENUES FOR RESEARCH

4.1. Drawing attention to the inspiration stage

Regarding the reportings on the tools employed in the inspiration phase, it was noted that solutions that were in more advanced stages of development – ranging from having a functional prototype to being fully implemented and commercialized – often failed to report the tools employed in the inspiration stage (19% of the sample) or lacked detail about this stage. We believe that this bias is due to the fact that researchers often prioritize describing the intervention developed to the detriment of reporting the development process.

We perceive this "setting aside" of the initial development stage as counterproductive for the replication of design thinking: the engagement and understanding of the final user which is acquired from the ideation stage are essential for developing appropriate solutions, at the risk of developing solutions that relieve the symptoms of a problem without addressing its root causes.[59] In fact, it is more crucial for the intervention direction that users and stakeholders are involved in early stages when compared to late stages of the innovation process.[18,60] If the body of literature on design thinking does not consider this stage's relevance, there is a tendency that individuals learning from this body of literature will have the same perception. This may incur professionals involved in projects employing the design thinking approach neglecting information collected in the ideation stage, and realizing that their solutions do not fulfill the user needs.[39,55] Although exhibits from the literature present a systematization of how to incorporate the results of the inspiration phase and user-centered research throughout the development process (e.g.:[27,29]), due to the variety of stakeholders, users, and types of problems in healthcare, further studies seeking to formalize the incorporation of immersion phase data throughout development would be beneficial to the theory and practice of health research involving design.

4.2. Research groups, networks and common platforms for healthcare innovation

One thing that caught our attention was the establishment of research groups and software platforms for improving synergy in the development of healthcare solutions. UK based Multidisciplinary Assessment of Technology Centre for Healthcare (MATCH) – a publicly funded research group with close collaboration with medical device industries –, presents substantial results on research regarding the role of the user in medical device development.[61] Project HealthDesign was a sponsored multi-year, multi-site project that gathered design teams across the United States to develop e-health applications using a common back-end platform.[35,41,43] Tidepool is an open-access platform designed to host and integrate applications related to diabetes management, counting with open-source development to augment and sustain the platform.[38]

How to make these fruitful connections happen? Norman et al.[62] propose the CoNEKTR model for integrating individuals from distinct backgrounds by their common interest in promoting innovation in healthcare; we could not find evidence of CoNEKTR's applicability and performance outcomes. A proven effective model for leveraging the integration of individuals around healthcare innovation will certainly be a major contribution to this research field.

4.3. The future of e-health

Approximately 56% of the articles in our sample reported a healthcare solution using e-health, with the major amount of those discussing mobile health (m-health). Regarding technology usage, a part of the papers in our sample reported the development of auxiliary technologies for telemedicine,[52,56] and data gathering technologies, such as personal health records,[29,35,41,43,55], patient self-monitoring,[3,40,46] and patient motivation trackers.[32,48]

Developing functional and usable e-health applications is not trivial, as there is a need to create an in depth understanding of the user's needs, desires, limitations, preferences, attitudes, and behaviors through a user model that will serve as a common point for the different individuals involved in the development process.[29] However, capturing these psychological and psycho-social nuances is not possible with the "traditional" application of user-centered methods like user-profiles and personas, as they tend to rely on demographic data and shallow caricatures of user groups.[29] Not employing the rigor, time, and collective sense of the importance of user research may doom user research to become an unactionable or overlooked work (e.g.:[39,55])

In-depth user research is necessary to address underlying users' cognitive and behavioral patterns, user subgroups, and characteristics unique to different conditions (e.g.: knowledge about the disease, support network, co-morbidities); capturing the amount of data necessary to build actionable user-profiles and personas is resource consuming, but its benefits outweigh its costs.[29] Design thinking may provide a framework for aligning healthcare system needs, user needs, and software requirements towards healthcare innovation.[34] There are numerous conceptual layers from which the development of successful e-health solutions can be studied: system integration, wearables, user heuristics, and interface design are just a few of them.

4.4. User involvement

Von Hippel[63] introduced the concept of lead users as composed of two main characteristics: the first is that lead users face needs that will be general in the market place prior to the bulk of that marketplace; the second is that they could benefit by obtaining a solution to their need and thus are highly motivated to seek one. These users take an active role in the development process, beyond the passive role implied by expert-driven user-centered practices, such as interviews, personas and journey mapping. There is evidence of the potential benefits of involving lead users in the co-creation and development of solutions in healthcare.[18] Involving these users could potentially increase development rates and expertise in pioneer technologies and boost commercial performance. Consequently, it could increase manufacturers' profits by reducing time to market and development costs.[18] Even though there are generic suggestions in the literature of how to retain these lead users,[64] further research on identifying and contacting lead users in the healthcare sector may benefit future development projects.

Another discussion regarding user involvement in the healthcare industry is motivated by understanding who is the user of interest. While there are more obvious contexts where we can identify the main user (e.g. a mobile app for patient self-monitoring[3,29,30,46]), in other cases, such as a medical imaging device,[27,39] it is not clear if the main user is the patient or the healthcare professional and it is not trivial to counterbalance their needs. On top of this, there is a third stakeholder – the payer – which could be either a provider or a healthcare organization. Further discussion on whether and how design thinking is a suitable approach to manage these user layers would be a contribution to the literature.

5. CONCLUSION

Design thinking is a flexible approach for innovation which is being used to develop healthcare solutions. Considering healthcare, our research shows evidence that design thinking is an approach to innovation in clinical and managerial settings, across a wide range of medical specialties. Our research findings endorse that design thinking provides a frame for addressing the development of innovation in healthcare by balancing contextual factors (e.g.: users, stakeholders, resources) and clinical evidence. Additionally, our sample shows that design thinking is an ally for democratizing access to healthcare through innovative solutions in low-resource settings. Design thinking provides an arsenal of tools for problem-solving across the phases of inspiration, ideation, and implementation.

With this review, we aimed to present a selection of practical applications of design thinking in healthcare, highlighting the most common practices among them. We present this selection of practice and tools as a guide, rather than as a toolset. The selection of 32 papers shows that design thinking is not a one size fits all approach and that it may be adapted to different circumstances. To further advance this field, future research should follow more rigorous procedures for reporting health research involving design; this could be achieved by following structured guidelines.[65] Additionally, future research on emerging technologies in service of health should address user-centered design, providing replicable procedures on how to identify and address user needs. Finally, once a more consistent body of literature is consolidated, with standardized report procedures, a research agenda for quantitatively assessing the relationship between design choices and clinical outcomes may provide more assertive recommendations for the incorporation of design knowledge into health innovation.

5.1. Strengths and Limitations

Despite our efforts to establish clear selection criteria, sample selection and subsequent codification were subjected to the authors' bias. The lack of standards in reporting health research involving design, and the variability of studies in our sample both in their objects of study and development stages refrained this review from assessing criteria such as design success rate, design success critical paths, optimal team composition for design success and types of intervention (e.g.: devices, products, processes) for which design thinking may be more suitable. This may be interpreted as a clash between design and health sciences underlying research traditions and epistemologies. To address this issue and enable further analysis in future literature reviews, we recommend future works that report interventions on the intersection of design and health to consider following systematic guidelines.[65]

CONTRIBUTORSHIP STATEMENT

AF and MO planned the study. MO conducted the data gathering and literature review analysis. AF and EZ guided the research method and revised the manuscript.

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COMPETING INTERESTS

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Appendix C

Paper 3

Design and Early Evaluation of a Device to Improve the Sharp Count Process in Operating Rooms

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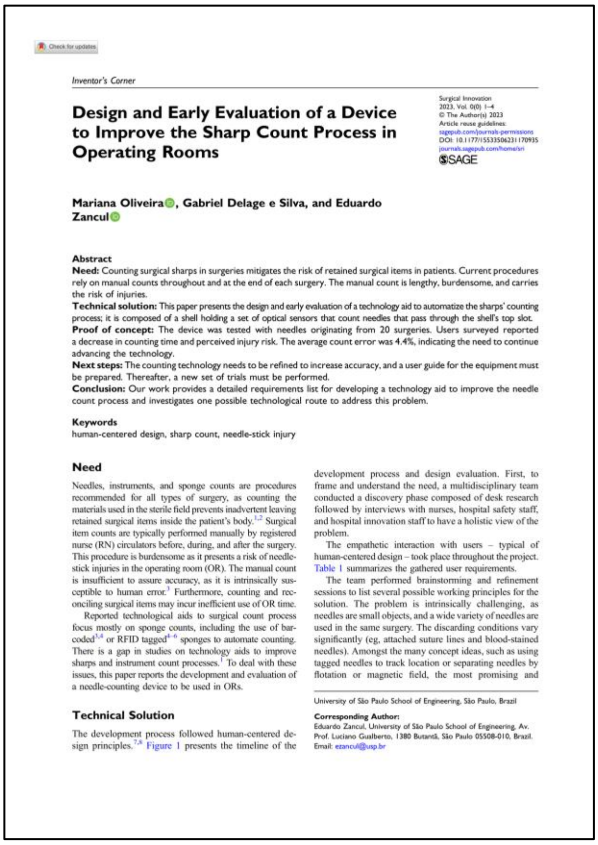

Design and Early Evaluation of a Device to Improve the Sharp Count Process in Operating Rooms

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SAGE

Mariana Oliveira, Gabriel Delage e Silva, and Eduardo Zancul

Abstract

Need: Counting surgical sharps in surgeries mitigates the risk of retained surgical items in patients. Current procedures rely on manual counts throughout and at the end of each surgery. The manual count is lengthy, burdensome, and carries the risk of injuries.

Technical solution: This paper presents the design and early evaluation of a technology aid to automatize the sharps' counting process; it is composed of a shell holding a set of optical sensors that count needles that pass through the shell's top slot.

Proof of concept: The device was tested with needles originating from 20 surgeries. Users surveyed reported a decrease in counting time and perceived injury risk. The average count error was 4.4%, indicating the need to continue advancing the technology.

Next steps: The counting technology needs to be refined to increase accuracy, and a user guide for the equipment must be prepared. Thereafter, a new set of trials must be performed.

Conclusion: Our work provides a detailed requirements list for developing a technology aid to improve the needle count process and investigates one possible technological route to address this problem.

Keywords

human-centered design, sharp count, needle-stick injury

Need

Needles, instruments, and sponge counts are procedures recommended for all types of surgery, as counting the materials used in the sterile field prevents inadvertent leaving retained surgical items inside the patient's body.[1,2] Surgical item counts are typically performed manually by registered nurse (RN) circulators before, during, and after the surgery. This procedure is burdensome as it presents a risk of needle-stick injuries in the operating room (OR). The manual count is insufficient to assure accuracy, as it is intrinsically susceptible to human error.[3] Furthermore, counting and reconciling surgical items may incur inefficient use of OR time.

Reported technological aids to surgical count process focus mostly on sponge counts, including the use of bar-coded[3,4] or RFID tagged[4–6] sponges to automate counting. There is a gap in studies on technology aids to improve sharps and instrument count processes.[1] To deal with these issues, this paper reports the development and evaluation of a needle-counting device to be used in ORs.

Technical Solution

The development process followed human-centered design principles.[7,8] Figure 1 presents the timeline of the development process and design evaluation. First, to frame and understand the need, a multidisciplinary team conducted a discovery phase composed of desk research followed by interviews with nurses, hospital safety staff, and hospital innovation staff to have a holistic view of the problem.

The empathetic interaction with users – typical of human-centered design – took place throughout the project. Table 1 summarizes the gathered user requirements.

The team performed brainstorming and refinement sessions to list several possible working principles for the solution. The problem is intrinsically challenging, as needles are small objects, and a wide variety of needles are used in the same surgery. The discarding conditions vary significantly (eg, attached suture lines and blood-stained needles). Amongst the many concept ideas, such as using tagged needles to track location or separating needles by flotation or magnetic field, the most promising and

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Abstract:

Need: *Counting surgical sharps is a mandatory process for each surgery as it mitigates the risk of retained surgical items in patients. Current standardized count procedures rely on performing manual counts throughout and at the end of each surgery. The manual count is lengthy, burdensome, and carries the risk of injuries to the counter.*

Technical solution: *This paper presents the design and early evaluation of a technology aid to automatize the sharp counting process; it is composed of a shell holding a set of optical sensors that count every needle that passes through the shell's top slot.*

Proof of concept: *The device was tested in 20 surgeries. Users surveyed reported a decrease in counting time, easiness in performing the count process, and perceived injury risk. The average count error was 4,4%, indicating the need to improve the technology.*

Next steps: *The counting technology needs to be revisited and improve to reduce count error, as well as standardized procedures for the users must be prepared. Once these activities are finished, a new set of trials must be performed.*

Conclusion: *Our work provides a detailed list of requirements needed to develop a technology aid to improve the needle count process and invests one possible technological route to address this process.*

Keywords: *human-centered design; surgical innovation; sharp count; needle-stick injury*

1. Need

Needles, instruments, and sponge counts are procedures recommended for all types of surgery, as counting the materials used in the sterile field is a resource in preventing inadvertent leaving retained surgical items (RSI) inside the patient's body[1,2]. Surgical items counts are typically performed manually by registered nurse circulators before, during, and after the surgery. At the end of the surgery, the count of opened needles and sponge packages has to match the number of discarded items. This procedure, especially when counting sharps and needles, is burdensome for the perioperative personnel as it presents a risk of needle-stick injuries in the operating room (OR). Furthermore, counting and reconciling surgical items may incur inefficient use of OR time, somatizing extra costs per surgery. Aditionally, the manual count alone is not enough to assure accuracy in counting, as this process is intrinsically susceptible to human error[3].

Reported technological aids to surgical count process focus mostly on sponge counts, including the use of bar-coded[3,4] or RFID tagged[4–6] sponges to automate counting; there is a gap in studies on technology aids to improve sharps and instrument count processes[1].

Technology aids empower OR personnel to be more confident in identifying count discrepancies in the OR[4]. To deal with these issues, this paper reports the development and evaluation of a needle-counting device to be used in ORs.

2. Technical solution

The development process followed human-centered design principles[7,8]. Figure 1 presents the timeline of the development process and design evaluation.

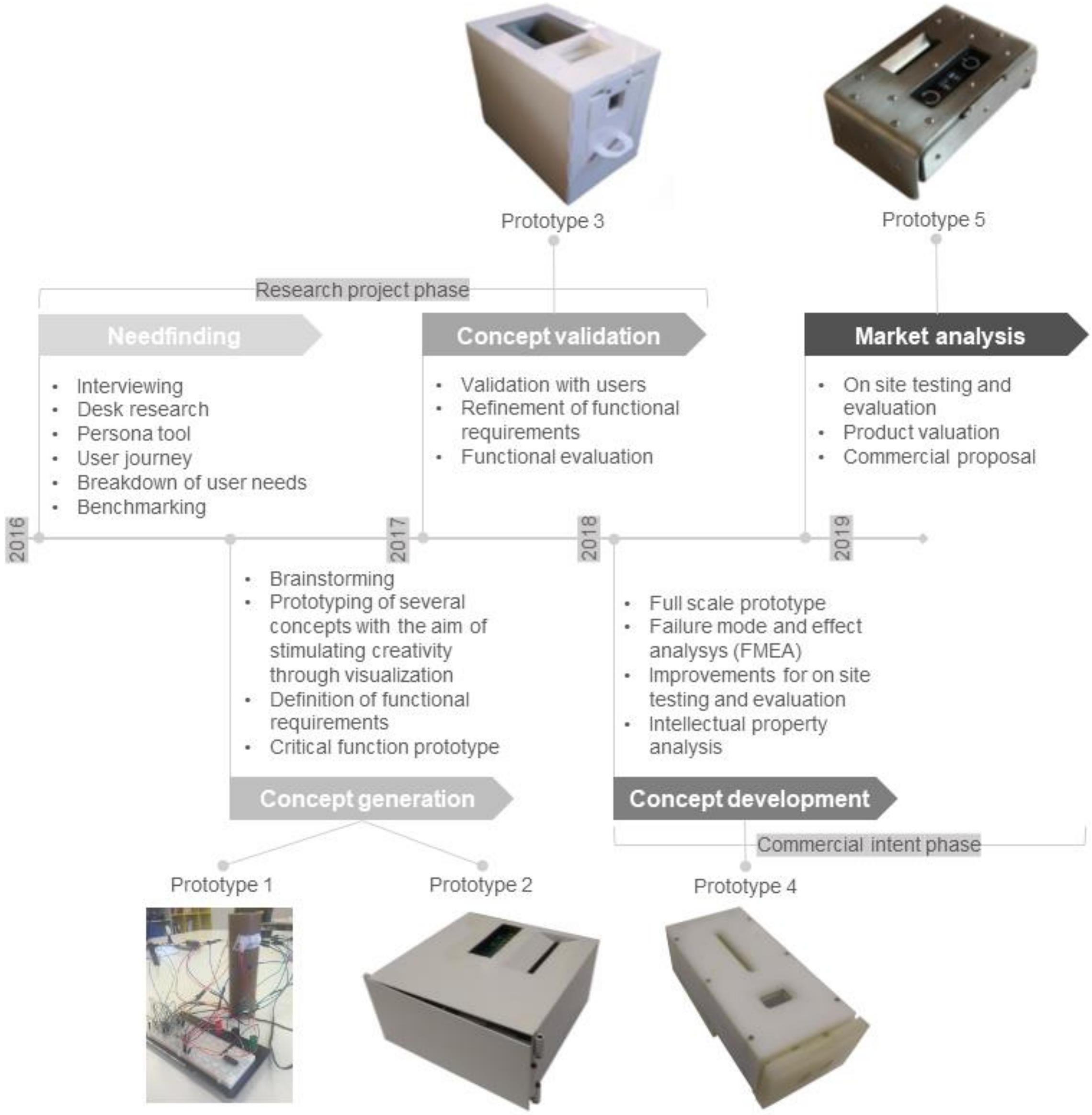

Figure 1 - Project overview; flags display project phases and bullets describe activities performed in each phase.

First, to frame and understand the need, a multidisciplinary team conducted a discovery phase composed of desk research followed by interviews with nurses, hospital safety staff, and hospital innovation staff to have a holistic view of the problem. This empathetic interaction with users involved in the process is typical of human-centered design and took place throughout the entire project.

The team performed brainstorming and refinement sessions to list several possible working principles and functional requirements for the product. Amongst the many concept ideas, such as using tagged needles to track location or separating needles by flotation or magnetic field, the most promising and selected concept was an automatic device with sensors to detect and count the discarded needles throughout the surgery. Table 2 summarizes the user requirements' list.

Table 1 - User requirements

Requirement	Description
Protect healthcare workers from sharp injuries	Needle disposal system must refrain healthcare workers from dangerously handling sharps; once disposed of, sharps must be kept in a sharp-safe container
Accurately identify sharps in diverse sizes and shapes	Identify different types of needles used in ORs with a high level of accuracy
Allow needle count audit	Allow recovery of disposed sharps for audit and recount if necessary
Maintain or reduce OR time	The new count process must not take longer than the currently standardized manual process
Be sterilizable	Auxiliary equipment to the counting process must resist standard OR sterilization protocols
Be wireless	Auxiliary equipment to the counting process must be standalone in power and connectivity
Endure at least one surgery uninterruptedly	Auxiliary equipment to the counting process must endure a surgical procedure without maintenance of any kind

Five prototypes (Figure 1) were developed following iterative cycles of building the prototype, presenting it to the stakeholders, collecting impressions and feedback from the users, performance checking, and implementing learned lessons to the new prototype.

The final concept is a modular product composed of a stainless steel housing (Figure 2A) with a top slot in which needles are deposited after they are discarded. The needles fall into a removable standard magnet box (Figure 2B), which allows the perioperative team to recount the needles manually, if necessary. The housing (Figure 2C), which is the part that will be in contact with the surgical setup table, can be detached from the internal inserts for sterilization. The electronic subsystem internal module (Figure 2D) holds a set of optical sensors that detect the passage of dropped needles. These sensors are connected to an electronic circuit to stabilize the signal, filter noise, and convert the captured signal into the count of one needle. The electronic filters are designed to avoid double counting of needles attached to suture lines and miscounts due to vibrations if the device is accidentally touched or moved. A microcontroller connected to the electronic circuit stores the numerical count and, through an OLED display, shows the count to the user as the materials are deposited. The display also shows the operating time until the rechargeable battery runs out. Finally, the device has two touch buttons: one on-off button and one button to restart the count. Even when the device is turned off, if the count is not reset by pressing the reset button, the count is stored until the battery is discharged.

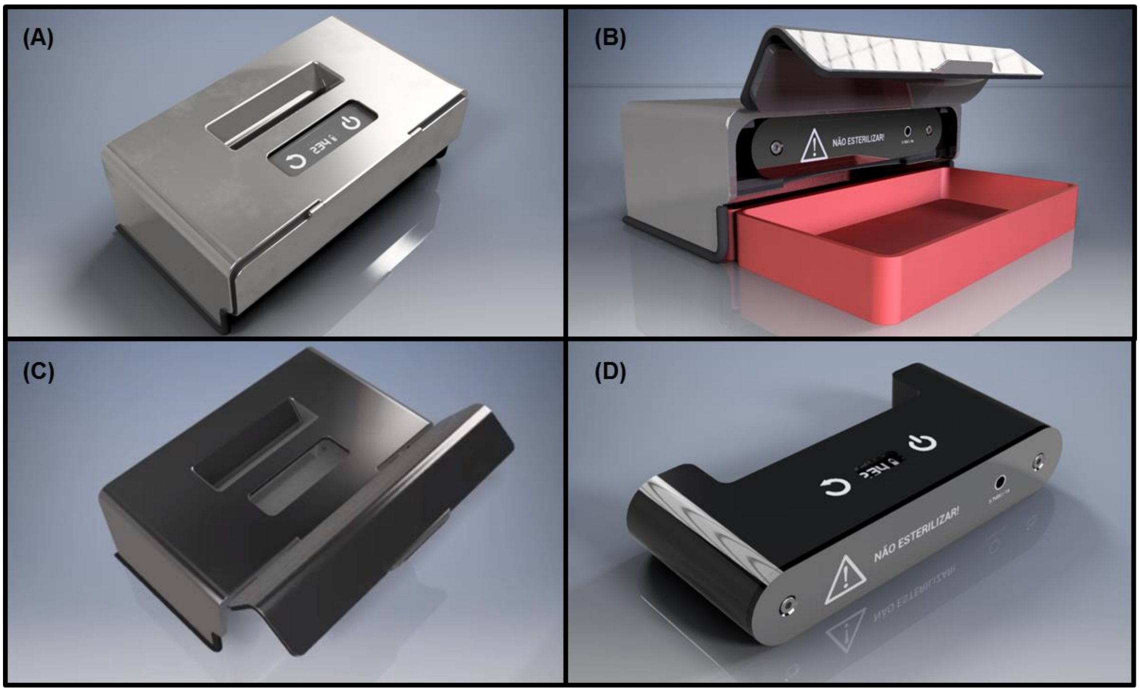

Figure 2 - (A) 3D model of the final concept; (B) Positioning of the magnet box, in red; (C) Sterilizable housing; (D) Electronic subsystem insert.

3. Proof of concept

Count accuracy was evaluated with needles from 20 elective surgeries from December 2018 to March 2019. During the evaluations, the RNs responsible for sharp count performed both the standard and technology-aided count processes. After the procedure, the RNs answered a questionnaire stating the number of needles used in the procedure, if the count was accurate or not, and their perception on how the device relates to potential benefits related to the reduction of: a) injury proneness or risk of needle stick injuries while handling sharps, b) time spent in the counting process, c) difficulty in performing the counting process, and d) risk of count error.

Count accuracy was evaluated with needles from 20 elective surgeries. In only three of the surgeries the count was performed accurately, and in all of the surgeries the average count error was of 4,4%. Causes of count errors are partially attributed to technical aspects, especially in double-counting needles attached to long suture lines and not counting tiny needles. Other causes of count error may be attributed to usability misalignments and the lack of a standardized procedure when using the counting device (e.g.: the device was not developed to count two needles dropped at the same time, but that was not clear to the users). To get a more accurate count, both technical and usability challenges must be overcome.

The results on user experience are overall positive, with the majority of the respondents acknowledging a reduction of injury proneness, difficulty in performing the counting process, and counting time when comparing the counting process using the new device versus the standard process. As expected, due to the relatively high rate of miscounting in our tests, the respondents were divided on their perception of whether or not the counting device reduced or increased count error proneness.

4. Next steps

As presented previously, the device's critical function of needle-couting still needs to be significantly improved. New rounds of research and development are required to improve count accuracy by either testing sensors with diverse sensibility levels, adding new components to post-treat the count signal, or adopting additional redundant new technology (e.g. image analysis of the magnet board combined to the current sensors). Moreover, the RNs must be trained to properly operate the device and its yet-to-be-defined count protocol. Once these activities are finished, a new set of trials must be performed.

5. Conclusion

This paper presents the human-centered development process of a solution aimed at improving accuracy and safety in surgical needle-counting processes, which are applied in ORs worldwide.

We contribute to the literature on the sharps count process by providing a detailed list of requirements needed to develop a technology aid to improve this process; moreover, we present one possible design and technological route to improve the needle counting process, bringing this routine one step closer to the OR in the future.

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Contributors

MO (Methodology, Investigation, Formal analysis, Writing - Original Draft), GDS (Methodology, Investigation, Formal analysis, Writing - Review & Editing), EZ (Conceptualization, Methodology, Investigation, Writing - Review & Editing, Supervision, Project administration, Funding acquisition)

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Appendix D

Paper 4

Hospital innovation process and organization evolution: from Design Thinking workshops to innovation outcomes

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CASE REPORT

Hospital innovation process and organization evolution: From design thinking workshops to innovation outcomes

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ABSTRACT
Design Thinking (DT) has been presented as a promising approach to developing innovative healthcare solutions. However, there exists a gap between understanding how to implement a DT approach at the organizational level and its connection to other innovation-management strategies. Using a longitudinal case study methodology, the study analyses an hospital with history of implementing DT as a comprehensive organizational approach to innovation for over six years. Data were collected through interviews, participant observations, and documents. Results indicate that DT supported the organizational culture transformation towards innovation and the dissemination of innovation practices across diverse areas and hierarchical levels. In addition, the study presents how DT can be implemented along with other project-management strategies to achieve better business and innovation outcomes. It is suggested that healthcare managers can use DT to enhance innovation-related business outcomes, and the hospital innovation process model may serve as a reference for healthcare institutions intending to develop innovation capabilities.

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KEYWORDS
Design thinking; innovation; workshop; product development; hospital; project management

Introduction

The healthcare sector has increasingly been applying design knowledge, especially design thinking (DT), to address its challenges [1–4]. DT is an abductive, human-centred approach to problem solving that empowers individuals not only with capabilities to solve a specific problem but also with a set of practices to address complex problems [5–7] or projects [8]. The approach follows three iterative phases: a) inspiration; b) ideation; and c) implementation. In these phases, individuals will, respectively, a) define and understand the problems they are trying to solve; b) brainstorm and build the products, processes, or services that will solve the problems; and c) evaluate and implement their solutions [1]. Across all three phases, they employ attributes such as user-centredness and involvement, abductive reasoning, creativity and innovation, interdisciplinary collaboration, design tools, and tolerance for ambiguity to mimic how professional designers think and work [6].

DT is acknowledged as a promising approach to innovation in healthcare, with positive reports on the clinical [8] and managerial [9] outcomes of healthcare interventions that claim to have employed it. Additionally, DT tools have been used to promote better communication in healthcare by addressing interprofessional work [10] and conversations with patients [11,12]. Despite these recognized benefits, studies on how to build a DT culture and its structured adoption to promote innovation within healthcare organizations are scarce [13].

From a health systems perspective, innovative solutions are required to progress towards better health coverage [14]. DT provides a systematic yet adaptable

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Abstract

Design Thinking (DT) has been presented as a promising approach to developing innovative healthcare solutions. However, there exists a gap between understanding how to implement a DT approach at the organizational level and its connection to other innovation-management strategies. Using a longitudinal case study methodology, the study analyses an hospital with history of implementing DT as a comprehensive organizational approach to innovation for over six years. Data were collected through interviews, participant observations, and documents. Results indicate that DT supported the organizational culture transformation towards innovation and the dissemination of innovation practices across diverse areas and hierarchical levels. In addition, the study presents how DT can be implemented along with other project-management strategies to achieve better business and innovation outcomes. It is suggested that healthcare managers can use DT to enhance innovation-related business outcomes, and the hospital innovation process model may serve as a reference for healthcare institutions intending to develop innovation capabilities.

Keywords: Design thinking; innovation; workshop; product development; hospital; project management.

1. Introduction

The healthcare sector has increasingly been applying design knowledge, especially design thinking (DT), to address its challenges [1–4]. DT is an abductive, human-centred approach to problem solving that empowers individuals not only with capabilities to solve a specific problem but also with a set of practices to address complex problems [5–7] or projects [8]. The approach follows three iterative phases: a) inspiration; b) ideation; and c) implementation. In these phases, individuals will, respectively, a) define and understand the problems they are trying to solve; b) brainstorm and build the products, processes, or services that will solve the problems; and c) evaluate and implement their solutions [1]. Across all three phases, they employ attributes such as user-centredness and involvement, abductive reasoning, creativity and innovation, interdisciplinary collaboration, design tools, and tolerance for ambiguity to mimic how professional designers think and work [6].

DT is acknowledged as a promising approach to innovation in healthcare, with positive reports on the clinical [8] and managerial [9] outcomes of healthcare interventions that claim to have employed it. Additionally, DT tools have been used to promote better communication in healthcare by addressing interprofessional work [10] and conversations with patients [11,12]. Despite these recognized benefits, studies on how to build a DT culture and its structured adoption to promote innovation within healthcare organizations are scarce [13].

From a health systems perspective, innovative solutions are required to progress towards better health coverage [14]. DT provides a systematic yet adaptable approach to developing innovative solutions that are ideal for several unique contexts found in healthcare [15], offering healthcare systems, programmes, organizations, and professionals a structured approach to responding to and planning for changes in healthcare delivery [3]. While the DT approach is beneficial for driving cultural change towards innovation [16], it must be accompanied by other project management approaches to provide enough structure to enable an organization to achieve end-to-end innovation [17,18].

This article presents a case study on how the DT approach was widely deployed in a healthcare institution across multiple hierarchical levels and disciplines, how it related to other project management capabilities in the institution, and an overview of the outcomes of this adoption. Based on this case, we derive a model that describes how to apply DT effectively and systematically combined with project-management capabilities to deliver business outcomes. The model portrays what we call the 'hospital innovation process model' and can serve as a reference for healthcare managers to apply in other contexts. Our study is innovative because it focuses on the effective adoption of DT, shedding light on the managerial process of adoption instead of project-specific outputs typical in studies related to healthcare and DT.

2. Methods

This is a longitudinal case study of Hospital X spanning six years. Hospital X, with over 11000 employees, is a non-profit healthcare institution based in City, Country. It holds several business units that offer undergraduate, graduate, and short-term programmes in the health sciences and healthcare management, including hospitals, research centres, and tertiary schools. Hospital X is an acknowledged pioneer in new-technology adoption; nevertheless, it did not have internal innovation capabilities in the early 2010s. In 2014, Hospital X instituted an innovation department that drove the programmes described in this study, and by the end of 2020, it was a reference in the national health-technology ecosystem.

2.1. Data collection

This study used primary and secondary data. We used multiple sources of evidence, including interviews, participant observations in meetings, workshops, product co-development projects, and several internal and external documents. Interviews took place between October 2019 and October 2020, lasted between 22 and 80 minutes, were held in person or through Zoom, and documented through recordings in 12 out of 14 interviews (2 interviews could not be recorded due to technical difficulties); recordings summed approximately 7,5h and resulted in 136 pages of transcripts. We held 4 additional non-recorded open interviews to confirm case details. If a document was referenced during the interviews, we sought permission for its use. To ensure reliability [20], the protocols used throughout the research were documented. We searched the press and public sources to establish how the case was presented in the media and reports; hence, we collected both historical and current data, aiming to mitigate the effects of interviewee bias when reporting previous events as recommended in case-study research [19]. A summary of our data sources and protocols is available in the online supplemental materials.

2.2. Data analysis

Analysis of data involved an in-depth review of the interview transcripts with the use of QDA Miner lite software for coding recurring themes. Our main sources of analysis were interview transcripts. Participant observation and internal and external documents were used to triangulate the emerging findings and ensure internal validity. Financial reports were used to assess the business outcomes explicitly related to innovation activities. Following methodological recommendations [19,21], we enhanced the internal validity and generalization of our case with a search of relevant literature. The resulting coding scheme is summarized in Figure 1: the first-order codes were directly identified from the interviews, and the second-order codes were grouped based on first-order codes and emerging themes in the literature. A sample of interview transcripts corresponding to each code is presented in the supplemental materials. Finally, we created a narrative and a timeline for the case, with confirmatory statements extracted from the transcripts, which are presented in the results section of this article.

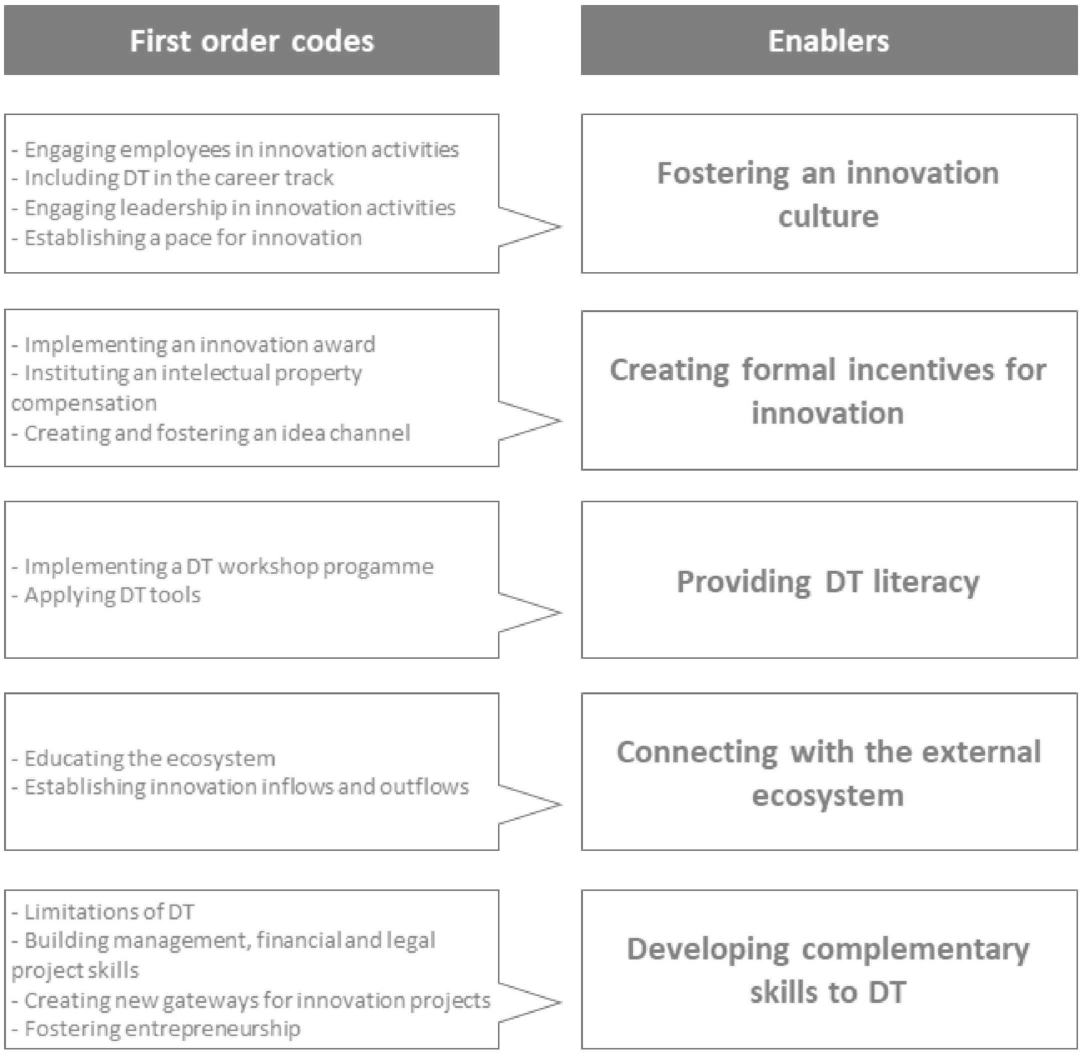

Figure 1 – Coding scheme

We then analysed public documents and press articles to cross-validate narrative facts and scout for events that were not mentioned in the interviews; following this stage, additional open interviews were conducted to investigate underexplored topics and confirm the details of the case. Finally, we derived a generic hospital innovation process model consolidating information from the case study on an aggregate level.

3. Results

3.1. Implementing a DT workshop programme

The central strategy for disseminating DT across the organization involved a workshop programme. Table 1 presents the current workshop structure in detail. The programme emphasized learning by doing: throughout the five weeks, the participants had weekly appointments during which they participated in interactive lectures on DT concepts, which were followed by practical activities employing tools presented during the lecture sessions. These tools were focused mainly on need definition and concept generation.

The participants were divided into groups of approximately five people each from different backgrounds and were guided to select a problem or need that would be their object of study in the following weeks; the problem might arise either from the strategic planning sessions or from the workshop attendees themselves, depending on Hospital X's latent needs. Prototyping activities were strongly emphasized: the groups were encouraged to prototype at least three solution ideas. Besides the solutions themselves, one major expected outcome of the workshops was the cultural shift towards seeking innovation. Workshop moderators encouraged the teams to pursue not only obvious solutions to their problems but also to cherish the memorable experience of the teams as innovation agents. The groups presented their progress weekly. In the last workshop session, a preliminary pitch presentation was delivered to an innovation committee. Following the orientation of this committee, the teams were allocated a few weeks to improve their solutions and voluntarily present them to an executive committee in a pitch event. The pitch event gathered potential project sponsors who defined which solutions would continue to be developed in a project-management workflow.

Table 1 - Design Thinking workshop description

	Description	Comments
Lecture contents	1st session	T[1] – Design Thinking definition and tools; examples of applications; inspiration tools (interviews, shadowing). Focus on the inspiration phase.
		P[1] – problem definition; icebreakers
	2nd session	T – need statement definition (emphasis on fundamentals of the problem, existing solutions, market potential, and stakeholders involved). Focus on the inspiration phase.
		P – results presentation; problem refinement; need statement definition
	3rd session	T – prototyping strategies; examples of applications. Focus on the ideation phase.
		P – results presentation; conceptualization tools (how might we, brainstorming, low fidelity prototype)
	4th session	T – conceptualization tools; intellectual property; market analysis. Focus on the ideation phase.
		P – results presentation; persona tool; user journey; business model canvas; prototype refinement
	5th session	T – business model refinement. Focus on the implementation phase.
		P – preliminary pitch event
Workload	5 weekly lectures*4h = 20h	Weekly setup to avoid dispersion of contents and absenteeism. Average of 1,25h lecture and 2,75h practical work.
Participant selection	Open call Nomination	Open call: e-mail invitation; any employee can apply
		On-demand: employees are invited or nominated to come up with solutions for specific problems
Team allocation	Emphasizes diversity	Multidisciplinary, multisectoral, various hierarchical levels
Idea selection	New idea channels Strategic problems	Open call: broad work areas are selected prior to the workshop; these areas are presented to workshop attendees on their 1st encounter and they must converge to a specific focus inside this broad area
		On-demand: problems or broad work areas are elected either by a department or an urgent demand
Promotion strategy	Open Call Mouth-to-mouth Results presentation	Open calls are announced via corporate e-mail; mouth-to-mouth recommendations, results presentation events, internal innovation events, and top-down recommendations were also mentioned in our interviews.

[1]T: theoretical; P: practical

Over the years, more than 600 employees have been trained in DT workshops and are currently considered champions to disseminate DT principles throughout the institution; additionally, over 700 employees have participated in DT satellite events, which provide a panorama of the DT approach in a single day and do not necessarily aim to create solutions to pre-defined problems.

3.2. Creating an effective hospital innovation process model

Throughout the six years (2014–2020) analysed in this study, Hospital X evolved its way of managing innovation. After the dissemination of DT, the organization needed to advance innovation projects in ways that DT could not support. This was ensured by building project-management capabilities to fulfil the innovation needs for which DT did not provide structure. Hospital X deliberately developed several enablers that supported both DT and project-management capabilities. Based on Hospital X, we derived the hospital innovation process model presented in Figure 1, which is detailed in the following paragraphs.

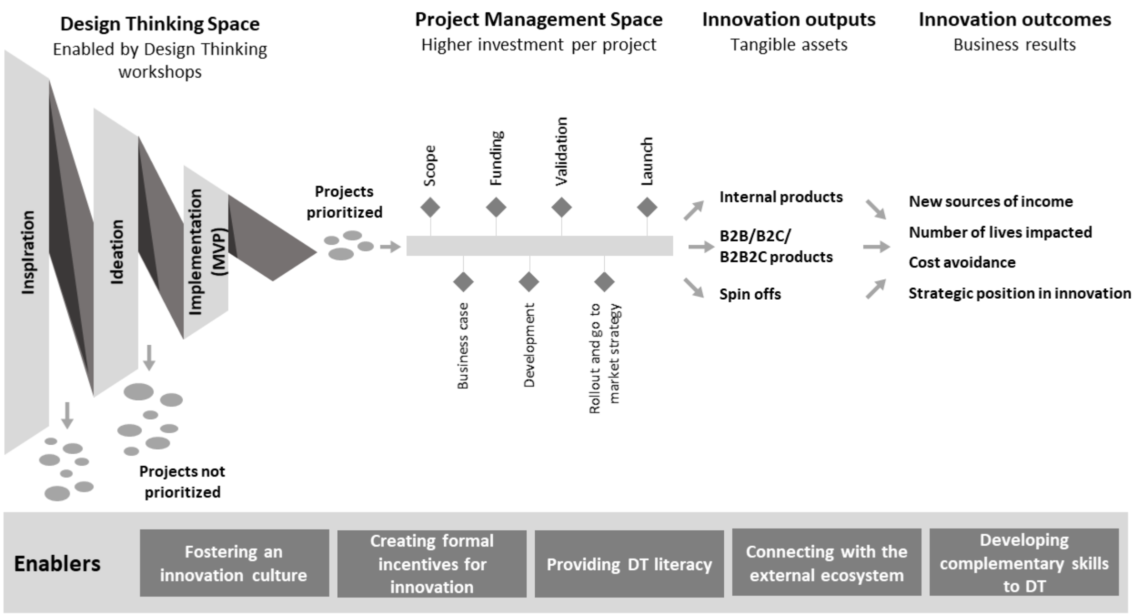

Figure 2 - Hospital innovation process model

At Hospital X, hundreds of employees were trained in DT workshops and had formal incentives to work in innovation endeavours, such as an internal innovation award. These initiatives popularized DT within the organization and created what we call the DT space, as presented in Figure 1. Employees were trained and encouraged to autonomously apply the workshop lessons to their activities and propose simple and efficient innovative solutions, as seen in the following quote.

> [Regarding the benefits of the DT workshops] There are things that we thought of in a certain way; then, we stopped, looked outside the box, and then brought another perspective. Daily, and not even in a structured, step-by-step manner, we applied what we learned even if we did not intentionally act thereon […]. It broadened my vision […], and that was what I gained the most from this workshop. – Workshop attendee.

Training employees in DT was also a deliberate strategy to allow innovation initiatives to grow autonomously until they proved themselves as a project worthy of investment. This allows for several inlets for innovation from the entire organization, preventing the innovation department from becoming a bottleneck. In the hospital innovation process model, we depict these fuzzy inlets for innovation initiatives as a DT funnel, which works with little interference from the formal innovation structures and ensures the 'survival of the fittest' ideas by empowering their very proponents with the tools to go through the 'inspiration – ideation – implementation' pipeline that is taught in the DT workshops.

> DT [workshops] were also a way we found to incorporate different skills into working together. If you consider it, if someone presents a problem to me, what do I do with it? Do I assemble a workgroup? Do I hire someone to act on it? [...] How do we depart from that initial insight? [With DT workshops] We now have a methodology, a pathway that is slightly clearer to explore these things. Moreover, these insights emanate from everywhere, from our idea portal, from an executive that gives me a call; thus, there are multiple entrances. – Director

If an initiative survived the DT funnel, it was then assessed by a committee that operated as a gateway to establish whether it was de facto aligned with the organization's strategic planning before investing time and resources therein. This gateway included several stakeholders that might be relevant to this decision, depending on the nature of the initiative.

The initiatives selected from the DT space were channelled into the project-management space. Unlike the previous phase, in which the focus was to generate as many initiatives as possible, with little concern about scalability beyond a minimal viable product (MVP), this phase was concerned with building selected initiatives in a scalable manner, addressing pragmatic inquiries regarding scope, business model, funding, scalable development, validation, rollout strategy, and/or go-to-market strategy. To accelerate this phase, Hospital X fostered capabilities for seeking funding for innovation projects, entrepreneurship training for project leaders, and the creation of spin-off companies. The following quotes illustrate this process.

> One big challenge with DT is understanding its limitations, when we use it, and who takes its inputs forward. [...] As a concrete example, we recently launched a genetic checkup, which started at a DT workshop. Obviously, the team used what was developed at the workshop to put it into production, in a lengthy process, a matter of years... [...] It was a project: there had to be validation, clinical studies, pricing, testing... However, DT does not overcome these phases. If the company does not have skills in project management, product development, pricing... It will not work. – Director

> We have worked hard, in addition to entrepreneurship, in another stream of training, other types of role models, mentorship... Other instruments to complement DT. DT alone would not have done what we did. – Director

Once the 'launch' activity in the project-management space was completed, it was possible to identify its innovation outputs, which might be products or services for internal use in the organization, those that might be used by external actors, or even spin-off operations. In Hospital X, we identified a few highlights in terms of innovation outputs that were presented in public annual financial reports, such as the creation of a startup incubator (2017), conclusion of 20 internal projects (2019), creation of three spin-off operations (2020), filing of seven patents (2020), conduction of 80 projects in partnership with other players in the healthcare ecosystem (2020), partnership with over 80 incubated startups (2020), and a national award as the most innovative organization in the healthcare sector for two consecutive years (2019 and 2020).

Moving beyond the innovation outputs, a few of Hospital X's innovation initiatives can already present results in the form of innovation outcomes; it is expected that the cycle for capturing innovation outcomes will be longer, as there is a need for the product or service to be in the market for some time before these outcomes become noticeable. The outcomes can be perceived either in terms of improving treatments and care, creating new sources of income, streamlining processes and avoiding costs, and/or positioning Hospital X in the innovation ecosystem.

The first innovation-outcome case in Hospital X related to creating new sources of income was a software-as-a-service (SaaS) platform that helped to manage healthcare professionals' allocation timetables and has been adopted by over 130 organizations—the initiative has become a spin-off operation. The second outcome related to both generating new sources of income and avoiding costs was the creation of software to aid genomics data processing and analysis, which was initially intended to significantly reduce the time employed by medical personnel in genomics diagnosing. After its internal success, it was later deployed as a spin-off operation, and the tool was incorporated into a SaaS business model. The third innovation-outcome case in Hospital X was its active role in supporting and fundraising for its incubated startups in generating solutions related to the COVID-19 outbreak; this outcome related to the number of lives impacted by Hospital X and its strategic positioning in the innovation ecosystem.

Beyond the linear process in Figure 1, we identified five organizational enablers in Hospital X that ensured the satisfactory outcomes of the hospital innovation process model. First, Hospital X began fostering an innovation culture by structuring an innovation department that actively developed several innovation-related events, courses, and incentives. Especially in healthcare, where there is an inherent mandate for safety, quality, and replicability in every practice, it is challenging to invite individuals to feel comfortable innovating, and an innovative culture helps break this blocker. To actively source this culture, employees were stimulated to engage in DT activities, leadership was involved in innovation committees, and these ongoing top-down and bottom-up approaches established a pace for innovation within the organization.

Second, Hospital X started creating formal incentives for employees involved in innovation activities, such as an annual innovation award with financial compensation for individuals involved in innovation projects and a policy for revenue sharing in licensed solutions developed by employees. Individuals will be more proactively involved in these activities if the organization values them and they can perceive tangible benefits.

Third, Hospital X fostered the emergence of innovation opportunities across the organization by providing DT literacy through a workshop programme that capacitated their employees in generating these innovation opportunities and autonomously pushing them through the ‘inspiration – ideation – implementation’ pipeline using DT tools.

Fourth, Hospital X began connecting with the external ecosystem as it acknowledged that healthcare problems were typically not isolated in one organization and required the involvement of multiple actors to solve them. This was achieved by educating the ecosystem through hosting open innovation events, and by establishing innovation inflows and outflows creating an incubation programme for health startups, establishing an internal flow for creating spin-off companies, and offering expertise in DT workshops to conduct their programmes with external players.

Finally, after identifying the limitations of the DT approach, Hospital X actively started developing complementary skills to DT by creating two innovation subdivisions: the innovation lab, which was responsible for the generative innovation activities (such as DT), and the innovation centre, which was responsible for the more bureaucratic side of innovation management, such as seeking funding, managing legal necessities, developing pricing strategies, creating new gateways for innovation projects, preparing for market launch through entrepreneurship training, etc.

4. Discussion

Innovation programmes are typically created with strong C-level support; however, their outcomes and impact on the cultural shift towards innovation are what make them endure throughout the years. If employees are well trained, DT can become an institutional resource through which employees across all levels of the institution can relate, and it can be used to address tactical and strategic demands. The hospital innovation process model presented in Figure 2 presents a pathway for delivering effective outcomes in healthcare organizations departing from DT efforts.

The DT space in Figure 2 ensures an ongoing pipeline of innovation initiatives in the organization at a small cost because the initiatives in this phase are proposed and conducted by employees who find innovation opportunities within their daily activities. This phase operationalizes the promotion of active experimentation and generates positive encouragement and confidence, which have been identified as enablers to promote the involvement of nurses in innovation activities [22].

The project management space requires more investment per initiative than in the previous DT phase; this investment may be in the form of employing human capital to support specialized activities or investing financial capital in developing the project. As expected, fewer initiatives reach the project management space portfolio, and it is assumed that a reasonable proportion of them are successful. This is quite the opposite of the DT space, in which one would expect that most of the initiatives would be rejected before moving into the next phase.

The model presented in Figure 2 comprehends five enablers to the hospital innovation process, which serve as a backbone for its adoption.

The first enabler is fostering an innovation culture: especially in healthcare, where there is an inherent mandate for safety, quality, and replicability in every practice, it is challenging to invite individuals to feel comfortable innovating. Instituting an open and supportive culture [26], a group cohesiveness [27], and even an energizing [25] or supportive environment [28] have been identified as antecessors of employee engagement [25] and innovation implementation success [26]. Several works refer to the need for having a leadership and an executive team supportive of innovation activities to make sure this innovation culture endures [25,27,29–32], and it has been reckoned by healthcare leaders that the organizational structure must follow this ambition at the risk of letting managers with no other options than to refrain for working with innovation activities due to lack of resources [30]. We extend the literature on fostering an innovation culture by formalizing two strategies to overcome this leadership engagement obstacle: the first is the creation of a position of Director of Innovation with the same status as other managerial business units, with autonomy to negotiate resources to guard and foster an innovation culture and formal incentives for innovation. The second is to include the attendance at design thinking workshops in the career development track, which ensured that at least the upcoming leadership had been exposed to the organization's instituted innovation literacy.

The second enabler is the creation of formal incentives for engaging in innovation activities, as individuals will be more proactively involved in these if the organization values them and the individuals can perceive tangible benefits from them. Individual job autonomy intrinsic to healthcare professions [23] and diversified workforce experience across several disciplines [24] make health professionals' engagement a fundamental ingredient for innovation [25]. Human resource management is a key enabling factor in idea generation and in moving from idea generation to innovation implementation [26], which are all stages presented in the hospital innovation process. Labitzke, Svoboda, and Schultz [33] suggest that formal control mechanisms may encourage proactive innovation-related behaviour in hospital employees. We extend this perspective by presenting four mechanisms: implementing an innovation award, instituting an intellectual property compensation policy, including DT in the career track, and creating and fostering an idea channel.

The third enabler is providing DT literacy through training. DT and human-centered design have been extensively employed in healthcare projects (see [1,2] for reviews) and have been pointed out as a competency domain for healthcare leaders [32]. Providing a structured approach to DT promotes psychological safety within teams novice to innovation, as well as enables these teams to drive idea generation [7]. Due to differences between achieving innovation in healthcare compared to other sectors, involving the non-obvious relationship between the complexity of the innovation initiative, the level of individual autonomy, and innovation initiative success, structured approaches to DT in healthcare have been tailored to guarantee cohesiveness [29]. Instituting such an approach organization-wide refrains the organization from facing known barriers to adherence to innovation programs, such as the lack of applicants, underdeveloped innovation ideas, and the need for training innovators [34].

The fourth enabler is connecting with the external ecosystem to identify opportunities to establish innovation inflows, and outflows and even to educate the ecosystem. Promoting links between organizations enables the exchange of capabilities and knowledge between them [32], as long as both parties are engaged and know what is expected of them [31]. Since the local healthcare ecosystem did not have mature innovation capabilities, the organization we studied also assumed an educational role in the ecosystem to promote the intended collaboration with the ecosystem.

The fifth and final enabler is developing complementary skills to DT to certify that the portfolio of initiatives selected for further investment is aligned with the strategic planning and that they can exist autonomously beyond their MVPs; the generative initiatives will typically be underexplored if the organization does not have this capability. These complementary skills will be enacted in the project management space in the hospital innovation process model; hence, there is a separation between generative innovation expertise and project management innovation expertise to avoid cannibalization between these scopes and counterbalance their potentials and limitations. The complementary skills to DT identified are: first, creating a set of gateways with high-level executives to assess innovation projects. Combined with the DT workshops, this approach balances the need for generating an ongoing pipeline of ideas coming from frontline employees by promoting innovative work behavior (as recommended by [24]), whilst promoting a control mechanism towards the boundaries of what innovation work will be prioritized and invested in (as recommended by [29]) later on the innovation process; this strategy promotes both bottom-up engagement and top-down support for innovation projects, avoiding a lack of efficiency in addressing hierarchical and heterarchical constraints in managing innovation projects [35]. Second, developing management, financial, and legal project skills to enable selected innovation projects to streamline towards launch phases (a similar approach for this phase is presented at [34]). Third, fostering an entrepreneurial education for employees to enable the creation of spin-offs as possible exits for innovation projects.

By explicitly describing how the hospital innovation process model grouped several capabilities and innovation-related efforts, we hope to unpack the dynamics of effective innovation in healthcare organizations.

4.1. Implications for theory

Our contribution to theory is fourfold. First, we contribute by presenting a longitudinal study on how DT supports building innovation within a healthcare organization. Previous studies have described and analysed, in detail, the adoption of DT in other industries [36,37]. We extend the understanding of DT adoption at the organizational level to the healthcare sector, which responds to a previous call to explore how DT may be adopted in industries that have historically valued perfectionism and siloed specialization [38]; we also complement previous studies that have explored DT in healthcare at the project level [1]. Second, we provide a detailed account of how DT interacts with enabling capabilities and other innovation management strategies. Thus, we join the sparse and recent literature that explores the enablers [39] of DT implementation, which is an opportunity for research that has been reported previously [6,38]. Third, due to our methodology, we contribute to unpacking the role of time in DT implementation, thus filling another known research gap in the literature [16]. Fourth, the hospital innovation process model presents DT as a phase at the forefront of innovation, filling previous research gaps in the literature regarding where and in which phases in innovation management DT should be adopted [18,40].

4.2. Implications for practice

Our practical contribution is twofold. First, we present the structure of a DT workshop programme that has been iterated and employed in a healthcare organization for over six years and can serve as an inspiration to healthcare managers and consultants. Second, we build and detail a hospital innovation process model that shows a pathway to building broad yet effective innovation interventions, specifying the organizational enablers and gateways employed. This perspective positions DT within a broader context in innovation for healthcare beyond its traditional resemblance to the development of a single product or service, which ensures the innovative nature of our work. Both the DT workshop programme and the hospital innovation-process model can be applied in other healthcare organizations at the national and international levels.

5. Conclusion

DT offers a pathway for disseminating an innovation culture in organizations; in this study, we show evidence of the benefits of its adoption in healthcare. Empowering the workforce with DT knowledge accelerates the dissemination of innovation beyond the silo of an isolated innovation department. Through the derived hospital innovation process model, we extend the discussion of DT beyond the portrayal of single interventions that are typical in the literature and present a model that can serve as a reference for other healthcare organizations.

Because our study followed a single-case study methodology, the generalization of our findings to different settings is limited. Nevertheless, as a longitudinal and comprehensive study, the results can serve as a reference for future works in the field. As DT has been and continues to be adopted by other healthcare organizations, future studies could rely on the hospital innovation process model presented here as a reference when analysing multiple cases. Additionally, although we collected longitudinal data across six years, the cycles of capturing outcomes related to innovation interventions can last for decades; future studies could rely on longer timeframes when studying the outcomes of innovation interventions. Finally, we recommend future quantitative studies to further assess the impacts of adopting DT in healthcare organizations on business outcomes.

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Appendix E

Paper 5

Capability building for Digital Transformation through Design Thinking

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Capability building for digital transformation through design thinking

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ABSTRACT

Design Thinking has been used to tackle complex problems and guide innovation across several industries. Most studies have relied on recounting experiences of the application of design thinking at the project level rather than the organizational level. The relationships among design thinking, digital transformation, and dynamic capabilities have received attention in recent times. We conduct a longitudinal analysis for a hospital's innovation department that has been implementing design thinking as a comprehensive organizational approach for digital transformation and innovation for six years. We analyze design thinking adoption, its relation to other innovation initiatives, and its contribution in developing dynamic capabilities for digital transformation. The data collection comprises interviews, document analysis, and participant observations. We show that design thinking supports the development of digital transformation and innovation capabilities. Additionally, we elaborate on how design thinking has positively contributed to capability development for digital transformation and analyze how this process has evolved over time. We contribute to the limited literature on the impacts of the adoption of design thinking at an organizational level by establishing its foundation in theories of dynamic capabilities and digital transformation. For practitioners, this study elucidates how to lead an incumbent down the path of digital disruption.

1. Introduction

The development of capabilities for innovation entails numerous factors and long-term efforts (Börjesson et al., 2014; O'Connor, 2008). Design thinking is a social technology that makes it easier for teachable and scalable methods to emerge, which, in turn, drives innovation (Liedtka, 2020). Additionally, it can reportedly boost organizational culture and capability building, thereby enabling digital transformation (Magistretti et al., 2021c; Marx, 2022) and the achievement of innovation goals (Magistretti et al., 2022). However, the mechanisms by which organizations use design thinking to drive change and capability building remain empirically underexplored (Elsbach and Stigliani, 2018; Marx, 2022).

Design thinking is a wide organizational resource (Kimbell, 2011) and project-level contingent set of practices (Kimbell, 2012), which aims to disseminate the organization's innovation culture and exploit its preexisting internal competencies. Design thinking may be applied to diverse business problems (Carr et al., 2010). Furthermore, if we extrapolate its application beyond the project level to an institutionalized organizational approach to innovation, we understand it as the basis of sustainable competitive advantage in rapidly changing environments, or as a dynamic capability (Magistretti et al., 2021b). Recently, design thinking has been presented as a strategy to build dynamic capability for digital transformation (Magistretti et al., 2021c; Marx, 2022). In the short term, digital transformation is pushed by companies, and in the long term, it is pulled by customers, technology, and markets (Kane et al., 2017). Hence, firms are challenged with preparing for a knowingly unpredictable environment driven by ubiquitous digital technologies (Sebastian et al., 2017).

Although design thinking has moved past its innovation buzzword status (Dorst, 2010; Johansson-Sköldberg et al., 2013; Micheli et al., 2019), studies have reported a lack of empirical evidence on the effects of design thinking adoption on organizations (Elsbach and Stigliani, 2018; Gruber et al., 2015; Liedtka, 2015; Micheli et al., 2019). Research on design thinking has evolved based on theoretical foundations (Johansson-Sköldberg et al., 2013; Liedtka, 2015; Micheli et al., 2019) and portrayals of its adoption across numerous industries (Carlgren et al., 2016; Dell'Era et al., 2020; Wrigley et al., 2020). Nevertheless, in-depth investigations that concern the boundary conditions of the adoption, implementation, and outcomes of design thinking as an organizational-wide approach to innovation are overdue (Elsbach and Stigliani, 2018; Micheli et al., 2019).

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Key words: design thinking, digital transformation, dynamic capabilities, capabilities, digitalization, healthcare.

1. Introduction

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Micheli et al., 2019) and portrayals of its adoption across numerous industries (Carlgren et al., 2016; Dell'Era et al., 2020; Wrigley et al., 2020). Nevertheless, in-depth investigations that concern the boundary conditions of the adoption, implementation, and outcomes of design thinking as an organizational-wide approach to innovation are overdue (Elsbach and Stigliani, 2018; Micheli et al., 2019).

Innovation and digital transformation challenges permeate several industries and sectors such as healthcare and seem to have unprecedent consequences in these contexts. This transformation has the potential to disrupt the core of health services because of the changing roles of patients, providers, healthcare professionals, and regulators, and the impact of digital technologies on care delivery and care quality (Ricciardi et al., 2019). Healthcare is facing the challenge of digital transformation (Agarwal et al., 2010; Niemelä et al., 2019; Sebastian et al., 2017; Vial, 2019). The sector has been sluggish in implementing transformation processes (Massaro, 2023) and as a consequence suffers from declining care quality (Torab-Miandoab et al., 2023). Moreover, research on digital transformation of the healthcare sector is incipient (Massaro, 2023).

Typically, healthcare organizations have decentralized structures (Aas, 1997), comprise professional groups with distinct knowledge bases and research cultures (Ferlie et al., 2005), and are subject to heavy regulation; these characteristics make organizational change challenging for the sector. Additionally, in healthcare, intrinsic high job autonomy makes innovation and change dependent on the individual contributions of employees (Schultz et al., 2012). Design thinking aims to engage and retain employees by scaling up and democratizing innovation efforts (Liedtka et al., 2017) in an organization. Thus, it seems suitable to foster digital transformation capabilities in healthcare organizations. Accordingly, design knowledge has been increasingly applied to address the challenges of the healthcare sector (Bazzano et al., 2017; Bessant and Maher, 2009; Oliveira et al., 2021).

The research question that drives this study is as follows. *How does design thinking relate to capability building for digital transformation in healthcare organizations?* The case study comprises a major hospital that has implemented design thinking as a pervasive organizational approach for innovation over the course of six years through its innovation unit. We derive a capability model and a timeline on the capabilities for digital transformation fostered by design thinking. Following a narrative of the case, we explore three main discussion points: *how capabilities for digital transformation are driven by design thinking*, *readiness for developing these capabilities,* and their *boundaries*.

This study's contributions to theory are as follows. First, in terms of the digital transformation theory, we extend the understanding of building capabilities for digital transformation (Appio et al., 2021; Guo et al., 2023; Matt et al., 2015). Second, regarding the intersection of design thinking and digital transformation, we reveal how design thinking actively sources dynamic capabilities for digital transformation at an organizational level. Third, regarding the intersection of design thinking and dynamic capabilities, we extend the theoretical underpinning of design thinking by connecting it with the dynamic capability literature. Fourth, in design thinking research, our study adds to the limited and overdue systematic literature on the adoption, implementation, and outcomes of design thinking as an organization-wide approach to innovation. For practitioners, this study presents a process model for developing capabilities for digital transformation and guides managers and executives involved in digital transformation. Specifically considering healthcare and other regulated, risk-averse industries, it indicates how a non-digital-savvy culture can be effectively broken and rebuilt to have a digital-savvy structure.

The remainder of this paper is organized as follows. Section 2 presents a literature review on design thinking, dynamic capabilities, and digital transformation, and explicates how they may be intertwined. Section 3 discusses the methods for gathering and analyzing data and a case vignette. Section 4 presents the findings and the capability model. Section 5 comprises a case discussion, the theoretical and practical implications of the study, its limitations, and recommendations for future research. Section 6 discusses the conclusions of this study and directions for future research.

2. Literature review

2.1. An overview of design thinking conceptualization and practice

In a broad sense, design thinking was first introduced in the 2000s as “a discipline that uses the designer’s sensibility and methods to match people’s needs with what is technologically feasible and what a viable business strategy can convert into customer value and market opportunity” (Brown, 2008, p. 2). It interlinks managerial organization systems, individual cognition, and design tools and methods (Cash, 2020).

It is portrayed as a distinctive and strategic approach to problem-solving that may be applied to virtually any business problem (Brown and Katz, 2011; Carr et al., 2010; Liedtka, 2015). It drives multidisciplinary teams (Seidel and Fixson, 2013) in a user-centered (Verganti, 2008), empathetic, and collaborative (Brown and Katz, 2011; Liedtka, 2015) quest to innovation. It is proposed as a strategy of balancing analytical and intuitive thinking (Martin, 2009), and utilizes abductive logic for value creation (Dorst, 2011, 2010). Additionally, it is described as an organizational resource for innovation (Kimbell, 2011) and a set of routinized practices inspired by professional designers (Kimbell, 2012).

The wide variety of definitions and characteristics attributed to DT puts its concept at the risk of becoming an “umbrella construct” with a loose meaning that could be applied to anything and everything, which might delay or even hamper design thinking theory development (Micheli et al., 2019). Research has focused on the attributes (Carlgren et al., 2016; Micheli et al., 2019) and history of design thinking (Auernhammer and Roth, 2021; Johansson-Sköldberg et al., 2013). We acknowledge the lack of consensus on the construct of design thinking over the years. Recent investigations have proposed more cohesive theory-based constructs and approaches to design thinking. For the context of the present study, we depart from Carlgren and BenMahmoud-Jouini's (2022) conception of design thinking adoption and diffusion in organizations as the generation and implementation of new "practices, processes, and structures that are intended to further organizational goals" (p. 46).

The practice of design thinking provides a foundation for individuals to continuously learn, thus enabling ongoing capability development (Liedtka, 2020), which can be explained and mediated by socio-psychological principles (Thompson and Schonthal, 2020). The capabilities fostered by design thinking are related to problem-finding (Garbuio and Lin, 2021), abductive reasoning (Garbuio and Lin, 2021; Magistretti et al., 2021b), research and development in regulated markets (Appleyard et al., 2020; Magistretti et al., 2021a), entrepreneurship (Klenner et al., 2022), Industry 4.0 (de Paula et al., 2023), design of digital technologies (Wang, 2022), the relationship between design thinking, digital capabilities, and platform-based venture performance (Kamble et al., 2023), and finally, coming to the subject of this work, capability-building for digital transformation (Magistretti et al., 2021c; Marx, 2022).

Marx (2022) builds a theoretically grounded proposal consisting of three ways in which organizations can employ design thinking to enhance their digital transformation efforts: 1) employing design thinking as a structured process to develop products or services; 2) applying design thinking to change the organizational setup and transformation mechanisms, understanding that design thinking may empower individuals (Liedtka, 2015) and teams (Appleyard et al., 2020) to drive this change; and 3) employing design thinking to build and sustain dynamic capabilities. We extend the understanding of 2) and 3) in the remainder of this study.

The success of design thinking adoption is highly dependent on organizational culture; cultures marked by values related to productivity, performance, and siloed specialization may hinder the adoption of design thinking (Carlgren and BenMahmoud-Jouini, 2022; Elsbach and Stigliani, 2018). When effectively adopted, design thinking-oriented collective practices support strategic discussions across different areas (Knight et al., 2020) and help to break organizational silos. Moreover, the practice of design thinking drives ongoing sensemaking in individuals exposed to design thinking training, thereby empowering them with flexible tools and structures that can be rearranged for a given purpose (Rylander Eklund et al., 2022). Roth et al. (2023) empirically assess that design thinking training positively contributes to creative self-efficacy and problem-solving in managers, thus positively affecting managerial dynamic capabilities. The value of DT is underpinned by the fact that it gathers a set of teachable practices that allow the development of capabilities for ongoing strategic adaptation (Kurtmollaiev et al., 2018; Liedtka, 2020; Magistretti et al., 2021b). The aforementioned findings highlight the practice of DT as a competitive advantage for organizations because it can boost their ability to reconfigure in changing scenarios.

Understanding how the adoption of design thinking occurs at an organizational level is underexplored in scholarly research (Elsbach and Stigliani, 2018; Micheli et al., 2019), with a few notable exceptions (de Paula et al., 2023; Magistretti et al., 2023; Randhawa et al., 2021; Wrigley et al., 2020). Randhawa et al. (2021) analyze how design thinking leverages the cognitive frame of middle managers in pursuit of ambidexterity. Departing from a cross-case study, Wrigley et al. (2020) describe organizational conditions that should be established before design interventions to avoid a “sugar-rush” effect in organizations adopting design interventions only to let them fade shortly after initial enthusiasm. De Paula et al. (2023) draw on the cognition theory to establish a managerial mental model to enable organizational change in the context of Industry 4.0 through behavioral strategies that can help to materialize desired organizational behaviors in the context of change; several of these strategies are related to design thinking, such as “apply design thinking in the early phase of innovation,” “embed design thinking within a larger cultural and mindset change,” “create cross-disciplinary teams,” and “provide sufficient resources for design thinking training.” Based on secondary data and interviews with top executives, Magistretti et al. (2023) elaborate on nine design thinking practices developed at PepsiCo to foster the approximation between design and innovation.

Nevertheless, there is little insight into the mechanisms and processes by which organizations widely adopt the practice of design thinking. The literature has not analyzed whether there is a preferred sequence for adopting design thinking tools depending on previous organizational culture (Elsbach and Stigliani, 2018) and whether design thinking can drive an innovation-prone organizational culture (Micheli et al., 2019). Hence, analyzing the adoption of design thinking in an organization in depth, discovering how it relates to other ongoing pressures, changes, and initiatives within the organizations, and exploring the role of time in this process is pertinent to academics and practitioners.

2.2. Building dynamic capabilities employing design thinking

The debate on assuring organizational ambidexterity and the simultaneous search for exploration and exploitation activities is extensively discussed in the literature (March, 1991; O’Reilly and Tushman, 2013; Tushman and O’Reilly, 1996). While a mainstream organizational mandate is rooted in reliability and replicability, a mandate for innovation is focused on adaptation, which can be achieved by developing dynamic capabilities (Schreyögg and Kliesch-Eberl, 2007).

As Teece (1997, p. 516) posits, dynamic capabilities refer to “the firm’s ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments,” and may be understood based on the level of processes, positions, or paths. They can be categorized as sensing capabilities, seizing capabilities, and reconfiguring capabilities (Teece, 2007).

There exists noise around the under-specification and boundary conditions of the dynamic capability construct (Schilke et al., 2018), its level of analysis (Kurtmollaiev, 2020), and its validity in a rapidly changing environment (Eisenhardt and Martin, 2000; Peteraf et al., 2013;

Schreyögg and Kliesch-Eberl, 2007). We depart from Kurtmollaiev's (2020, p. 3) concept of "dynamic capabilities as the regular actions of creating, extending, and modifying the organizational resource base," and understand that these actions have been taken by individuals, who act and interact to reassemble the organizational resource base, and that their individual-level micro-interactions may reflect on firm-level macro-outcomes (Felin et al., 2012; Helfat and Peteraf, 2015).

2.3. Understanding digital transformation

In a digitally transforming era, firms have to position themselves to be competitive in an unpredictable environment (Sebastian et al., 2017). Following a semantic analysis of the digital transformation definitions, Vial (2019, p. 118) defines the digital transformation phenomenon as "a process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies." Digital transformation goes beyond managing the adoption of digital technologies or management of IT infrastructure. It is because the adoption of digital technologies naturally triggers major changes in an organization's value proposition and regular operations (Matsumoto et al., 2022; Matt et al., 2015; Usai et al., 2021; Van Veldhoven and Vanthienen, 2022; Zhang et al., 2023).

Digital transformation is unlikely to be a process is ever complete, because the technologies that drive it and innovative solutions associated with it are yet to be developed or popularized (Appio et al., 2021; Kane, 2017). Adopting and executing a digital transformation strategy requires a high upfront investment because of its needs such as acquiring new assets and investing in high-qualified personnel. Although managers reckon that digital transformation efforts should be taken, they are unsure if these efforts will benefit firm performance (Guo et al., 2023). Managerial strategic myopia and the pressing need to maintain superior firm financial performance in the short term may delay or even restrict organizations from adopting digital technologies and pursuing digital transformation efforts (Ceipek et al., 2021; Guo et al., 2023).

Interestingly, Usai et al. (2021) analyze the correlation between the adoption of digital technologies and firm innovation performance and found no direct relationship between them. As digital technologies push the standardization of knowledge, their adoption may impoverish a firm's creativity and hinder value creation; "digital technologies cannot replace the role of creativity, intuition, serendipity, and intellectual capital in the innovation process. Very likely, their role is subordinated to those of other resources, such as financial resources or human capital." (Usai et al., 2021, p. 332).

Conversely, Zhen et al. (2021) find that an organizational digital culture and digital capabilities support the arrangement of organization resources in the face of a digital transformation, which drives firm innovation performance. We understand culture "as the pattern of shared values and beliefs that help individuals understand organizational functioning and thus provide them norms for behavior." (Deshpande and Webster, 1989, p. 4). A digital culture is a culture applied in a digital domain. Similar to any cultural change, building a digital culture is an endeavor that requires the involvement of top executives and their support for its success (Ceipek et al., 2021).

A previous study focuses on driving digital culture change and development of digital capabilities at an executive level (Yeow et al., 2018); however, no investigation has explored the mechanisms of driving digital culture change and digital capabilities development at an employee level, even though managers and employees receive training for organizations to achieve successful digital transformation (Ghosh et al., 2022). Considering the ubiquity of digital technologies and digital transformation, employees demand digital training (Van Veldhoven and Vanthienen, 2022). In a landscape with on-going digital transformation, firms need to develop capabilities to create, expand, and modify their resource base to ensure digital transformation. In this case, digital dynamic capabilities are a source of competitive advantage

(Sousa-Zomer et al., 2020). Hence, there is an opportunity for research on exploring the nature and drivers of digital capabilities and drivers of digital performance (Annarelli et al., 2021).

Firms with broad scopes of operations and environments with high coupling among activities —for example, a hospital operation that requires coordination among multiple internal and external actors to deliver integrated care—face the challenge of defining the measures they take to achieve organizational change as whole to stay in sync or drive their digitalized ecosystems (Hanelt et al., 2021). Warner and Wäger (2019) propose that organizations can improve their workforce's digital maturity by redesigning internal structures and navigating innovation ecosystems. On a macro-level, design thinking has been proposed as a process that enables digital transformation (Correani et al., 2020).

Overall, digital transformation is a resource-intensive process for firms (Guo et al., 2023) to maintain a competitive advantage in the digital era and provide innovative value for their customer base (Kane, 2017). While digital transformation scholarship has extensively focused on the adoption of digital technologies (Matt et al., 2015; Zhang et al., 2023), the latter are largely imitable and may not be a source of competitive change (Usai et al., 2021). The unique traits that make firms competitive during their digital transformation are related to the capacity of humans to deploy the digital technology resource base in the best service of the organization (Usai et al., 2021; Zhang et al., 2023). Hence, they need to train the workforce to be digitally mature (Van Veldhoven and Vanthienen, 2022), or their investments in digital technologies are not likely to pay off. Considering that digital transformation is an ongoing process, firms must develop individual dynamic capabilities so that their employees can deal with a rapidly changing environment. Our study focuses on understanding how design thinking can drive these human dynamic capabilities for digital transformation and the mechanisms by which these capabilities are built.

2.4. A note on the idiosyncrasies of the healthcare sector

In our case setting, which is located in a highly-regulated market, design thinking may be a valuable strategy in challenging pre-existing risk-averse and even neglected cultures (Azzolini et al., 2018) that hinder innovation and digital transformation. Additionally, the healthcare sector comprises highly decentralized organizational structures (Aas, 1997; Mintzberg, 1993), contains complex payment systems (Peiffer et al., 2019), is subjected to strict regulation agencies (Food and Drug Administration, 2018), and has multiple professional knowledge bases and research cultures (Ferlie et al., 2005). These factors pose a challenge to organizational changes in healthcare.

While the healthcare sector is considered sluggish in implementing digital transformation (Massaro, 2023), the success of the sector depends on its ability to digitalize (Garcia-Perez et al., 2023). Moreover, research on digital transformation of the healthcare sector remains incipient (Massaro, 2023). The sector has historically focused on high quality and efficiency and has failed to employ technology to fulfill these goals (Garcia-Perez et al., 2023). Digitalization challenges related to the availability and actionability of health data have been hindering care quality (Torab-Miandoab et al., 2023), which highlights the urgency to address this issue. Moreover, the success of digital health strategies is dependent on user adoption—regardless of whether those users are physicians, patients, or managers—and how these strategies are implemented (Garcia-Perez et al., 2023), thereby emphasizing the need for adopting user-centered strategies involving both customers and the workforce.

3. Methods

3.1. Research design

This study analyzes how the adoption of design thinking leverages innovation, and digital transformation initiatives and capabilities. Given the gap in in-depth empirical research on the adoption of design thinking within organizations, case-based evolutionary research is a methodological fit for our investigation. This type of research helps uncover patterns and constructs that have not been previously identified. To address this gap, we conduct a single case study at TakeCare, a healthcare organization that has been applying DT as an approach to innovation in a structured manner for about six years.

We select TakeCare for three reasons. First, we have a good level of access to the organization because of our previous involvement in new product co-development projects; this advantage made us aware of the transformation occurring within the organization. Second, healthcare organizations have been sluggish in conducting digital transformation; hence, studying the early days of this transformation in a pioneering organization can provide relevant findings for researchers and practitioners. Third, it is a typical healthcare organization with a risk-averse culture resulting from a long evidence-based and quality tradition, and decentralized organizational structures. Therefore, TakeCare can be considered a "critical case" (Flyvbjerg, 2006). These traits inherent to the healthcare sector constitute barriers to foster innovation and, consequently, allow us to gain insights, possibly expanding it to other high-complexity industries or scenarios. This aspect also increases the generalization of the study because it may serve as an inspiration and relate to other settings, as Siggelkow (2007) recommends.

We employ a grounded theory approach (Corbin and Strauss, 2015), and interact with TakeCare managers and technical staff for six years, participate in product development for TakeCare, and intensify interviews in the final year of the study. As is typical in grounded theory phenomenological approaches, our research protocol evolves through time. To guarantee reliability (Yin, 2018), the protocols used are documented and available in Appendix A.

4. Data collection

The research data pool consists of primary and secondary pieces of data. We collect data from multiple sources, which are documented and triangulated to ensure internal validity and convergent findings (Eisenhardt, 1989; Voss et al., 2002). Table 1 summarizes our data sources. Appendix B presents a short profile for each interviwee.

Table 1 – Description of data

Data types	Volume	Collection date	Key information gathered
Primary data			
Interviews			
Innovation unit personnel Position of interviewees: Innovation Specialist #1, Innovation Specialist #2, Design Thinking Analyst, Digital Transformation Manager, Innovation Manager, Innovation Medical Consultant, Innovation Director	6 semi-structured interviews (4 recorded) 4 open interviews (none recorded)	10/2019-01/2020	Context Innovation structures and challenges Design Thinking workshop evolution Design Thinking as mindset, culture driver and mental model Limitations of DT Emblematic cases Productization of DT Digital transformation Inward and outward-focused innovation Specificities of medical innovation
Workshop attendees from mainstream organization Position of interviewees: Nurse, HR Analyst, Facilities Supervisor #1, Facilities Supervisor #2, Big Data Manager, IT Analyst, Government Relations Specialist	6 semi-structured interviews (6 recorded)	01/2020	Perceptions of innovation culture Workshop highlights Critiques of the workshop Description of solution development in the workshop After the workshop: application of Design Thinking in daily activities
Spin-offs and startups Position of interviewees: Design Technical Leader, Chief Operating Officer	2 semi-structured interviews (2 recorded)	10/2020	Motivation for joining the ecosystem Ties with the mainstream organization
Participant observation			
Support to workshop teams	16h participation in lectures 4h in work meetings	04/2020-05/2020	Design Thinking workshops format Attendee reaction and evolution
Secondary data			
Institutional and open press			
Videos (2013-2020)	12	06/2020	Cross-validation Information about spin-offs
News and blog articles (2008-2020)	15	06/2020	Cross-validation Information about spin-offs

Public results reports (2015-2021)	7	05/2022	Reported financial outcomes; reported innovation outcomes
Internal document analysis			
List of workshop participants (2014-2020)	Spreadsheet (1)	01/2020	Dimension of Design Thinking in the organization
List of projects developed in the workshop (2014-2020)	Spreadsheet (1)	01/2020	Nature of Design Thinking projects in the organization
IO internal performance evaluation presentations (2019)	PowerPoint presentations (limited)	01/2020	Evolution of Design Thinking inside the organization Design Thinking as B2B service
Presentations used in the Design Thinking workshops (2015–2020)	PowerPoint presentations (several)	10/2019-05/2020	Evolution of the contents presented in the Design Thinking workshops

Primarily, we conduct semi-structured interviews with members of TakeCare's innovation unit, employees of other departments who have been involved in innovation-related activities, and external actors engaged in TakeCare's innovation activities. We select the first three interviewees based on our previous knowledge of the case and the remainder by snowballing. Interview protocols are refined throughout the data collection process and available as supplementary research data. We structure our interview protocols to understand and clarify each interviewee's perception, following Isabella's (1990) approach. The semi-structured interviews are complemented with open interviews to address specific issues that arise during either the semi-structured interviews or analysis of secondary data. This stage of data collection consists of two rounds: the first took place between October 2019 and January 2020, and the second in October 2020.

Moreover, the first author participated in one edition of the design thinking workshop as a volunteer engineering consultant in 2020. The second author coordinated the cooperation agreement for new product development between TakeCare and the University between 2014 and 2017. This initiative enabled students to tackle TakeCare innovation challenges by applying design thinking and the transfer of design thinking practices to TakeCare employees. Hence, collectively, this study is composed of longitudinal and retrospective data because we rely on the authors' experiences within TakeCare.

Regarding secondary data, if a document is mentioned during the interviews, we ask for permission to access it. Some documents are shared integrally, some partially, and some denied because of confidentiality issues. Furthermore, an extensive search of the press and mandatory reports is undertaken to triangulate the information gathered.

4.1. Data analysis

Following the personal notes, interview transcripts, supplied documents and public documents, and drawing inspiration from Gioia (2019) and Gioia et al. (2013), we conduct a first-level open coding of recurring themes in the transcribed interviews and available documents. We define the first-order codes with respect to the informants' choice of words; this round yields 58 first-order codes that are reassessed and regrouped into 36 overarching first-order codes. Subsequently, we perform a round of axial coding in which these first-level codes are grouped in second-level themes. This step further groups the first-level codes into more broad categories that represent the dynamic capabilities identified in our case. Finally, the second-level themes are grouped together under aggregate dimensions that provide the classifications for these dynamic capabilities.

We then create a narrative and a timeline of the case for sensemaking with appended confirmatory statements extracted from the transcripts. The subsequent step is to analyze public documents and press articles to scout for relevant information that is not mentioned in the interviews or screened for reported outcomes in financial reports. We then conduct additional interviews to investigate underexplored topics and confirm details of the case. Finally, after completely understanding the case, we perform a targeted search of the literature to ground our case data in established theory.

4.2. Case vignette

TakeCare is a major player in the Brazilian health sector with over 13,000 employees. It is mainly a non-profit private hospital; other units are a research center and a tertiary school that offers undergraduate, graduate, and short-term programs in health sciences and health-care management. During the course of its nearly 60-year existence, TakeCare has been a nationwide pioneer in technology adoption; however, it has not acquired the competencies required for internally developing technological solutions. Faced with an imminent digital transformation, the organization instituted an innovation unit in 2014 to bridge this gap. As TakeCare did not have an innovation-savvy track-record at the time, the strategy of the innovation unit to disseminate an innovation culture was to initiate a design thinking workshop program that any employee could apply for. In the workshops, the participants were split into groups and assigned a specific problem that they would investigate. Accordingly, they proposed one or more solutions to the problem during the four to six sessions of the program. The solution outcomes that emerged from the workshops gave the innovation division momentum to leverage other initiatives and develop capabilities (e.g., prototyping capabilities; innovation-related funding, legal and project management capabilities). Moreover, the reception of the workshop outputs enabled the innovation division to seek board support for other initiatives such as the institution of a national conference for health innovation and a health-tech startup incubator. When the hospital deliberately adopted a digital transformation strategy, the innovation unit was selected to be the owner of the digital transformation because of its previously developed capabilities. We elaborate on how these initiatives pulled or pushed the development of capabilities in the remainder of this study.

5. Findings

Figure 1 illustrates our data structure. The following subsections further detail each of the attributes presented in the data structure and present a sample of the statements that prompted our coding. Appendix C presents a more extensive selection of coded interviewee statements. Subsequently, we arrange the codes that emerged in our data structure in the following two formats: first, into a capability model (Figure 2), relying on the Teecian "sensing, seizing, reconfiguring" framework for dynamic capabilities. This presents a static perception that is instrumental in our sensegiving of the case and can be compared with other accounts of capabilities for digital transformation in the literature (e.g., Sousa-Zomer et al., 2020; Warner and Wäger, 2019). Second, we arrange the codes into a timeline (Figure 3), an approach that enables us to discuss the practices by which the identified capabilities are developed. We elaborate on our case in a more grounded discourse, and address how the capabilities are developed over time. We emphasize that building these models is the final step in our data analysis; we present them to lend structure to our narrative, following the example of previous research that adopted a similar methodological approach (Patvardhan et al., 2015). We present our narrative in a logical instead of chronological order to better elaborate on the role of design thinking in this case.

In our coding, identified dynamic capabilities are the second-level themes and aggregate dimensions are a group of dynamic capabilities that are sufficiently close to one another. When we began exploring the case, we were interested in the impacts of the long-term adoption of design thinking observations revealed how the ongoing efforts to disseminate design thinking across the organization enabled it to implement digital transformation by developing human capabilities for digital transformation. Accordingly, we analyze the data through this lens.

Figure 8 - Data structure

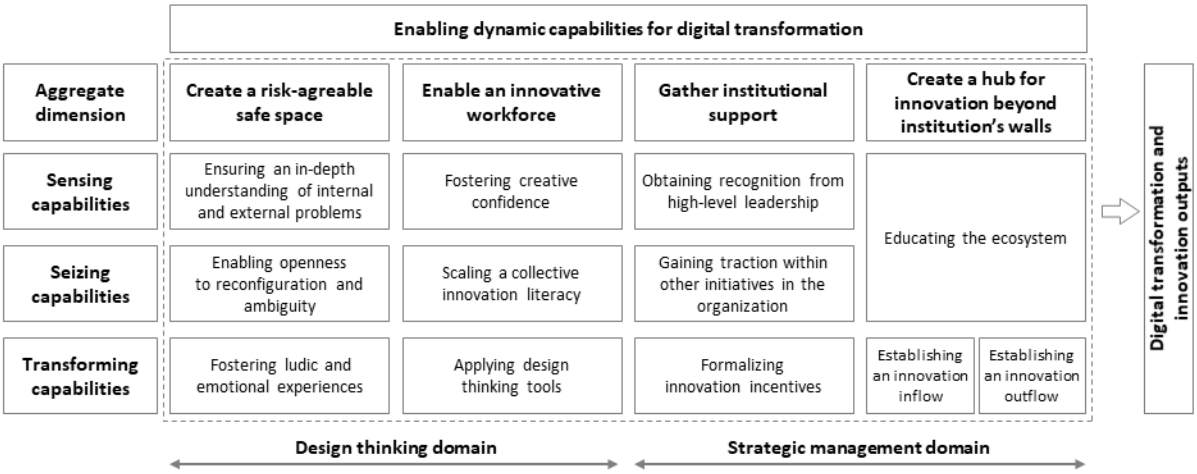

Figure 9 - Capability model for the enabling capabilities for digital transformation

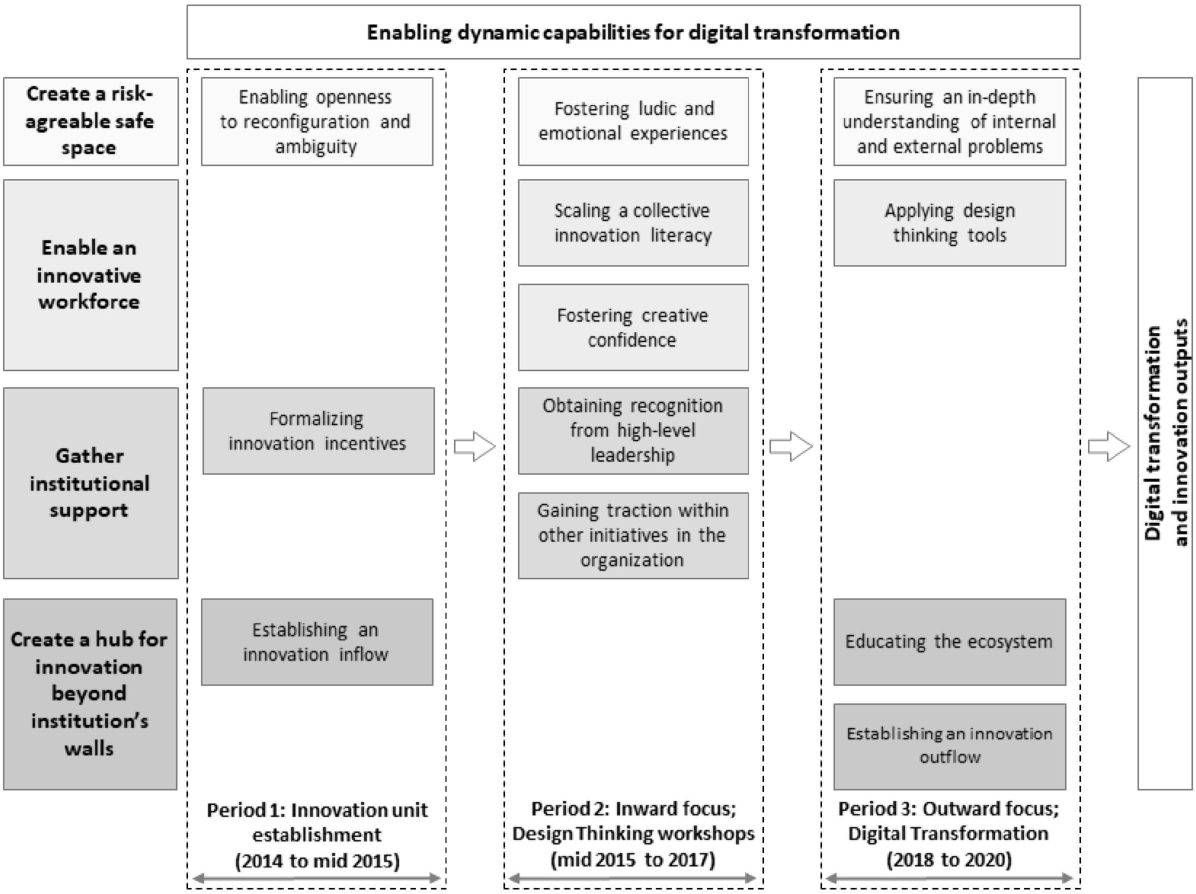

Figure 10 – Process for developing the enabling capabilities for digital transformation

5.1. Create a risk-agreeable safe space

Having a separate unit for innovation allows for an environment within the mainstream organization in which learning and experimentation are encouraged and failure is tolerated. This risk-agreeable space is built based on three main capabilities: *fostering ludic and emotional experiences*, *enabling openness to reconfiguration and ambiguity*, and *ensuring an in-depth understanding of internal and external problems*; these capabilities are ignited in design thinking workshops and hence fall under the "design thinking domain" in our model in Figure 2. Appendix C: Table 1 presents the confirmatory statements for this dimension.

5.1.1. Fostering ludic and emotional experiences

One of the first initiatives to foster a collective understanding of innovation within the organization was the launch of an in-house design thinking workshop program that took place in the middle of 2015 and was still ongoing at the time of data collection (mid-2020). The workshops had sessions dedicated to ideation, in which the participants were encouraged to seek risky ideas through ludic activities such as prototyping. Building prototypes was also meant to sentimentally touch the individuals engaged in the workshop with a memorable experience and a sense of the power of their creativity as a group. The effectiveness of this strategy is perceived as positive by our interviewees:

> *"At the ideation phase, we advise the participants to prototype the boldest ideas [...]. We take on several [prototyping] rounds looking for [the participants to have] a memorable experience. Sometimes our focus is mainly cultural and if we insist too much on a marketable result, we might loose on the memorable experience which is culturally interesting." Innovation unit personnel*

> *"There is also a playful side to it, creating the prototype. [...] Even if you're not conscious, when you build a prototype you sort of liberate yourself, you are not judged." Mainstream organization personnel*

5.1.2. Enabling openness to reconfiguration and ambiguity

The innovation unit has had buy-in from the C-level since its origins in 2014. It was created with a mandate to disrupt how the organization understood and worked toward innovation. As one of our informants states, it is a “clash of worlds” between a conservative hospital practice and a risk-taking innovation practice. It was made possible, first, because of the autonomy granted to the innovation unit to reconfigure itself. In the early days of the innovation unit, it was expected to develop a generative capability of exploring as many ideas as possible. This capability was built by creating an innovation laboratory with multifunctional squads that had a role in enabling products, services, and projects selected by the management team. A significant fraction of these products, services, and products was digital solutions. A former employee of the innovation unit sheds light on this trajectory:

> *“At the time, we were proving our identity and our reason to exist within the institution. We were building innovation gateways to approve the innovation projects that were coming from different stakeholders, but we also had a lot of flexibility because we had to build a portfolio, show our work and outputs, and sort of make mistakes, you know? But really, to give it some velocity and to show execution abilities.” Former innovation unit personnel; current spin-off/startup personnel*

Over the years, some of these projects, products, and services demonstrated their product-market fit. Accordingly, the innovation unit was again challenged to build a new competence; this time, which was in the middle of 2016, it was a capability related to navigating the ecosystem. This new competence was built by fostering entrepreneurship and mentorship programs within the organization, which resulted in the creation of four spin-offs. The intention of building this capability is illustrated in the following quotes:

> *“In the beginning, what happened was like “let’s build it”. Then, we were like, we can’t keep on building MVPs [minimum viable products], we have to take something to the market and be successful, and how do we do that? And then we built the spin-offs” Innovation unit personnel*

> *“We worked a lot with [fostering] entrepreneurship, so there were other approaches, other types of capacitation, other types of role models, mentorship programs, to complement design thinking.” Innovation unit personnel*

At the beginning of 2019, when the organization developed its digital transformation strategy, the innovation unit received more resources to become the owner of digital transformation initiatives within TakeCare. Once again, it reconfigured itself to support the organization’s needs, which is explained below.

> *"As an innovation lab, we went through stages: first, we had the big challenge of proving that we were able to develop (products and services). Then, we had to prove that we were capable of taking products to the market, so we had the spin-offs, and now we are reinventing ourselves, considering digital transformation." Innovation unit personnel*

5.1.3. Ensuring an in-depth understanding of internal and external problems

By assessing that some of the problems they dealt with were wicked by nature, the innovation unit acknowledged that there was no right or unique pathway to pursue a solution and that they might have to pursue multiple paths until they achieved a satisfactory one; that was a change in the paradigm of working with innovation at TakeCare, which, as any health provider, tended to be risk-averse and looked for previously proved solutions. This technique of assessing problems in depth before pushing out a previously existing solution was used across the workforce through design thinking workshops. Moreover, as illustrated in the below-mentioned quote by a member of the innovation unit, if a problem perceived by the organization was brought to the innovation unit and was assessed as a problem of relatively low complexity, the unit would transfer it to other other departments such as continuous improvement or quality assurance as they did not need the innovation unit's specific knowledge to solve the problem.

> *"The institution started having a bit of maturity to understand that when someone comes in with a new idea, we might have to take some steps back to assess the problem, or that a person needs to bring up a problem and then we look at it together, if it makes sense out to the market, and see if we apply the methodology [design thinking] or if continuous improvement or other methodologies can handle it." Innovation unit personnel*

This maturity in understanding problems in depth was more intentionally developed after the innovation unit received the mandate for defining and executing the strategy for digital transformation at the beginning of 2019. Since then, DT has been employed as a strategic approach for managing digital transformation by engaging the workforce. In the following explanation, the members of the innovation unit outline how design thinking has been adopted to address the changes in understanding the problems related to digital transformation:

> *"We are using design thinking as a cultural foundation for digital transformation. It cannot go any other way. That's why my sector embraced digital because we have a very strong cultural challenge." Innovation unit personnel*

> *"I believe that when we talk about digital transformation, we have processes that were built throughout history that were not based on technology; they were based on a bunch of people doing repetitive actions. When you transition to a digital mindset, there is a complexity due to the history of the behaviors revolving around that processes… […] Technically, the problems involved in that processes might not even be that complex, but because we have a cultural transformation associated with those behaviors, we end up applying the [design thinking] methodology to reassess the process. You have to break with the past." Innovation unit personnel*

5.2. Enable an innovative workforce

Our study analyses a decentralized healthcare institution with over 13,000 employees and 10,000 registered healthcare professionals with a 24/7 operations across distributed locations. One of our informants clarifies: "A hospital is a single company formed by several microbusinesses inside." Hence, to achieve capillarization in these several microbusinesses, TakeCare invested in a strategy to enable its employees to become innovation agents through the institution's previously mentioned design thinking workshops. It was achieved by developing three capabilities: *scaling a collective innovation literacy*, *applying design thinking tools*, and *fostering creative confidence*. These capabilities were developed in design thinking workshops and consequently fall under the "design thinking domain" in our model in Figure 2. Appendix C: Table 2 presents the confirmatory statements for this dimension.

5.2.1. Scaling a collective innovation literacy

In the course of five years, beginning in mid-2015, over 600 employees have been formally trained in design tools, prototyping techniques, new business models, and user research, under the "Design Thinking workshop." In the workshops, the training was both theoretical and hands-on. A theoretical lecture was presented to the employees, and after the lecture, they would work and apply the theory to an actual solution they were building, which was digital solutions in the majority of cases. By training numerous employees from several areas, the innovation unit aimed to form multiplicators of this innovation literacy within their sectors.

> *"For example, when we are focused on the process of cocreating a product in a specific area. We turn this into an event or a series of events where we put our [innovation unit] people to train the individuals at this event. In the event, we get a group of around 40 people from [several areas of] the institution and lead a series of training. We start the training by explaining what is design thinking, and these people learn about design thinking but intending to create a product. So in this cocreation*

process, we combine the two things: teaching the techniques and building a product that might be relevant for the institution" Innovation unit personnel

A relevant remark is that the approach to fostering innovation literacy does not focus on learning the specifics of new technology; instead, it focuses on a culture of holistically restructuring processes and products, as indicated by one of our informants:

> *"I cannot think of a way to transform an institution that is not through experience. So, when I think about design thinking today, I think of it as a platform, a tool... Everyone talks about it as a framework, a toolbox, but I call it a mindset, it is much more of a mindset than anything else. Without this mindset, we will be talking about technology for the sake of technology" Innovation unit personnel*

> *"The great merit of the design thinking workshops was to find these multipliers and disseminate this culture of restructuring processes, products, and a different way of thinking about health among our employees." Innovation unit personnel*

5.2.2. Applying design thinking tools

Similar to most organizations in the healthcare sector, TakeCare had a strong physician-centered culture. It was challenged by forming multidisciplinary workgroups in the design thinking workshops, which surpassed the workshops' settings when employees realized the value of working in diverse groups. One of our informants describes this diversity thus:

> *"I liked the methodology, the way the classes were assembled, and how they put different people in the groups. My team did not have anyone from my sector, for example, so it was a very multidisciplinary group." Mainstream organization personnel*

Moreover, employees were encouraged to actively engage with customers' needs in a structured way using tools such as personas, interviews, and shadowing. They were trained how to apply these tools in the workshops. The interviewees claim that they continue applying these tools in their routine activities:

> *"[During one of the workshops] For example, on one of the days, we went on to conduct the empathy sessions, and the interviews along with the group, and this changed everything about their perception and feedback of their experience with the methodology, because we went along with them, did the shadowing with the patients, or were there while they were talking to the patients […] One of the doctors that were resistant about doing the empathy sessions, and had been saying "we should hire a consultancy to do this", he went and did the interviews himself, and he was touched about making things right. This perception of going into the field with them was excellent because sometimes we give an assignment on the workshops, and then one or two people in the group conduct the empathy sessions. And it is really not the same experience for the people who cannot participate in empathy-related activities." Innovation unit personnel*

> *"[Regarding the benefits of the design thinking workshops] There are things that we thought of in a certain way, and then we stop, look outside the box, and then bring another perspective. On a daily basis, and not even in a structured, step-by-step way, but we apply the things we learned even if we do not intentionally stop to develop something now. It broadened my vision […], and I think that was what I gained the most from this workshop." Mainstream organization personnel*

Finally, the collective design thinking literacy and autonomy in applying design thinking tools legitimized innovation and digital transformation initiatives to emerge and grow autonomously, at least in the initial ideation steps. It is because they could be conducted by employees who were previously trained. Accordingly, the innovation unit avoided becoming a bottleneck in overseeing low-scale innovation and digital transformation initiatives, and each employee could kickstart these ideas into ideation using what they had learned in the design thinking workshops. When the innovation unit started to execute the organization's digital transformation strategy in 2019, hundreds of employees were already trained to use design thinking tools. As our informants reveal, they are qualified for in digital transformation satellite projects in their sectors:

> *"Design thinking [workshops] were also a way we found to incorporate different skills into working together. If you look at it, if someone comes and brings me a problem, what do I do with it? Do I assemble a workgroup? Do I hire someone to act on it? So when someone inputs an idea into our idea collection portal, this is a structured way to advance from an initial insight, or sometimes a problem, but then you have to find a way to advance it. And well, this is a hospital. I don't have dedicated staff [for R&D], I don't have an engineering team dedicated for… Well, now we have a digital lab, but anyway [...] how do we depart from your initial insight? [With design thinking workshops] Well, we now have a methodology, a pathway which is a bit clearer to explore these things. And these insights come from everywhere, from our idea portal, from an executive that gives me a call, so there are multiple entrances." Innovation unit personnel*

> *"[About design thinking workshops] It undoubtedly helped me at the moment that I am living now. There is an area in HR that is implementing a project which works with agile methodologies, and I was invited to be a part of it. […] The workshop gave me a foundation for this." Mainstream organization personnel*

5.2.3. Fostering creative confidence

Employees must have the encouragement, tools, psychological safety, and creative confidence to actively engage in transforming activities. TakeCare fostered these attributes within the design thinking workshops that began in 2015, in which employees were encouraged to take proactive roles and become aware of their own abilities in seeking innovative solutions for their daily problems. This fact is demonstrated in the following statement:

> *"When we arrive at the workshop, the group has a conversation, it understands from each sector each one comes from, what problems they are aware, where they navigate, what are their competencies, and this self-awareness is also a part of the methodology, understand all the possibilities so they chose their path and direct a few problems that can be relevant." Innovation unit personnel*

5.3. Gather institutional support

The innovation unit had buy-in from the C-level, but it gained respect among the employees by connecting with ongoing initiatives. It was achieved by developing three capabilities: *formalizing innovation incentives*, *gaining traction within other initiatives in the organization*, and *obtaining recognition from high-level leadership*. Appendix C: Table 3 presents the confirmatory statements for this dimension. While design thinking-related initiatives overlap with the capabilities identified in this dimension, we characterize this dimension under the "Strategic management domain" in Figure 2 because the development of these capabilities is not a direct outcome of design thinking adoption.

5.3.1. Formalizing innovation incentives

Along with initiatives to culturally change the organization to promote innovative solutions, there was also a movement to implement formal incentives for innovation within the organization. This initiative began in the first months of the innovation department's existence (2014) and evolved over the years. It comprised the following incentives: the creation of a system for capturing innovation ideas from employees, creation of an internal yearly award with financial compensation for employees who engage in innovation activities that generate successful outputs, creation of an intellectual property shared ownership policy on profits, and mandatory inclusion of design thinking workshops in the hospital's career development track. Our informants highlight the incentives and explain how employees regarded them.

> *"[Regarding the increase in employee innovation activities] I think it is a multifactor issue… For example, we have the innovation employee award, which is another way to foster employee initiatives, we have the design thinking workshops, we have the*

> *startup incubator, which is an incentive to internal entrepreneurship itself… […] The award has money in it. It's symbolic, I mean, it's maybe 500USD… It's symbolic but it's good, I'd like to win it." Innovation unit personnel*

> *"Here is something interesting: the HR department incorporated it [design thinking workshops] in the career development track of their employees. So when it comes to a certain level of seniority, a senior analyst or a specialist needs to have this workshop." Innovation unit personnel*

5.3.2. Gaining traction within other initiatives in the organization

The innovation unit was conceived with the mission of using innovative solutions to help the mainstream organization fulfill its objectives. Even though the new unit was disruptive, there was no conflict within the organization. The first initiatives of the innovation unit focused on employing technology to solve problems related to healthcare institutions in clinical and non-clinical fields, such as shift management and genomic data analysis. Nevertheless, even though the innovation unit mandate was strongly rooted in technology-related initiatives in the beginning, their problem-solving abilities were soon required to coordinate the development of solutions within the organization. These issues were not directly related to technology but were seen as wicked problems such as the creation of a new remuneration model for healthcare professionals and elaboration of the strategic planning of the organization in 2019. The members of the innovation unit narrate how they actively became involved in these issues:

> *"There are lots of elements that have to do with TakeCare's digital transformation. But there are also more pragmatic problems that a stakeholder needs help with, that need a non-traditional approach for solving, and then our team acts on demand on those." Innovation unit personnel*

> *"At TakeCare, for example, we have several challenges that are also in operation, in the medical-institution relationship, and the medical-patient relationship, so we have several landscapes, sectors, and even cultures within the institution that bring us challenges that are not exactly related to technology. [...] We have applied design thinking even in building the strategic planning of the institution. […] The institution has seen it in a very positive way, and we end up extrapolating our scope with this insertion in the institution as a whole."* - *Innovation unit personnel*

5.3.3. Obtaining recognition from high-level leadership

The innovation-related initiatives and benefits of the design thinking workshops started being recognized in an expressive way in the organization. Top executives began to request the involvement of the innovation unit in solving their units' latent problems. Moreover, managers started nominating selected employees to take part in the design thinking workshop dynamics and became actively involved in workshop ideation, problem debriefing, and assessment of workshop outputs. This approximation led the innovation unit to create formal innovation and entrepreneurship committees to continuously assess the innovation projects portfolio and emerging opportunities. Finally, in 2018, "Innovation" became a stand-alone section in TakeCare's public financial report, which also indicates its value as perceived by upper management. The following quotes illustrate this perceived value of design thinking by high management:

> *"[Regarding how they had become enrolled in the workshop] It was a suggestion from our manager… With this dissemination within the hospital, he thought it would be good for my team, because of the services we provide here in the hospital." Mainstream personnel*

> *"[After the workshops] Then we get these products and set up a committee, in which I take part, [innovation director] takes part, and a series of guests to collaborate. [...] Sometimes we collaborate by saying something like "Have you studied this other market?" [,,,] When you bring up expertise from outside healthcare [...] there lies the richness of these committees, you start saying "there is this other industry that is doing this well, have you checked them out?". So that these people refine their products, to the point where it is actually interesting and refined. And then, we gather these most promising products and take them to an entrepreneurship committee here, in which even our president participates." Innovation unit personnel*

5.4. Create a hub for innovation beyond the institution's walls

The final dimension that stands out in our case was TakeCare's establishment of an innovation hub to connect with external actors in several configurations; within this hub, TakeCare acted as a focal firm. One of our informants stated: "Our core business is not to develop products, it is to take care of people." Knowing the place they wanted to occupy in the ecosystem shaped how TakeCare allocated its resources to elevate the plateau of the ecosystem, internalize valuable solutions produced outside, and externalize valuable solutions produced inside. These solutions needed more traction than TakeCare was willing to provide. This feat was achieved through three capabilities: *educating the ecosystem*, *establishing an innovation inflow*, and *establishing an innovation outflow*. Appendix C: Table 4 presents the confirmatory statements for this dimension, which falls under the "Strategic management domain" in Figure 2.

5.4.1. *Educating the ecosystem*

TakeCare connected the ecosystem by creating a place and context for different actors to meet and connect, such as startups, investors, pharmaceutical companies, and universities. This movement started in 2014 by hosting keynote speakers on thematic events and moved to creating a conference for healthcare innovation (four yearly editions from 2017 to 2020); it culminated in opening the first healthcare-focused startup incubator in the country (2017). An innovation manager delineated these efforts:

> *"Last year [2019] we had... I don't know exactly the number, but we had more than 200 events here (in the startup incubator). And all sorts of events, for example, we hosted an angel investment meetup, and the leader of one of the angel investment groups said that it was the first time he saw so many groups reunited, so the exchange caused a commotion. Another excellent keynote was when people from [Unicorn startup outside the Heath sector] came to discuss high growth [...], which was open to internal and external audiences. You can go online, sign up, and come to watch. And we had more than 200 of these, so this continuous promotion of knowledge is a part of our dynamics" Innovation unit personnel*

Additionally, TakeCare participated in open innovation initiatives as a strategy to combine its assistive expertise and the technological expertise of other institutions in problem-solving. Through its open innovation initiatives, the innovation unit identified a gap in innovation literacy for the healthcare sector. Accordingly, in 2019, it began providing the same design thinking workshops as an external service for employees along with two other consulting services for new product development and immersion in innovation activities. The market acceptance of these services also helped to legitimize the innovation unit inside TakeCare. Our informants illustrate this ambition of elevating the sector plateau by connecting with problems that go beyond TakeCare:

> *"A lot of what we do here at TakeCare's innovation sector is not related to TakeCare's problems; we even have a map at our office that says "Solutions for the healthcare system", so these were always our targets." Innovation unit personnel*

> *"Our idea when we go to the market [...] We're not a teaching institution, nor a consulting, we don't want to be stuck on it: we want to disseminate the innovation process both internally and in other firms because we come to a point where we can't fulfill as an organization. [...] Our very methodology is based on this, to elevate the plateau of the sector." Innovation unit personnel*

5.4.2. *Establishing an innovation inflow*

The innovation unit also started to import external knowledge and experiences related to the organization's internal problems from the ecosystem. It was done by acquiring and investing in other companies and establishing partnerships for co-development on specific technologies. In 2014, TakeCare hosted a "Startup circuit" for connecting internal sectors with early-stage solutions developed in the market. As an outgrowth of this strategy, TakeCare opened its startup incubator focused on health-tech in 2017. TakeCare's brand and acknowledgment of its high-quality services made health-tech startups want to be associated with their incubator. The development of capabilities for conducting this inbound open innovation strategy was intentional and structured by a project management office within the innovation unit. According to the following testimony by one of our informants, it was effective:

> *"The ecosystem they [TakeCare] created is really an ecosystem. [...] People meet through TakeCare, people meet through their events, the incubation... We, health techs, we can meet because TakeCare is a good hub." Spin-off/Startup personnel*

This strategy allowed TakeCare to enjoy the benefits of solutions that would take months or even years to be internally developed. The partnerships with startups have been highlighted in TakeCare's financial reports since 2017, which is when they made their first investment in a startup.

> *"As a strategy, several projects have been developed here using the open innovation concept. More than 1000 startups have sought TakeCare; about 500 were evaluated in person, and 15 partnerships were established involving technical cooperation, product co-development, clinical research, and investment." Financial report*

5.4.3. Establishing an innovation outflow

The boiling internal environment for innovation began showing effect. Innovation projects with positive innovation outputs and business outcomes became new businesses, with their customer portfolios being inside and outside TakeCare. These projects thrived for acceleration beyond TakeCare's rhythm, an incumbent institution. Subsequently, the innovation unit started tracking tailored pathways for each prominent project, and provided training to foster intra-entrepreneurship and broaden the possibilities of advancing these projects. These pathways were primarily based on establishing partnerships with players that had abilities that TakeCare did not have or intend to develop (ex.: manufacturing). This process enabled it to externalize internal projects that, as a result of a strategic decision, needed to be developed in a high-growth environment that was unavailable within TakeCare. The results of this strategy were creating spin-offs (four spin-offs had been created at the time of data collection), licensing internal technology for incubated startups, and licensing internal technology to external partners or manufacturers. The following statements describe the strategy:

> *"Our core business is not to develop products, it is to take care of people. So we do everything through partnerships, and even the idea of building spin-offs is based on that. It is hard for us to prospect partnerships, and if someone in here [builds something worth of commercializing]… Laissez-fare, then if it works, sell it to me. Our idea is always to prospect [partnerships] because we will not build an industry to produce surgical materials and sell them, for example. It does not make sense." Innovation unit personnel*

> *"We divided our digital transformation mandate into three foundations: first, we have the incentive to intraentrepreuneurship […] We have former employees who, while they received their regular paycheck, they built products that proved interesting, then went to the market, that became a spin-off and now they are entrepreneurs, and TakeCare is their partner." Innovation unit personnel*

To illustrate the nature of the solutions that pursued this innovation outflow, we draw on two cases of digital innovation. First, we draw on a solution developed in a multidisciplinary DT workshop that is focused on the interaction with oncological patients through a mobile app during follow-up. The workshop team engage in further development efforts after the workshop and manage to build and test a functional prototype. However, full development would not be cost-effective unless the solution could also be launched to external users. Sensing the synergy among its initiatives, TakeCare's innovation unit licensed the software solution to one of its incubated startups that was already in the market for oncological patient care.

Second, we examine the case of a web platform for analyzing genetic data. The initiative was submitted by a bioinformatician in TakeCare's idea platform in 2015 as a tool to increase quality and reduce time in genomics diagnosis. The business case of the idea was validated and the innovation unit assembled a multifunctional squad to develop a functional software application. In 2018, the software was launched in the market in a spin-off operation. Since then, the spin-off has garnered more clients and product-service offerings.

5.5. Digital transformation and innovation output

Finally, TakeCare was able to identify outputs related to its innovation initiatives. We use only the accounts reported in TakeCare's public financial reports to avoid employee confirmation bias. Appendix C: Table 5 present the confirmatory statements for this dimension.

5.5.1. Innovation Award

The first outcome identified is the recurring recognition of TakeCare among the most innovative companies in the country, according to a national innovation award from 2020. The external recognition positively reinforces Take Care's position among external actors in the ecosystem.

5.5.2. Quantifying digital and innovation initiatives

By gathering information from their public reports, we ascertain that from 2017 onward, the digital innovation initiatives are explicitly reported among the main results of the organization. These initiatives are mainly reported in terms of the number of initiatives related to digital innovation and not the business outcomes generated. Nevertheless, they indicate more than 80 incubated startups, four spin-offs, more than 80 consulting projects completed, seven registered patents, and unspecified benefits related to innovation projects of operational and assistive nature.

6. Discussion

To date, the relationship between design thinking and digital transformation has remained underexplored. Recent studies have elaborated on the capabilities driven by design thinking in digital transformation projects by analyzing them at the project level (Magistretti et al., 2021c). They have also drawn on manager's perspectives on how design thinking can help to build a managerial mental model suitable for digital transformation and Industry 4.0 (de Paula et al., 2023). By answering the research question that drives this study, “*How does design thinking relate to capability building for digital transformation in healthcare organizations?*,” we extend the understanding of the relationship between design thinking and digital transformation. We analyze how design thinking-driven capabilities that enable digital transformation are built across time within a non-digital-savvy organization, by adopting a social construction perspective.

We classify the capabilities in the study as enabling capabilities for digital transformation; that is, firms willing to conduct a digital transformation should mobilize to develop their capabilities before executing a digital strategy to assure that the organization is sufficiently mature to implement this strategy. Digital transformation is a long endeavor and launching ambitious initiatives without organizational readiness may hinder the innovation-driven enhancement of business(Zhen et al., 2021). While previous studies contribute to consolidate the microfoundations of capabilities required for an organization’s digital transformation (Warner and Wäger, 2019), the mediating roles of digital capabilities and firm digital performance (Sousa-Zomer et al., 2020) can facilitate capabilities in discovering digital technology opportunities at a project level (Magistretti et al., 2021c). No previous study has examined how organizations can adopt design thinking to drive enabling capabilities for digital transformation over time. We present a timeline for the development of enabling capabilities for digital transformation in Figure 3. We focus not on the technical capabilities that are necessary for digital transformation but on analyzing the managerial capabilities of individuals exposed to a digital transformation.

This study makes the following contributions. First, we detail the mechanisms by which the dynamic capabilities for digital transformation are driven by design thinking. Second, we discuss how the organization’s readiness for an ecosystem in which these capabilities can be developed and continuously deployed, consistently generating value throughout the years.

Third, we discuss the limitations of design thinking in building capabilities for digital transformation and how they may be overcome.

6.1. How are capabilities for digital transformation driven by design thinking?

Figure 3 illustrates that, after the initial period of development of the innovation unit, in which the initiatives were mostly endogenous to justify and establish the existence of this unit within the organization, period 2 strongly focuses on deploying design thinking to engage the workforce. It broadens the scope of the innovation unit's work and fosters capabilities for engaging in innovation activities. We further discuss each capability developed in periods 2 and 3 and present it in Figure 3. These capabilities can be directly or indirectly attributed to design thinking and relate to digital transformation.

Fostering ludic and emotional experiences. This capability was put into practice through the creation and engagement with prototypes, allowing for the reinterpretation of what was previously perceived as a failure as a teaching opportunity. It leads individuals to understand that failure is an expected and perhaps necessary part of developing products or services, as Gerber and Carrol (2012) assert. It enables people to break away from the risk-averse that is typical of the sector and prepares them to actively engage in and have a mindset for rapid prototyping. This aspect has been presented as a capability required for digital transformation (Warner and Wäger, 2019).

Scaling a collective innovation literacy. Training hundreds of employees in design thinking workshops and making them the ambassadors of design thinking within the organization crafted a shared digital mindset and digital-savvy workforce. Warner and Wäger (2019), Solberg et al. (2020), and Souza-Zomer et al. (2020) identify both these capabilities as requisites for digital transformation.

Fostering creative confidence. Magistretti et al. (2021b) defines individual creative confidence as "a sense of belonging and willingness to contribute to the organization's innovativeness by creatively proposing opportunities." It can be fueled through coaching and experience (Kelley and Kelley, 2013). In design thinking workshops, individuals were encouraged to connect their technical abilities with their creative potential. The workshops focused on the learner's experience, and fostered the individual's sensibility and reflection, which are typically absent in managerial cultures (Rylander Eklund et al., 2022). Those involved in digital transformation initiatives are constantly challenged with the unknown and must be resilient and self-aware of their work (Cavalcanti et al., 2022). This approach fosters individual creative confidence, an ability that can positively contribute to digital transformation efforts and must be supported by organizations willing to carry out effective digital transformation.

Obtaining recognition from high-level leadership. The innovation unit reinforced the buy-in it had from the C-Level and obtained executive support and respect through design thinking initiatives, extensive portfolios, and their outcomes. This fact is evidenced in the executives' requests for the involvement of the innovation unit in their projects. Executive support is seen as an enabler of digital transformation (Sousa-Zomer et al., 2020; Warner and Wäger, 2019).

Lifting traction within other initiatives in the organization. By enabling employees and managers to contribute to solving problems in the design thinking workshops, the unit helped solve latent problems in clinical and non-clinical areas of TakeCare. We confirm the findings of Björklund et al. (2020) who found that organizations' ongoing transformation initiatives and needs have been linked to as a strategy to legitimize design-related capabilities, such as DT and building contribution.

Ensuring in-depth understanding of internal and external problems. Design thinking has helped the organization with framing and reframing pre-existing problems in different areas. Magistretti et al. (2021c) proposed that digital transformation goes beyond the digitalization of previous analogical processes, products, or services, and necessitates the capability to expand the knowledge base after considering how technology can actually improve a previous analogical interaction. In departing from this understanding, we deduce that this capability, fostered by design thinking directly contributes to digital transformation.

Applying design thinking tools. Design thinking's attributes such as interdisciplinary collaboration and user-centeredness can relate to how individuals overcome challenges and learn (Dell'Era et al., 2020; de Paula et al., 2023; Marx, 2022). In the design thinking workshops, employees learned how to autonomously apply design thinking tools and methods in a replicable manner. Thus, they used design thinking as a social technology that could be reconfigured for given purposes on demand—a construct introduced by Liedtka (2020). This ability to continuously reconfigure their toolbox to overcome new challenges helps organizations achieve integration and innovation in their digital transformation endeavors (Guo et al., 2023; Hanelt et al., 2021; Usai et al., 2021).

Educating the ecosystem. Our case positioned itself as a focal firm within the ecosystem, -providing a hub for actors to meet and interact. It also offered resources to elevate the plateau of the ecosystem in terms of innovation, such as the creation of partnerships with universities and other companies, and in offering consulting services. By capacitating the ecosystem, the organization benefited from co-creation and coopetition initiatives with other actors. As Warner and Wäger (2019) propose, such actions directly enable the capability for digital transformation to navigate the digital ecosystem.

Establishing an innovation outflow. Consequent to the design thinking generative initiatives, more internal projects showed positive results and necessitated the creation of new paths to market and funding. It led the organization to create spin-offs, license internally developed technologies, and establish open innovation partnerships. As Warner and Wäger (2019) emphasize, navigating digital ecosystems, which entails establishing collaboration initiatives with external partners, is a dynamic capability for digital transformation.

Collectively, the capabilities directly or indirectly enabled by the structured adoption of design thinking as an organization-wide approach led to innovation and digital transformation, digital savviness, navigation of digital ecosystems, and a digital mindset within the organization. We elaborate how these capabilities were built and explore the role of time in this construction.

6.2. Readiness for developing capabilities for digital transformation

In Figure 3, even though period 1 does not directly relate to the central inquiry of this study—capability development for digital transformation through design thinking—we find this period to be relevant for our capability model for three reasons. First, the organization only empowered the innovation unit with the resources for conducting the design thinking workshops. Eventually, it implemented the digital transformation strategy because of its proven capacity for *enabling openness to reconfiguration and ambiguity*, which was highly valuable within a risk-averse environment. Hence, our case corroborates Warner and Wäger's (2019) proposition that strategic agility and internal structure redesign the enabling capabilities for digital transformation.

Second, *formalizing innovation incentives* made employees voluntarily seek out initiatives driven by the innovation unit. It provided the unit feedstock to develop solutions that eventually increased the innovation unit's social and political capital within the organization. Through such volunteer involvement, even though the firm strategy can be steered toward pursuing either operational efficiency initiatives or innovation initiatives depending on external and internal factors, employees will willingly use their idle time—or seek efficiency in their routine tasks—to pursue innovation activities, thereby assuring organizational ambidexterity. The existence of innovation-oriented financial incentives positively moderates ambidexterity within organizations (Ardito et al., 2019). Ambidexterity is considered a necessary capability for competitive firms in the digital world (Vial, 2019).

Third, by *establishing an innovation inflow*, the innovation unit demonstrated to the middle and top management that they could make a better use of new technology, business models, and solutions to provide enhanced care and operational efficiency. It started with the connection of internal sectors to health-tech startups in 2014, and ignited digital-savviness within management that served as a catalyst for their future involvement in design thinking and digital transformation initiatives. Digital-savviness is a capability required for digital transformation (Sousa-Zomer et al., 2020). In our case, this capability was fostered by the exposure of risk-averse management to the potential benefits of importing existing innovation solutions by connecting with external partners.

Hence, these three capabilities (enabling openness to reconfiguration and failure, formalizing innovation incentives, and establishing an innovation inflow) create a nourishing environment for the capabilities of digital transformation driven by design thinking to emerge and endure. Our findings support the need to ascertain organizational and readiness conditions for adopting the practice of design thinking (Wrigley et al., 2020) and digital transformation.

6.3. Limitations on the digital transformation capabilities driven by design thinking

Over the years, the benefits of engaging and empowering the workshop outweighed the role of design thinking initiatives in effectively developing and deploying products and services. The capabilities gained at the more difficult stages of digital transformation, such as managing digital portfolios (Warner and Wäger, 2019), establishing digital business models (Vial, 2019; Warner and Wäger, 2019), balancing rapid innovation and operational excellence (Sebastian et al., 2017), and seeking digital-based sources of funding, required more structured management processes than the practice of design thinking could effectively provide. Hence, the activities related to hard skills in project management and generative, design-thinking fuzzy innovation front-end were split into two separate structures within the innovation unit. This situation prevented them from cannibalizing one another.

The generative design thinking activities ensure the outputs of innovation in terms of new products, services, or processes. Typically, these outputs are in their infancy and require further investment before they can produce business outcomes. Furthermore, these outputs are formally assessed by innovation and entrepreneurship committees, where executives analyze them based on their potential. If selected, these outputs are tunneled into a project management pipeline separated from the generative design thinking activities; this pipeline strives to further embed these solutions to ensure that the outputs generate business outcomes in terms of financial success, customer base, or other specific business goals. Design thinking does not provide the structure to drive the validation and launch of elaborated products or services within a regulated market. Thus, there is a need for more rigid approaches to project management to complete these stages.

From our case, we find that separating the structures responsible for generative design thinking initiatives and hard skills related to digital transformation and innovation management is beneficial in achieving the outputs and outcomes of digital transformation.

6.4. Implications for theory

This study's contributions to theory are as follows. First, regarding the digital transformation theory, we extend the understanding of building capabilities for digital transformation (Appio et al., 2021; Guo et al., 2023; Matt et al., 2015). Our study explains the dynamics of actively building capabilities for digital transformation through design thinking, explores the changing dynamics of organizational structures responsible for managing digital transformation (Appio et al., 2021; Warner and Wäger, 2019), and examines the role of time in building capabilities and producing business outcomes (Sousa-Zomer et al., 2020; Warner and Wäger, 2019). We elaborate on the mechanics of this construction of capabilities using a longitudinal lens, and complement research that has analyzed the phenomena at an aggregate level (Correani et al., 2020; Ghosh et al., 2022; Warner and Wäger, 2019).

Second, regarding the intersection of design thinking and digital transformation, we explain how design thinking actively sources dynamic capabilities for digital transformation at an organizational level. The literature has explored the potential of design thinking powering capabilities for digital transformation at the project level (Magistretti et al., 2021c), its relationship to digital capabilities in light of platform-based venture performance (Kamble et al., 2023), and has presented it as a process embedded in the dynamics of the digital transformation of an organization (Correani et al., 2020). Nevertheless, our study is the first to explain the mechanisms by which design thinking drives dynamic capabilities for digital transformation.

Third, regarding the intersection of design thinking and dynamic capabilities, we extend the theoretical underpinning of design thinking by connecting it with the dynamic capability literature. For this purpose, we follow previous studies that were built on this theoretical comprehension (Auernhammer and Roth, 2021; Magistretti et al., 2021b).

Fourth, in response to Micheli et al.'s (2019) call, our study adds to the limited and overdue systematic studies on the adoption, implementation, and outcomes of design thinking as an organization-wide approach to innovation. We find evidence that wide-spread design thinking adoption may provide collateral benefits to firms that were not initially predicted. In our case, design thinking was not deliberately deployed to build capabilities for digital transformation; however, when the firm defined their digital transformation strategy, the already entrenched learnings of design thinking were recognized as valuable for executing this strategy and accordingly fostered. We present evidence of how design thinking drove innovative and strategic thinking across the organization, thereby providing new business opportunities such as the creation of spin-offs and licensed products. It answers Elsbach and Stigliani's (2018) question as to whether the results of using design thinking on a project level can surpass the boundaries of the project at an organizational level. Finally, we have shed light on the trajectory of change within an organization that adopts design thinking as a practice, thus exploring the limitations of design thinking, the challenges in its adoption, and ways in which these challenges can be overcome. Accordingly, we complement Carlgren and BenMahmoud-Jouini’s (2022) cross-case study on the cultural challenges on design thinking implementation with a longitudinal analysis of design thinking adoption. Additionally, similar to Carlgren and BenMahmoud-Jouini (2022), we contribute to the body of research that seeks to study the individuals engaged in using design thinking has been scarcely explored in the literature and offers a chance to investigate the implementation of design thinking and compare it with other innovation management practices.

6.5. Implications for practice

This study provides a timeline to develop enabling capabilities for digital transformation, and guide managers and executives involved in a digital transformation themselves. Additionally, it provides evidence on how design thinking can contribute to an organization beyond the outputs of its projects. Hence, by departing from our timeline, digital transformation and design thinking initiatives can benefit one another and help organizations gain strength.

Specifically, for healthcare and other regulated, risk-averse industries, this study outlines how a non-digital-savvy culture can be effectively broken to build a structured digital-savvy one. This process can be time-consuming; therefore, we provide a timeframe within our process models; healthcare managers may learn from these experiences and set realistic plans to endure their digital transformation process without borrowing unrealistic benchmarks from other industries.

6.6. Limitations

This study has its limitations. First, it presents a single case study from an industry, thus significantly restricting the extent of its generalization. To mitigate this issue, we provide a thorough description of our findings and appended transcripts of our interviewee data, and allow the audience to assess the transferability of our findings. Second, we are unable to isolate the effects of each capability on the generation of innovation and digital transformation outputs and outcomes. Nevertheless, to avoid speculation and assure consistency regarding the impacts of design thinking adoption, we rely on triangulated qualitative data from employees in the mainstream organization, innovation unit organization, spin-offs and startups, and on financial reports. Finally, while we collect data spanning six years, this study covers a transformation process that is still in progress within the organization. Considering that "digital transformation is a process that will never be completed," we believe that this limitation contributes to the value of the study, as it presents a transient perspective of an ongoing phenomenon that might go through other stages of maturity that can analyzed in future research.

We suggest future research on design thinking to further explore the mediating relationship between design thinking adoption and emerging innovation streams of research such as digital transformation, the adoption of agile approaches, and construction of ecosystems. Moreover, while we explore here the possible benefits of adopting design thinking as a widespread approach to innovation, its benefits could be analyzed more tangibly. We recommend future research on design thinking and digital transformation to quantitatively investigate the return on business outcomes of design thinking initiatives, and consider new businesses and process improvements stemming from design thinking results of these studies may present more factual evidence on the mediating effect of design thinking on digital transformation output and outcomes.

7. Conclusion

This case study explores the adoption of design thinking as a structured approach to innovation and digital transformations in an incumbent healthcare organization. In departing from the research question, "*How does design thinking relate to capability building for digital transformation in healthcare organizations?*" we extend the understanding of how the practice of design thinking can be implemented in organizational settings and how it can be leveraged to drive capability development for digital transformation. We help establish design thinking as a credible field of innovation research by relating it to other innovation approaches and illustrating the empirical evidence for this relationship. Developing the capabilities for executing a digital strategy is a continuous process. Our study contributes to the literature by presenting how this construction may occur over time.

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