THE POLITICS OF USER FRIENDLY:
A TECHNO-ANTHROPOLOGICAL INVESTIGATION OF THE ROLE(S) OF UX IN CULTIVATING INFRASTRUCTURE IN A DANISH MEDICAL COMPANY

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Abstract

This thesis sets out to explore the role(s) of UX in the development and establishment of information infrastructure in DMC, a Danish pharmaceutical company. UX professionals constitute an important link between technology and users, yet the prevalent framing of UX work seems to reduce it to a straightforward, mechanical, and uncomplicated endeavor. With infrastructure studies as our analytical lens, we challenge this impression and examine more closely the infrastructuring work carried out by UX professionals as they contribute to the complex socio-technical task of cultivating working infrastructures. Conceptualizing infrastructure as a complex actor-network encompassing a plethora of heterogenous actors, the thesis employs the notion of infrastructural inversion to explore the practical-political process of establishing an information infrastructure in DMC and investigates the 'battles' taking place in the process. Based on our analysis, we identify four roles enacted by the UX team. First, they act as a *rescue team*, summoned to repair infrastructural breakdowns. As *negotiators*, they build and negotiate relations between different configurations of human and non-human actors, often with the aim of helping users appropriate less-than-optimal infrastructure. As *strategists*, they employ tactics to maximize the impact on their work and intervene in change initiatives to fend off infrastructural crises. Finally, they engage in *activist* work to establish UX as a 'golden standard' in infrastructural change processes. Based on these roles, we argue that UX professionals can act as central change agents in the establishment and cultivation of infrastructure, and we suggest that foregrounding and leveraging these 'invisible' modes of infrastructuring work can potentially lead to more effective and inclusive infrastructural change processes.

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1. Introduction

Infrastructures are an integral part of modern society and thus inevitably embedded in today's labor market. The world is becoming increasingly connected via networked digital technologies (Karasti, 2014) and today's workplaces are characterized by complex infrastructures consisting of social, material, technical, and political components entangled in IT systems enabling communication, information sharing, collaboration, and support of a wide range of other activities central to modern worklife.

Bowker and Star (1999) argued that infrastructures are not simply physical or technological systems, but also involve social, cultural, and political elements. Their work on infrastructure studies has been influential in shaping the field of STS and has contributed to a better understanding of the role of infrastructures in shaping social, cultural, and political life.

The term *work infrastructure* is coined by Pipek & Wulf (2009) and refers to "the entirety of devices, tools, technologies, standards, conventions, and protocols on which the individual worker or the collective rely to carry out the tasks and achieve the goals assigned to them" (p. 455). Furthermore, *information infrastructures* - which refers to the collection of communication networks, software, hardware, and data that supports the processing, storage, and dissemination of information - has become an increasingly significant part of today's labor market. As more and more businesses and organizations rely on digital tools to manage data, communication, and collaboration, the need for efficient, user-friendly information infrastructures has grown. But who is present at the decision-making table and agrees on what these infrastructures should contain, and whose needs the infrastructures should accommodate? An effective, successful information infrastructure invisibly supports work practices, and therefore its components should be designed with the user in mind. Accordingly, user experience (UX) researchers and designers may be hired by organizations to conduct user research, uncovering what the users sees, experiences and does in the encounter with a system or application, and conveying knowledge about the users' experiences, needs and challenges to other actors such as IT architects and engineers, so that solutions are built *with* the users and not just *for* them. By actively engaging users in the design, development, and evaluation of products, services, or systems, UX researchers and designers can help ensure that a product or service meets the needs and expectations of users (and other stakeholders), potentially

increasing the efficiency and usability of the overall infrastructure. Furthermore, since the visual interface(s) of an information infrastructure is the user's 'access point', that is, how they use the infrastructure, the outcome of a UX professional's work can greatly impact what the user can and cannot do by, e.g., affording new choices and possibilities or restricting room for maneuver (Edwards et al., 2009, p. 371).
In this sense, UX constitutes an important link between technology and the users interacting with it. Yet, the prevailing perception of UX professionals and their function is somewhat reductionist, with definitions usually limited to work that 'simply' provides a good user experience and an easy-to-use and intuitive interface (Norman & Nielsen, n.d.; Rajanen et al., 2017). While such achievements are in themselves important and are preconditions for a working infrastructure, they do not necessarily take into account important questions such as *what* it is a good user experience *of*, what choices and potential conflicts an 'intuitive' experience entails, or what sort of work is involved in making an infrastructure *an infrastructure*. In other words, the narrow understanding of UX as a means to make human-technology interactions 'enjoyable' and 'easy-to-use' implies a neutral end-goal that largely ignores the fact that establishing a working information infrastructure is a highly complex socio-technical task (Hanseth & Monteiro, 1997, p. 183).
This argument can further be supported by Star, who argued that infrastructure is an ethical choice in that it always values specific ways of organizing the world (Star, 1999). According to Star, infrastructure is not merely neutral technical systems; instead, it reflects and promotes particular values, norms, and power relations. She considered it a dilemma rather than just a complex task. Star contended that ethical considerations are always involved when decisions are made about infrastructures. The choice of infrastructure forms and systems has consequences for various stakeholders and society as a whole, where certain infrastructures might favor particular modes of organizing, communicating, or exerting power, while potentially marginalizing or suppressing alternative ways (Ibid).
In this thesis, we seek to draw a link between the inherently practical-political process of establishing an information infrastructure, and one of the perhaps most prominent disciplines in technological development in today's digitalized society - namely, UX.

Although the idea of including the user in the design of technology in some way or form has a very long history, the modern conceptualization of UX as a discipline emerged in the 1990s, concurrently with an academic turn to user studies. The study of user involvement in designing new technologies emerged as a part of the Science and Technology Studies research

movement's wider effort to develop alternatives to crude forms of technological determinism - the idea that technology develops on its own, and its impact on society is inevitable (Elgaard Jensen & Hyysalo, 2023). At that time, many policy actors and academics subscribed to ideas or ideologies about the existence of a so-called technological imperative, where technology was believed to develop according to its own inner logic or driven by economic necessity, and that it would have necessary and determinate impacts on society (p. 1).

To counter these deterministic views, STS scholars conducted historical or ethnographic case studies to offer a more nuanced and realistic view of how technological innovations develop in practice, emphasizing the role of historical contingencies, local circumstances, and various actors, including users, in shaping the development and use of technology (Ibid, p. 1-2). With such accounts arose new constructivist perceptions of technology and technology development, and the idea that users were simply passive recipients of whatever new technology that emerged was challenged by explanations demonstrating a reality of complex socio-technical assemblages, giving much more attention to an organic interplay between technology and humans.

Perhaps not surprisingly, economic benefits do constitute the main argument for integrating UX research in product and system development, with the rationale being that a seamless experience generates more users and therefore more revenue (e.g. Nielsen, 2017). Similarly, a well-functioning information infrastructure successfully supporting employees in their day-to-day work tasks can improve efficiency and productivity. However, the emergence of the discipline and its still increasing popularity on the labor market alludes to an underlying recognition of technology as something that is not only shaped by economic incentives, but rather is constructed and evolves through social and technical forces. We believe this encourages an inquiry that goes beyond the immediate understanding of UX professionals' work and digs deeper into their position as central actors in the creation of a technologically interconnected world.

This thesis sets out to do just that. With infrastructure studies as our analytical lens, we wish to challenge the prevalent conception of UX professionals and their work, and explore whether there might be more depth to the role of UX in the process of designing, establishing and configuring information infrastructures. To move beyond a principal discussion of what UX should do, we wish to explore what role(s) UX professionals specifically embody. We do so by turning our gaze to a specific UX team in a Danish organization, and examining their

situated contributions to processes aimed at changing or cultivating the organization's information infrastructure. We explore both the roles they attempt to take on in these processes, as well as what roles other actors encourage or impose on them.

We present a case study of an information infrastructure project taking place in a Danish pharmaceutical company, which for the sake of this report will be assigned the pseudonym the Danish Medical Company (DMC). The purpose of the project - *The Infrastructure Project*, as the case has been given as a pseudonym - was to redesign an already existing information infrastructure since it did not live up to its purpose of supporting DMC's employees in their opportunities to seek for internal material related to professional learning and development in an easy and intuitive way. An internal project team in DMC therefore reached out to the UX team to help improve the infrastructure by making it more user-friendly. With the case study as our empirical basis, we set out to explore two questions:

What is the practical-political process of establishing an information infrastructure in DMC, and what role(s) does UX play in that process?

In this thesis, a practical-political process refers to both practical considerations and political dynamics in decision-making or problem-solving. For example, political factors could be power dynamics and competing interests, and practical considerations such as feasibility, efficiency, and effectiveness.

In the following sections, we provide a more in-depth presentation of our case. We first introduce the Danish Medical Company as our empirical setting, including the UX team connected to the organization's internal IT systems. Following this, we provide an introduction to the specific case project, *The Infrastructure Project.*

1.1 The Danish Medical Company

In this thesis, the authors collaborated with a UX team from a Danish founded pharmaceutical company, The Danish Medical Company (DMC). DMC is a global healthcare company, founded in 1923 and headquartered just outside Copenhagen. It is the largest medical company in Denmark. The company employs more than 50,000 people in 80 offices around the world and markets their products in 170 countries.

DMC's mission is to drive change to defeat diabetes and other serious chronic diseases such as obesity, and rare blood and endocrine diseases. The company strives to achieve their mission with pioneering scientific breakthroughs, expanding access to their medicines and working to prevent and ultimately cure the diseases they treat. Furthermore, DMC has, with its almost 100 years of experience, one of the broadest diabetes product portfolios in the healthcare industry, as well as an award-winning pipeline of innovative products.

1.1.1 User involvement in the Danish Medical Company

User experience and user involvement is far from a new approach in DMC. However, in DMC, there is not just one department or area dedicated to user experience and user involvement - on the contrary, there are many different larger and smaller UX teams across the entire organization that all focus on user involvement. The primary focus for the UX team in scope for this thesis is the various internal IT systems in DMC, and to ensure ease of use for the 50,000 internal employees at DMC using their internal IT systems.

While DMC has a long tradition of conducting rigorous UX work on end users for their marketable products, UX on internal IT systems is a more recent and less established effort that aims to increase the usability of DMC's information infrastructure and thus, conducting UX research on the internal IT-systems at DMC is a relatively new approach. This UX team was established approximately three years ago - by the time of writing - as part of an organizational change towards a so-called agile framework, where agile methodologies were employed to be responsive to changing circumstances and requirements. Prior to this establishment, there had not been a project approach within IT where UX and user involvement were naturally included in the culture of development of internal IT systems. The purpose of employing an agile approach is to help teams to be more flexible and adaptable in their work and the agile methodologies furthermore emphasize the delivery of working software in short, iterative cycles, which ideally can help teams to deliver products more quickly and with higher quality (Alexander, 2018).

As of today, it is yet a common perception within the organization that working with standardized IT systems indicates that you cannot make user improvement and involvement, because the majority of the IT systems in DMC are already existing systems. However, since the establishment of the UX team in 2020 there has been a growing interest in UX across the organization, and the work done by the team has repeatedly shown that it is possible to make

user inspired improvements on already existing IT-systems. The increasing interest in UX can be showcased by the fact that the UX team has found it necessary to expand in order to meet the increasing demand from teams across the organization and has gone from consisting of two employees in addition to the UX manager until in 2021 to, at the time of writing, consist of 14 employees in the team. And further, DMC's IT support department receives fewer support cases - i.e. situations where employees need assistance with a respective IT system - after the UX team has completed their work.

Furthermore, the consultants in the UX team use a wide range of objective research metrics to measure the effect of their work, which enables them to objectively assess whether the user satisfaction and intuitiveness of a respective system has increased or decreased. One method of doing so is through the use of a semantic differential scale, the Single Ease Question (SEQ). The SEQ presents a 7-point scale with the ends labeled ‘very easy’ and, respectively, ‘very difficult’.

1.1.2 The UX team as a consultancy business

Within the various departments and larger teams in DMC, there are also so-called ‘project teams’. Project teams are smaller work groups that collaborate around a specific task or project, and usually consist of a number of 5-8 people. It is typically these project teams that are involved in collaboration with members from the UX team and hire the UX consultants into their projects.

The UX team have developed a “service catalog” containing all the UX services and activities with a detailed description related to focus areas (e.g., interview, workshop, usability test ect.), an estimated number of working hours for the UX consultant and fixed prices for the UX services.

The people who reach out to the UX team are responsible for finding the budget within their department to finance the services offered by the UX team. This is a quite atypical procedure in DMC, where other services are not usually being financed between departments. Thus, one may characterize the UX team as a consulting business, where other teams or departments across DMC contacts the UX team if they wish a certain service from the catalog.

The formal procedure for establishing a collaboration with the UX team reads as follows: The respective project initially contacts the UX manager as the first step in the engagement process and thereafter the UX manager and the project team engage in a non-binding conversation on

which UX research methods and approach might be relevant to fit the purpose of the project. The project team will then be connected with a UX consultant with the competencies and professional experience that matches the respective task in scope for the project, and during a kick-off meeting between the UX consultant and the project team, the UX consultant receives information and insights about the respective IT system's characteristics, functionalities, capabilities, and limitations.

Thus, the UX consultants are involved in the project(s) on the premise of being unbiased partners to assess and evaluate the IT system(s). The UX manager thereby serves as a link between the project team and the UX consultant, enabling the UX consultant and the project team to further align on the duration and project scope and to discuss and identify the relevant characteristics of the desired end users of the IT system.

Once the UX consultant has conducted the relevant user research, she will present an executive summary of her findings together with some design recommendations for the IT system(s). In the duration of the project, multiple alignment and work meetings are held, ensuring that the project and its involved stakeholders are on the same track and thus, it is an iterative process with ongoing back and forth discussions between the UX consultant and the project team.

This overview provides an important basis for understanding the fundamental dynamics for integrating UX in efforts to make changes to DMC's information infrastructure. The procedure described above also reflects the UX team's entry point into The Infrastructure Project which we, the authors, had the opportunity to study and which will be described in the following section.

1.2 The Infrastructure Project

This thesis presents a case study of DMC and, in particular, The Infrastructure Project, which was initiated in an attempt to make changes to a part of the organization's internal information infrastructure. The project was carried out by a UX consultant who collaborated with a project team from DMC consisting of a Product Owner, a Development Lead, an Associate Director and a UX student assistant.

The purpose of The Infrastructure Project was to redesign an already existing information infrastructure and to develop one integrated platform for internal material related to professional learning and development for DMC's 50,000 employees. The project was a re-

design of an already existing site on SharePoint - a Microsoft cloud service commonly used by enterprises for storing and sharing files. The two systems that particularly caused frustration among the employees were 'Degreed' and 'LearnIT', which were also scoped for investigation in The Infrastructure Project. Degreed is a learning experience platform (LXP) that provides individuals and organizations with a centralized platform for discovering, tracking, and validating learning and development activities. LearnIT is also a LXP where shorter video materials and articles on a specific topic are available to the users.

The initiative behind The Infrastructure Project stemmed from a growing frustration with the already existing infrastructure among the employees in DMC. These frustrations were particularly rooted in an incohesive user journey for the employees - i.e, the steps that the user will go through in order to reach a certain goal - when they had to use and navigate the infrastructure.

A thorough description of the project's process line together with a description of the activities carried out throughout the project and a description of the involved actors will be presented later in the thesis' methodology chapter.

1.3 Reading guide

Having set the scene for our thesis, we now present an overview of the rest of the thesis' structure to enhance the readability and introduce its main components. A brief description of each chapter will be provided to give the reader an idea of how we will build up our arguments.

1. First, we present our theoretical framework. We provide a discussion of infrastructure studies as a prominent field of research in STS. We build upon this by supplementing with relevant terms from Actor-Network Theory (ANT), positioning our empirical field within a relational ontology.
2. The second chapter presents our methodological considerations, delimitations and choices, an overview of our empirical material, and further touches upon research ethics, methods, as well as an in depth description of the steps and activities carried out during The Infrastructure Project.
3. In the third chapter, we present the analysis of our case study. The analysis is divided into three parts where we explore the practical-political process of cultivating infrastructure in DMC, and how the UX team seeks to gain influence on the processes.

4. In the fourth chapter, we present a discussion of the analysis in which we turn to consider the infrastructuring work carried out by the UX team. We do so by identifying four different 'roles' that the UX professionals embody as they participate in infrastructural change processes. The chapter ends with a discussion on further implications for practice.
5. In the final chapter of this thesis, we present the conclusion together with an answer to our research questions.

2. Theoretical framework

We now present our framework of theoretical resources which we will draw upon to investigate our empirical field. Our framework consists of two 'legs'. First, we present infrastructure studies as a theoretical and methodological field in STS and discuss central terms and themes that have served as both inspiration and analytic foci for the investigation undertaken in our thesis. We then unfold this theoretical foundation by turning to Actor-Network Theory, drawing on its relational ontology as a means to explore infrastructures and infrastructural change as heterogeneous networks containing multiple interests and objectives. Finally, we outline how we will apply these theoretical resources to our research questions.

2.1 Infrastructure studies

Studies of infrastructures originated within STS with ethnographic examinations of digital communication systems (Star & Ruhleder, 1994; Star & Ruhleder, 1996). Inquiries into these systems were motivated by a desire to understand how technical infrastructures and classification systems enabled systematization and classification of information, and how this influenced communication and cooperation between workers (Langstrup & Winthereik, 2021). These studies brought a new, holistic perspective to infrastructures and revealed that far from being mere technical artifacts capable of circulating people, objects, or information, they were results of complex social and political processes, and as such they inhabited and enforced values and social order.

Central to infrastructure studies are the scholars Susan Leigh Star and Geoffrey Bowker. In their influential book *Sorting Things Out: Classification and Its Consequences* (1999), the authors investigated how categories and standards order and systematize the world, and how

infrastructure takes shape - and often becomes invisible - through such ordering. Their argument was that while "to classify is human" - since classifications act as boundary objects which allow for cooperation across social worlds (p. 15) - it is never a neutral endeavor, since "each standard and each category valorizes some point of view and silences another" (p. 5). The point was - and is - that infrastructures depend on, and are therefore imbued with, choices about how to represent social order, practice, and norms. Thus, the book suggested that infrastructures should be perceived as systems that inhabit both technical and social elements, have built-in instructions for use, and therefore often act normative in the contexts in which the systems are used (Langstrup & Winthereik, 2021, p. 183). Star, in particular, was concerned with how these characteristics could lead to marginalization and cut off groups and individuals from the infrastructure, emphasizing how "one person's infrastructure is another person's brick wall" (Star, 2002, p. 116). For instance, Bowker and Star (1999) pointed out how the International Classification of Diseases reflects Western values and perceptions of physiology and medicine, largely discrediting the legitimacy of the realities of other cultures. Similarly, Star pointed to the encoding of 'master narratives' into infrastructure, using as example a medical history form for women that "encodes monogamous traditional heterosexuality as the only class of responses", leaving no room for other crucial forms of information that fall outside this type of classification (Star, 2002, p. 119).

Based on such discoveries, Star argued that the ecology of the workplace is "profoundly impacted by the [...] infrastructure that permeates all its functions" (Star, 1999, p. 379). Echoing this sentiment, Edwards et al. (2009) argue that infrastructure can shift or conserve resources and potentialities for action; while some groups or individuals may find their room for maneuver expanded, others might end up being constrained.

In the rest of this section, we will further elaborate on central themes within infrastructure studies and relate them to the research conducted in this thesis.

2.1.1 Infrastructure as relational and invisible

The point of information infrastructure is that it supports activity. Accordingly, scholars often refer to infrastructure as the 'substrate' that allows the 'substance' to happen: the technical fabric of the infrastructure is insignificant in itself because it is a fundamentally relational concept that always happens "in practice, for someone, and when connected to some particular activity" (Star & Ruhleder, 1996, p. 112). As such, it is always seen as a relationship between peoples' organized ways of 'doing things' and the technologies that enable and support these practices (Simonsen, Karasti & Herzum, 2020, p. 118). For the same reason, an intrinsic

property of a working information infrastructure is that it remains invisible to its users. Standards and intuitive infrastructure 'outlets' - such as the computer screen and the digital interface - serve to ensure a seamless exchange of translations between technology(ies) and user (we shall elaborate on the notion of translation later). As a result, the user - who, at the workplace, is likely to use the infrastructure all the time - will rarely ever think about it. Good infrastructures, in a sense, are those who come to be taken for granted, which often happens once their use has been learned as part of membership of a community of practice (Star & Ruhleder, 1996). So, as long as the technologies serve their designated purposes, they remain invisible to the user. However, the invisibility becomes visible when the infrastructure breaks (Star & Ruhleder, 1996), and when that happens, "the interdependencies among work tasks and IT tools make the infrastructure failure a primary concern for workers" (Pipek & Wulf, 2009, p. 449). Such a situation, according to Pipek & Wulf, represents a 'point of infrastructure' in which invisible elements of the work infrastructure become salient for the actors in the situation, and various strategies for repairing the breakdown may be orchestrated. Classic examples of an infrastructural breakdown are power outages or server failure (the latter might also be a result of the former). In these instances, normally taken-for-granted dependencies become very clear because they make it impossible or at least difficult to perform the activities they supported. Other, less tangible - but just as crucial - examples of breakdowns might be when updates or changes to protocols or data exchange formats render systems incompatible, or when system capacity and user base do not match. Studies of information infrastructure have shown that infrastructural breakdowns may be 'reversed' by either fixing them so as to restore them to their former state and possibly improving them, or by acts of user innovation where users may either reconceptualize their own work or find ways around the infrastructure to make it work (e.g., Pipek & Wulf, 2009).

While information infrastructures are invisible by definition, they do not emerge naturally as such. Establishing an information infrastructure is a highly complex sociotechnical task and its invisibility is an outcome of considerable effort, work and investment (Simonsen, Karasti & Herzum, 2020, p. 120). Below we will unfold this argument further.

2.1.2 The installed base

A central argument in infrastructure studies is that infrastructures are never built 'de novo'. Rather, they "develop amidst a stream of technical antecedents, social conventions and professional rules and have to be adaptive to the developments of work practice" (Aanestad et al., 2017a, p. 30). This observation is related to the previously discussed idea that the technical,

the material and the social are inherently interwoven in infrastructures, but it has further implications yet. The argument here is that any new infrastructure builds upon, and must integrate with, an existing installed base that includes "not only artifacts but human habits, norms, and roles that may prove its most intractable elements" (Edwards et al., 2009, p. 366). Hanseth and Lyytinen (2008) argue that new infrastructures are designed as extensions to or improvements of existing ones in contrast to 'green field design' - that is, design that emerges independently from existing surroundings. Accordingly, they define information infrastructure as "a shared, evolving, heterogenous installed base of IT capabilities on open and standardized interfaces" (p. 208). The conceptual distinction between infrastructure and installed base is, therefore, difficult to capture. Indeed, it seems there is little consensus across literature, and the concepts may be either used interchangeably or as two completely different phenomena. Infrastructures, when they settle, stabilize, and become an integrated part of work practice, become *part of* the installed base - which, again, new infrastructural development must build upon. However, until such 'fusion' happens, and the infrastructure is still in what we might call a contested state, it is more so *at odds* with the installed base.

The installed base is an important concept in infrastructure studies because it has a direct impact on the possibilities and constraints for future development of an infrastructure (Grisot, Hanseth & Thorseng, 2014, p. 202). New technologies and practices must often be compatible with the existing installed base in order to be adopted and integrated into the system. For instance, a new software application must be compatible with the existing hardware and network infrastructure in order to be useful to users. Aanestad et al. (2017a) argue that an organization's "huge and messy portfolio of IT systems" may significantly impact its freedom to improve and innovate, for both technical and financial reasons (p. 28). Accordingly, projects for infrastructural change and development are shaped by "the organizational, institutional, regulatory, sociotechnical arrangements that are already in place" (p. 29). Aanestad et al. remind us that the notion of the installed base is a conceptual tool, and "not a name for some independently existing reality. [...] [By] focusing on the installed base, attention is directed towards the links with existing arrangements and the evolutionary processes of [infrastructures]" (p. 51).

2.1.3 Infrastructuring

Having discussed the most salient characteristics of information infrastructures and their implications for the sociotechnical contexts in which they operate, we now turn to another

important concept central to this thesis. The notion of infrastructuring refers to the continual activities that contribute to the successful establishment of an infrastructure (Pipek & Wulf, 2009), including various actors' efforts to tailor, modify and reconfigure infrastructures for local use. It implies that infrastructures are not only relational, but also processual, in that they are never just 'built' or 'emerge', but rather are continually negotiated through both design and use. Elaborating on this idea, Pipek and Wulf argue that in the realm of information infrastructure, we need to move away from the traditional designer/user dichotomy, because it imposes a narrow perspective that evokes wrong associations pertaining to the impact each group can have on the infrastructuring process. For instance, an employee (user) who is confronted with new systems must find ways to integrate them into existing work practices, and thus engages in infrastructuring.

This emphasizes infrastructure as a fundamentally social and organic phenomenon rather than a 'build-and-serve' object that can be separated from use and practice. Additionally, by switching to viewing infrastructure as a transitive verb, "new moments in infrastructural development and new kinds of work come into view" (Edwards et al., 2009, p. 370). Several ways of describing the continuous process of creation and reinvention of information infrastructures have been proposed as alternatives to the static 'building' orientation: Edwards and colleagues has suggested 'growing' as a metaphor for infrastructure as an organic unfolding within an existing and changing environment (p. 369), while Ribes and Finholt (2009) describe participants' activities as 'enacting' infrastructure (p. 379). A third metaphor, which we have found to be particularly suitable for our study, is provided by Aanestad et al. (2017a), who advocate for using the notion of 'cultivating' infrastructure: rather than emerging through separate and deliberate construction processes, this metaphor encapsulates the fragility of an infrastructure and reminds us that it needs nurturing and tending to, and that many different sources of influence are responsible for its form, success and possible failure.

Infrastructuring, then, can be perceived as the breadth of work and activities involved in growing, enacting, and cultivating infrastructure. In our thesis, we refer to it as *infrastructuring work*.

The notion of infrastructuring also points to the political and contested nature of infrastructure. Information infrastructures are, by definition, community resources that must be able to reach beyond a single event or one-site practice to continually support and connect activities and (work) practices (Ribes & Finholt, 2009; Star & Ruhleder, 1996). They must be designed and built with scalability and sustainability in mind; preconditions which are problematic, because,

as Ribes and Finholt argue, the rapid pace with which IT changes opposes long-term planning of a future-proofed infrastructural landscape (p. 376).

Nevertheless, the extensive work involved in creating and 'cultivating' an information infrastructure necessitates the pursuit of "persistent institutional arrangements", suggesting "connotations of permanence, transcending individual lives, interests, or intentions" (p. 379).

As a consequence, infrastructuring as a multi-actor process will often give rise to tensions among these actors as conflicting goals, purposes, and motivations clash and complicate the process of establishing a useful infrastructure. Global (e.g. organization-wide) goals and visions may overrule local or individual needs, such that infrastructuring becomes an involuntary or even unwanted practice that involves attempts at achieving individual or local (work) goals not with the aid of, but *despite* of the infrastructure. Actors may therefore find themselves in a situation in which immediate problems and needs need to be addressed simultaneously with strategic goals and potential future alignments (Edwards et al., 2009, p. 370), which, at the same time, must take into account the rigidity of the installed base.

As such, it follows that there is no 'correct' solution for developing new information infrastructure; instead it involves trade-offs and necessitates some working resolution between possibly conflicting interests. As Edwards et al. (2009) put it, infrastructures seem to be "both an all-encompassing solution and an omnipresent problem, indispensable yet unsatisfactory, always already there yet always unfinished work in progress" (p. 365). Indeed, this description captures the embedded, fragile and inherently controversial nature of information infrastructure.

2.1.4 Infrastructural inversion

How, then, do we go about exploring information infrastructure as a relational, processual, and distributed phenomenon capable of dictating social order and room for maneuver? To reveal and study the sociomaterial fabric of information infrastructure and its hidden complexity, Bowker and Star suggest we turn to the notion of *infrastructural inversion*. As an analytic strategy, infrastructural inversion is a struggle against the tendency of infrastructure to disappear (Bowker & Star, 1999, p. 34) by shifting attention from the activities invisibly supported by an infrastructure to the activities that enable the infrastructure to function (Simonsen, Karasti & Hertzum, 2019, p. 115). It entails "learning to look closely at technologies and arrangements that, by design or by habit, tend to fade into the woodwork" (Bowker & Star, 1999, p. 34). As such, it is a way of opening up the infrastructure to descriptions of how it came into existence, how and by whom it is used, which standards, values

and decisions it encompasses, and which consequences it has (Langstrup & Winthereik, 2021, p. 185). In other words, infrastructural inversion makes it possible to reveal and study the normally invisible, taken-for-granted elements of the infrastructure *and* to explore the infrastructuring work taking place behind and around these elements.

According to Simonsen, Karasti and Herzum (2020), there are several strategies for using infrastructural inversion to study infrastructures. The *conceptual-analytic* strategy exploits an infrastructural breakdown as a useful entry point for infrastructural inversion. For both researchers and people working with infrastructures, the authors argue, moments of breakdown are opportune situations because they reveal large swaths of infrastructural activity. (Simonsen, Karasti & Herzum, 2020, p. 122). An *empirical-ethnographic* strategy, on the other hand, involves "turning to the members who are involved in infrastructuring activities as part of their job description". Finally, infrastructural inversion may be employed as a *generative* resource on which actors draw in shaping and reinterpreting their own infrastructure (p. 123).
In our research, we draw primarily on the conceptual-analytic and the empirical-ethnographic strategies (though all three strategies are interrelated and may be employed by researchers and participants alike). Our point of entry into our empirical field is a local breakdown; part of our analysis aims to identify what caused such a breakdown. Through this point of entry, we proceed to explore the UX professionals as an actor directly, and formally, involved with the infrastructuring activities going on around the breakdown.

2.2 Actor-Network Theory

We now turn to the second 'leg' of our theoretical framework. Infrastructure studies has much in common with, and draws inspiration from, the relational ontology underpinning Actor-Network Theory (ANT). Originating in studies examining the production of scientific facts, ANT is grounded on the claim that science, just like any other social practice, is constructed by a number of human and non-human actors interacting with each other towards achieving specific objectives (Latour & Woolgar, 1979). Throughout the years, the initial interest in the construction of scientific facts has expanded to include technology, organization, and more (Elgaard Jensen, 2021, p. 82).
Generally speaking, ANT rejects both technological determinism and *social* constructivism as viable approaches to explaining the relationship between humans and technology. It says that "there is no reason to assume, *a priori*, that *either* objects *or* people in general determine the

change of social change or stability" (Law, 1992, p. 383). That is, according to ANT, technology and the social cannot be meaningfully separated but are inherently interwoven in a socio-technical web (Latour, 1996). The world, including scientific facts and technological inventions, is constituted through laborious processes that are effects of relations between actors enrolled in networks. Consequently, the focus of ANT is the effects of relations (Jensen, 2021, p. 83).

In ANT, *actors* are very loosely defined because they are inherently heterogenous. They can be anything (an object, a text, a discourse, etc.) as long as they contribute with an effect on the surrounding network. Actors are what they are *in their relation* to other actors, and not by virtue of any inherent characteristics. In other words, an actor can never exist outside of a network because it is an outcome of conditions and activities happening within the network. In this sense, actors are material-semiotic: they may embody material qualities but those qualities are granted meaning through their relations (Law, 2019).

This idea also posits the presence of intrinsic agency within any actor, regardless of its nature or whether or not it is intentional: a thermometer lets us interpret the world outside by representing temperature, rain falls and makes the farmer's crops grow, GDPR policies in an organization may dictate how co-workers communicate - and so on. When something acts to transform a certain arrangement - a network - it is an actor. In extension of this notion, ANT claims that there is no difference between an actor and a network: actors *are* networks who, from a certain perspective, have reached stability and predictability and thus are perceived as 'black boxes' (Elgaard Jensen, 2003, p. 7).

In line with this conception of actors and agency, ANT adopts a 'flat' ontology in that it assumes that there are no essential differences between different kinds of things (Law, 2019, p. 4): all entities in a network are granted the same explanatory status and should be analyzed on equal terms, and with the same terminology. This is called the principle of generalized symmetry.

2.2.1 Programs, scripts and translations

As mentioned before, actors operate in accordance with certain objectives or interests. One way to understand such objectives, and how actors seek to reach them, is through the notion of programs and anti-programs. Programs of action can be viewed as the strategies actors employ to stabilize and achieve order in a network in such a way that certain actions are enabled or restricted. To illustrate this, Latour (1990) described a scenario in which a hotel manager has a

problem: he keeps losing his hotel keys because the guests bring them outside of the hotel and lose them. He wants to make sure the guests leave their keys at the front desk when leaving (the program), so he verbally asks them to do so - but to no avail. The guests keep taking their keys with them (the anti-program). Then the manager puts up a sign in the reception. A few guests now comply, but many still ignore or overlook it. Finally, the manager decides to attach inconvenient metal knobs to the keys, compelling the guests to subscribe to his program and leave the keys since they can no longer ignore it.

In Latour's hotel key example, the hotel manager gains strength and pushes the front line of his program by associating other actors which, in return, eventually succeed at enrolling the actors previously associated with the anti-program in the network. The way he does it is, essentially, by *inscribing behavior* into the network. The notion of scripts, or inscription, refers to the way actors such as technical artifacts embody patterns of use. As such, they represent specific programs. Akrich (1992, p. 208) explains the notion as follows:

> "Designers thus define actors with specific tastes, competences, motives, aspirations, political prejudices, and the rest, and they assume that morality, technology, science, and economy will evolve in particular ways. A large part of the work of innovators is that of 'inscribing' this vision (or prediction about) the world in the technical content [...] The technical realization of the innovator's beliefs about the relationships between an object and its surrounding actors is thus an attempt to predetermine the settings users are asked to imagine."

Depending on their strength, scripts may or may not succeed at enrolling other actors in a program: the hotel manager's words were a weak script, whereas the metal knobs were strong enough to enforce the program of action onto the guests. The concept thus emphasizes the ways in which human and non-human actors form relations essential to the way the network takes form, and it demonstrates the mutual influence humans and technologies have on each other.

In ANT, the processes through which an actor obtains strength by associating with others through programs, anti-programs and inscriptions, are called *translations*. In a nutshell, the notion of translation points to the processual philosophy of ANT: a network changes, stabilizes and destabilizes through 'movement' brought on by actors connecting to and substituting each other. Such translations entail that "the identity of actors, the possibility of interactions, and the margins of manoeuvre are negotiated and delimited" (Callon, 1984, p. 201). According to

Callon (1984), the process of translation involves several distinct stages over which an actor attempts to convince other actors to strive for a particular objective, i.e., to align and appropriate other actors' interests to one's own. In the first stage, problematization, the actor defines a shared problem and relation between a group of actors. In doing so, the actor positions itself as an indispensable part of the whole that every other actor must relate to - it establishes an obligatory passage point. By taking the position as an obligatory passage point, an actor becomes a 'bottleneck' or point of control that all actors must pass through in order to achieve their objectives. In the second stage, interessement, the actor seeks to garner support from the other actors by redefining their interests to fit the specific program. The third stage, enrollment, follows immediately after as the actors are enrolled and begin to participate in the program. Then, in the fourth and final stage of the translation process, mobilization, the first actor seeks to increase its number of allies by connecting current representatives of the program with the wider network of entities they speak on behalf of. At the end of these stages, a certain network - or a modification to a previous network - of relations has been formed, and the world - whether on a small or a large scale - has changed; or at the very least, it will be in the process of changing.

2.2.2 A comment on critique

As it goes for any theory, especially those that have garnered widespread attention and interest, ANT has not escaped critical commentary. For this there are many both compelling and sensible reasons, which it is beyond the scope of this thesis to discuss - after all, ANT's conceptual repertoire is still utilized across multiple disciplines to examine the relational dimensions between artifacts and people (Jackson, 2015).

We do, however, find it appropriate to briefly address one of the arguments against the 'classic' version of ANT since it was raised by Star, whose work on infrastructure studies constitutes the backbone of our thesis' theoretical framework. Star's critique was that ANT is too managerialist and "biased toward the point of view of the victors" (Star, 1991, p. 33) because its typical focus on powerful actors making their way to 'victory' ignores important issues like power imbalances and marginalization. Using her own experience as a person with onion allergy in McDonald's, a standardized machinery not geared to accommodate 'special needs', she noted: "McDonald's may provide sameness and stability for many people [...] but for me and for others excluded from their world, it is distinctly not ordered. Rather, it is a source of chaos and trouble" (ibid., p. 42).

What is order, stability and predictability to some is chaos and struggle for others - which is the exact argument that infrastructure studies presents. By taking this position as our vantage point, we hope to show that the theoretical resources provided by ANT can help bring forth the complexity of dealing with infrastructure, rather than narrowing it down to a mere description of how one program succeeded in establishing a universally accepted information infrastructure. As such, our focus is just as much on the struggle, and accordingly, we (only half-jokingly) refer to the process of infrastructural change in DMC as 'the battlefield'.

2.3 Applying our theoretical framework

We have presented and discussed a range of theoretical resources which, in combination, will aid us in answering the research questions put forth in the introduction. The conceptual underpinnings of the sociology of information infrastructure, as well as ANT's relational ontology, provide us with a strategy for infrastructural inversion. Using the theoretical resources to perform such an infrastructural inversion enables us to examine a range of questions, such as:

- *What kind of infrastructuring work do the involved actors partake in, and which translation processes does it engender in terms of infrastructural change?*
- *How and where does the installed base present itself in DMC, and how do actors work with (or against) it to achieve a working infrastructure?*
- *Which programs (and anti-programs) are at play in the infrastructural change process, how do they relate to each other, and how might this explain in which way the infrastructure takes shape?*
- *How do the UX professionals position themselves on 'the infrastructural battlefield'?*

As we explore these questions throughout our analysis, it is our aim to gradually build a narrative of the practical-political process of cultivating an information infrastructure in DMC in order to contribute to existing research on how information infrastructures come into being and are negotiated through complex sociotechnical relations. Further, our particular empirical phenomenon concerns the role(s) that UX professionals and their work play in infrastructural change. We discuss this issue as a direct extension of our infrastructural inversion as described above. By identifying and bringing attention to the parts played by UX in infrastructuring work,

we believe new aspects and possibilities for infrastructural development and change may come into view.

3. Methodology

In this chapter, we present our methodological framework and related considerations. Firstly, we present our strategy for collecting the empirical material, including our chosen research methods. Secondly, we present our approach for analyzing the empirical data. Finally we present some reflections regarding what it entails to study infrastructure, and, more specifically, what it has meant in our case.

Our methodological approach follows the ontological and epistemological positions of our theoretical framework as well as our own academic convictions. As Techno-Anthropologists, we 'belong' to the STS tradition which, broadly speaking, insists that to understand the world - including technology, science, and knowledge - we need to reject the idea of universal truths that exist and can be observed independently from social practices. Ratner (2021) speaks of an 'ontological turn' in STS which implies that worlds are built and maintained through practices in which both human and non-human actors participate, and so it is concerned with investigating the creation, upkeep and modification of reality (or realities) (p. 144).

Both infrastructure studies and the Actor-Network Theory have ethnographic origins and purposes and their analytic strategies prescribe qualitative methods to trace relations and 'follow the actors' (Latour, 2007, p. 12). According to Brinkmann and Tanggaard (2015), qualitative research seeks to uncover meaning, experiences, and subjective interpretations of individuals or groups. The qualitative research is particularly useful for gaining a deeper understanding of a phenomena that cannot be adequately captured through quantitative methods alone. Instead methods such as interviews and participant observations are used to gather rich and descriptive data. Through close examination of people's experiences and perspectives, qualitative research can provide a more nuanced and contextualized view of a particular issue (Brinkmann & Tanggaard, 2015). Accordingly, we have used interviews and observations as our main methods of research. In-depth reflections about each method as well as additional implications and an overview of our empirical data will be provided below.

3.1 Data Collection

3.1.1 Empirical overview

Our empirical findings are derived from interviews, observations and additional data obtained from internally available material related to The Infrastructure Project such as project reports, internal email correspondences, desk research, one of the author's personal experiences as a UX student assistant in the UX team in DMC, and informal conversations with the UX professionals in DMC. The table below specifically provides an overview of the data gathered through interviews and observations.

INTERVIEWS			
#	**Name**	**Role/title**	**Duration (mins)**
1	P1	User Employee, QC Chemist	25
2	P2	User Employee, Environmental Strategist	20
3	P3	User Employee, Chemist	20
4	P4	User Manager, Global Affairs and Patient Relations	20
5	P5	User Employee, People Management	45
6	P6	User Employee, Development Scientist	30
7	P7	User Employee, Chemist	30
8	"UX Manager" "UX Employee"	UX Manager and UX employee	60
9	"UX Manager"	UX Manager	45
OBSERVATIONS			
#	**What**	**Participating**	**Duration (mins)**
1	Workshop 1	UX Consultant UX student assistant Product Owner Associate Director	55
2	Workshop 2	UX Consultant UX student assistant Product Owner Associate Director	90

Overview of stages in The Infrastructure Project

This section aims to provide the reader with an consolidated overview of the phases and activities in The Infrastructure Project, as well as an outline of which of the activities the thesis' authors were able to engage in. The project was carried out over a period of approximately 3.5 months and involved members from the UX team as well as stakeholders from across DMC.

Due to the complexity of The Infrastructure Project with conflicting interests of various stakeholders and a tight schedule, we did not have the opportunity to participate in all the activities and phases throughout the project process, as there simply were not enough resources allocated for this.
As will be described further in detail, we participated in the kick-off meeting for The Infrastructure Project as well as two workshops, and the author who is employed in the UX team participated in a follow-up meeting, after which she shared her observations with the two other authors. At the end of the project, the UX consultant's report with her findings and recommendations was shared with the authors.

We acknowledge that this way of doing ethnographic research may differ from the classical anthropological approach, where the researcher over a longer period *"achieve[s] a place in the community being studied"* (Pink, & Morgan, 2013, p. 352). However, we will argue that based on the premise that this thesis too expanded over a short period of time and that the data collection had to take place relatively early in the process to enable us to examine and analyze it, taking what Pink and Morgan describe as a *'quick and dirty'* approach to qualitative research does not equal poor quality (Ibid., p. 353). Thus, the limited time frame provided the basis for our research activities, prompting us to actively engage in the center of action rather than passively waiting for events to unfold. In the last section of this chapter, we further elaborate on the challenges unique to the endeavor of studying infrastructure.

In the following section, we provide an overview of the weeks in which important activities and meetings took place related to the project, their purposes and results and involved stakeholders. We present this timeline to provide a basis for the narrative built throughout the thesis, to acquaint the reader with the most prominent actors in The Infrastructure Project, as well as to provide an initial mapping of the empirical field.

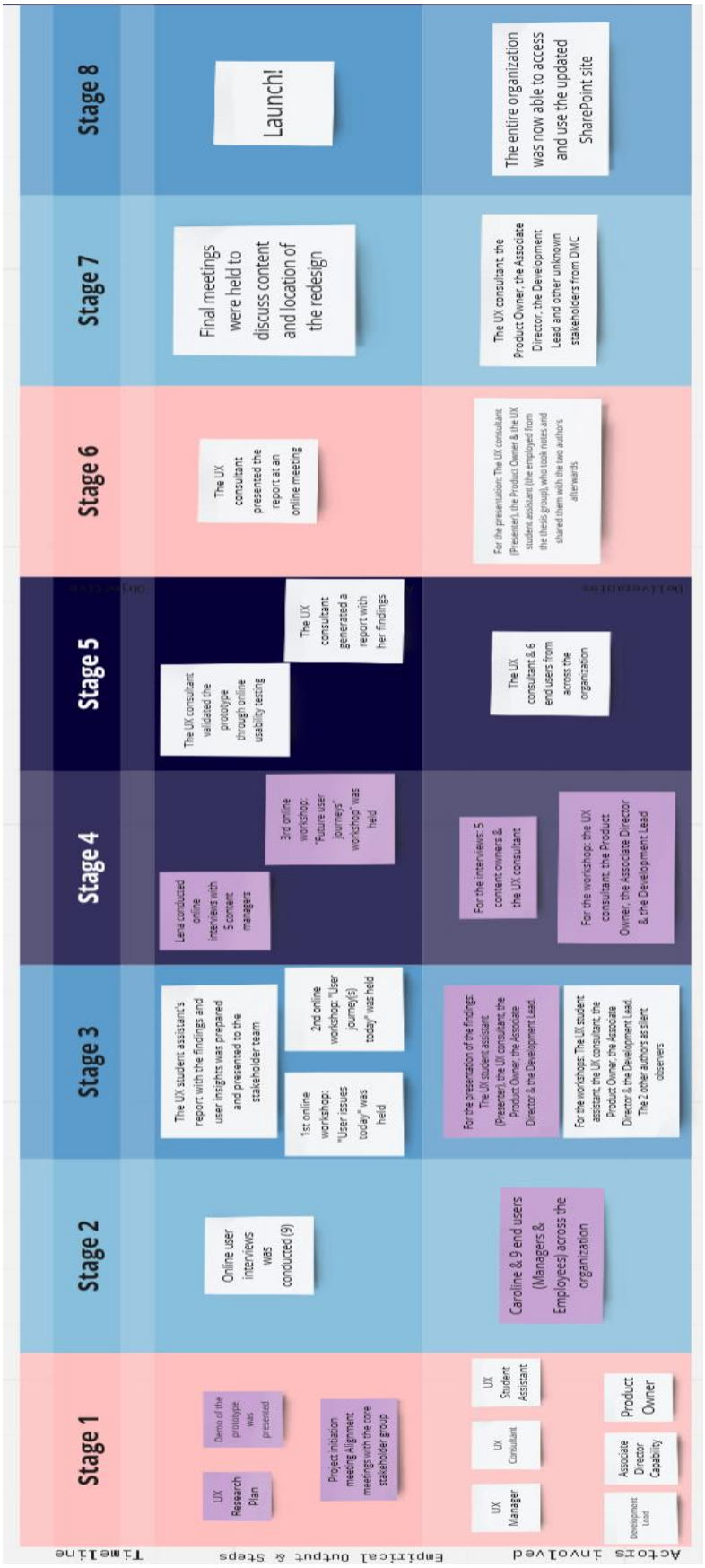

Figure 1. Visualization of the phases and activities carried out for The Infrastructure Project

Stage 1:

In the startup phase of the project, a kick-off meeting was held to discuss and align on the scope of the project. The entire stakeholder group consisted of:

The project team:

- The Product Owner. From the Talent & Learning Department
- The Associate Director of Capability Development. From the Learning & Capability Development Department
- The Development Lead. From the Talent & Learning Department

Members of the UX team:

- The UX manager from the UX Team
- The UX consultant from the UX Team
- The author from the thesis who works as the UX team's student assistant

At this meeting, the demo of a SharePoint site as a prototype page was presented to the entire stakeholder group.
Following the kick-off meeting the UX consultant composed a research plan which was sent out to the stakeholder group to discuss and agree upon. The research plan further had the purpose of being a guideline and ensuring that all the involved stakeholders had the same frame of reference throughout the project and thereby minimizing the risk of misunderstandings or misalignments.

Stage 2:

During the two first weeks of the project, the UX student assistant conducted interviews with end users across DMC.
The purpose of these interviews were to collect insights about employees' and managers' needs and behaviors related to finding material for learning and development and to collect feedback on the wording and look of the prototype. Based on the insights from these interviews the UX student assistant generated a report which she presented to members of the stakeholder group.

Stage 3:

The UX student assistant presented the report with insights and findings from her user interviews to the group, where the UX consultant, the Product Owner and the Development

Lead were present. This presentation was recorded and shared with the two other authors afterwards.
During this week, two online design workshops were held, where all three authors were able to participate. Prior to these workshops the thesis group had developed an observation guide, and two of the authors took observation notes during the workshop, while the last author participated as the UX student assistant and played an active role in the workshop.

The first workshop: "User issues today"

The purpose of the first workshop was to review the list of user issues identified from the interviews with the users which the UX student assistant had conducted. Another purpose was to clarify which issues the employees had when looking for material related to learning and development.
Furthermore, the purpose was for the group to agree on which of these issues should be prioritized in the further steps of the project. Here the *issues* that were in scope for the project were discussed and decided upon - *not solutions* for the issues.

The second workshop: "User journey(s) today"

The purpose of the second workshop was to clarify and map out what employees do today when they look for learning and development - e.g. which path they are taking through the systems.
Furthermore the discussions were based on insights from the Product Owner who provided the entire group with an overview and list of the systems and sites related to learning and development which DMC have today.
At this workshop, the intention was to create an overview of today's user journeys and high level pain points as an output.

Stage 4:

The UX consultant conducted online interviews with 5 content managers with domain knowledge related to the systems containing content about learning and development - i.e. Degreed and LearnIT.

An online workshop called 'Future user journeys' was held. Here, the UX consultant, the Product Owner, the Development Lead and the Associate Director convened to discuss the interviews that the UX consultant had conducted with the content owners. Solutions for user

issues were discussed, including the redesign of the SharePoint platform as an entry point and what content it should contain.

Stage 5:

The prototype was validated through usability testing by the UX consultant with 6 end users across DMC. The purpose of the usability tests was to test the prototype, the usability of the typical user journey and the relevance of the content.

Stage 6:

The results from the usability tests were presented by the UX consultant to the Product Owner and the UX student assistant. Due to the urgency of other meetings and illness neither the Development Lead nor the Associate Director were able to participate. During this meeting, the author employed in the UX team took notes and shared the insights with the two other authors afterwards. The user feedback of the prototype was further presented to the Product Owner and the UX student assistant and it was decided what to change.

Stage 7:

In the last phase of the project we were informed that the last alignment meetings and workshops were being held with the UX consultant, the Product Owner, the Development Lead, the Associate Director, and other relevant stakeholders across DMC. At this point, we could no longer be a part of the project due to strict deadlines and sudden adjustments to the stakeholder group.

Stage 8:

Rollout! After these last meetings and workshop the new re-design of the SharePoint page was launched to the entire organization, enabling them to access and use the new updated version. In the aftermath of the launch, the UX consultant shared her project report with an executive summary and overview of her findings and recommendations with the authors.

3.1.2 Case study

The strength of a case study is that it entails an intensive examination of a specific individual, group, organization or situation, capturing its historical trajectory over a short or extended duration (Flyvbjerg, 2006). It aims to elucidate both anticipated, predictable aspects of an event and, ideally to uncover additional, less quantifiable details which plays a role. This provides

the researcher with the great opportunity to move beyond quantitative analyses and instead construct rich and comprehensive portrayals of the observed phenomena. Regardless of investigating a single case or conducting comparative analyses of multiple cases, the study of cases makes it possible for the researcher to acquire profound knowledge and understanding of the subject matter which goes beyond the limitations of large quantitative studies. However the insights gained on behalf of a case study does not automatically or necessarily apply to others. The matter of generalizing the insights to other groups or events is therefore a question which each individual researcher needs to consider and decide (Flyvbjerg, 2006). As we are studying a single case - The Infrastructure Project in DMC - and for a limited amount of time it is not possible for us to determine whether our insights are to be generalized to other organizations or even across the whole organization of DMC. With that said, it is possible for us to state that our insights showcase knowledge about the infrastructure in DMC and the work practices of a specific UX team. As we will also argue later, such knowledge can both contribute to a richer understanding of the dynamics at play in establishing infrastructure, and technology uses in general, as well as help point to opportunities for explicating the ways UX work can contribute to form working infrastructure that supports a diverse range of practices.

Flyvbjerg (2006) acknowledges that traditionally there has been a controversy surrounding the contribution of case studies to scientific endeavors (p. 221). However, he strongly refutes this notion and argues that case studies are not only sufficient but also necessary for conducting academic research (p. 241). Consequently, Flyvbjerg's perspective offers a solid rationale for the relevance of the methodological approach to our thesis.

3.1.3 Access to the field

With one of the authors being an employed student assistant in the UX team, we were able to get direct access to the field that has been studied, allowing us to examine the role of this specific UX team in DMC. We were granted the opportunity to follow The Infrastructure Project that had been initiated only a few weeks prior to the beginning of our thesis semester, and which the co-author was assigned to as a UX student researcher. The co-author’s professional relation to the UX team in DMC also meant that many of the relevant informants knew her, which made the process of recruiting and establishing rapport (Spradley, 1979) much easier and less time-consuming. However, as The Infrastructure Project progressed, new stakeholders were included in the work, forming a complex network of actors which made The Infrastructure Project a time consuming task for the UX consultant in charge of the project.

The increasing pressure on the UX consultant throughout The Infrastructure Project unfortunately became a hindrance for us to continuously follow the project as planned. This ultimately resulted in, as previously mentioned, that the UX consultant did not have the time to obtain consent from all stakeholders participating in meetings and workshops in order for us to be able to observe. This, of course, had a significant impact on the empirical material we were able to collect. However, this represents both a premise and an argument for doing qualitative research: the social world is constantly shifting, changing, and slipping out of hand. It resists capture by planning. It also shows that we, as qualitative researchers, are not immune to its instability, and we are certainly not the facilitators of the world we wish to examine. Other priorities sweep in and make our lives difficult. But we can still tell meaningful stories from what we *have* been able to capture.

3.1.4 Interviews

Rowley (2012, p. 261) outlines a number of questions which are associated with the design and planning of the interview process and aspects of conducting interviews which has been used as guidelines to explain 'interviews' as one of our chosen research methods. According to Rowley, interviews are mostly used when conducting qualitative research where the researcher is interested in gaining insights into or understanding of opinions, attitudes, experiences, processes, behaviors or predictions. Choosing interviews as a research method limits the number of informants compared to a research method such as a questionnaire. However, Rowley (p. 262) argues that if the interviews are well designed and informants appropriately selected the data generated from interviews will likely be richer and provide valuable insights. By choosing interviews as one of our research methods we have collected insights from key informants such as employees and the UX teams' manager. It has allowed us to trace and build a story around the process of establishing and changing infrastructure within a particular organization by relying on individual narratives and situations.

Semi-structured interviews are the most commonly used type of interviews (Rowley, 2012, p. 262). They are characterized by covering a list of open-ended questions and being flexible, meaning that one does not have to follow an interview guide strictly (Rowley, 2012, p. 265). This allows the interviewer to elaborate on what the informants say, ask additional or follow-

up questions, and vary the order and phrasing or framing of the questions during the course of the interview with the purpose of obtaining rich and detailed answers.

It was decided to conduct a semi-structured interview with the UX manager from the UX department in DMC. Besides the UX manager, a recently hired UX employee was present at the interview. The purpose of the interview was to gain insights into the work practices of the UX team and the establishment and history of the UX team from the UX manager's perspective. Furthermore, the purpose of including the UX employee for the interview was to gain insights into his previous work experience of scaling up a UX department in another large Danish organization.

Prior to the interview it was discussed in plenary who should participate in the interview as interviewer and observer. It was agreed that the author who is employed in DMC should not participate and thus, the two other authors conducted the interview to decrease the risk of bias. A potential risk of relationship bias could be that internal and tacit knowledge would not be explained in depth if the employed author participated and thus, this could potentially affect the outcome of the interview. On the other hand, one may argue that by having the employed author participate it could have made the UX manager feel more comfortable, due to their professional relationship, and thus she could potentially have elaborated even further on her answers and spoken more freely. A benefit from having the employed author participate in the interview could also have been that, because of her existing knowledge about DMC and the UX team's work practices, she could have asked follow-up questions, on a more informed basis, which could have granted us with even richer answers.

However, to accommodate the difference between the authors' frame of reference prior to the interview, the employed author informed and briefed the other two authors about the UX team's workflows and which follow-up questions might be of relevance.

An interview guide was prepared according to the UX manager's role and background so that the follow-up questions would be rooted in the contexts of the UX team. This should not be considered as an expression of preconceptions about the UX manager, but rather as prior knowledge required to ask relevant and context-specific questions (Spradley, 1979, p. 49).

When developing the interview guide, a distinction between research questions and interview questions was made. Research questions rarely work well as interview questions because they

are too abstract and distant from the informant's lifeworld (Brinkmann & Tanggard, 2015), p. 40). Instead, the thesis' research question served as an inspiration and as a guidance for our interview guides, 'translating' the research questions into descriptive, less formal questions better suited for a semi-structured interview. The interview guide can be found in Appendix 8. The interview guide was not sent to the UX manager prior to the interview. However, the meeting agenda was included in the invitation email and sent to the UX manager prior to the interview. This was done to respectfully prepare the UX manager to some extent and also to increase the possibility of reaching the full potential of the outcome of the interview.

After analyzing the data from the first interview with the UX manager and the UX employee, the authors agreed that a follow-up interview with the UX manager would be relevant. The purpose of the follow-up interview was to elaborate on some of the conversations that took place in the first interview and to ask follow-up questions which emerged as we transcribed and began our coding sessions from the first interview. The UX manager agreed to participate in another interview and thus, an interview guide was again developed in plenary with open ended questions based on the questions and information gaps we had identified from the first interview. This interview guide can be found in Appendix 10.

As part of the preliminary user research conducted for The Infrastructure Project, nine interviews were conducted with employees across DMC by the employed author of the thesis. The aim of the interviews were to gain insights into how employees navigated in the current infrastructure and to present and get feedback on the prototype which was developed for the project. These interviews were also transcribed and processed similar to the interviews with the UX manager and the UX employee. While transcribing the nine interviews, we screened them to assess their usability in relation to our research objectives. One interview was excluded due to technical issues. Two interviews were excluded due to language barriers where, unfortunately, too many insights were lost. Ultimately seven transcribed interviews were left which provided valuable insights and was included as part of our empirical material.

3.1.5 Observation of workshops

The thesis group participated in two workshops for The Infrastructure Project. Two of the authors conducted observations of the two workshops as part of our infrastructural inversion.

Spradley (1980) explains how a participant observer differs from an ordinary participant by introducing six features. One of them is "*explicit awareness*" (p. 58). The social life of an ordinary participant or just a human being requires an exclusion from conscious awareness meaning that not *all* activities, *all* objects and *all* information are perceived at *all* time. Simply to avoid "overload" which is referred to as a person's ability to process inputs from the surroundings because of too many inputs to cope with. On the contrary, the participant observer seeks to become explicitly aware of things which normally are blocked out to avoid overload. However this does not come easily and the ethnographer is required to overcome *selective inattention* (Spradley, 1980, p. 55).

"Wide-Angle Lens" is another feature Spradley (1980, p. 56) uses to distinguish between the participant observer and the ordinary participants which explains how a wide observational focus for the participant observer leads to some of the most important data when doing research. This emphasizes the importance of the two authors' presence at the workshops and the choice of doing participant observations as one of the research methods in our thesis.

Conducting observations of the workshops was a great opportunity to see the priority setting process in action and gain insights into the development of the research priorities and work practices in The Infrastructure Project. Prior to the beginning of the workshops, it was clarified and approved in writing by the project team that the two authors who were not employed in the UX team were allowed to participate as observers. Spradley (1980, p. 59) describes different types of participant observations. One of them is *passive participants* which means that the observer is present however she does not participate nor interact with the other participants. The two authors were to observe as *passive participants* (p. 59). The workshops were planned as physical workshops, but due to illness and other circumstances the workshops were held online. The two observers were muted and with camera off during the entire workshop to make sure no interrupting happened (p. 59). The fact that the workshops were held online instead of physically naturally had an influence on how and what to observe since a lot of body language is missing and general interacting among the participants.

The employed author took active part in the workshop sharing her insights from the interviews with the users and since she had knowledge about the general work practices in the UX team as an ordinary participant, according to Spradlly (1980 p. 61) she conducted *complete*

participation. Acting as a *complete participant* is a difficult position to have and challenges the study since tacit knowledge will be difficult to acknowledge due to the familiarity with the social situation (p. 62). Such a constellation of roles provided a unique opportunity to view the field from different perspectives - both as researchers and as one of the 'infrastructuring actors'. Prior to conducting observations of the workshops we prepared an observation guide with the purpose of directing our observations to our research questions. We were aware of the potential bias imposed by an observation guide in that one might risk missing important observations and tacit knowledge due to an already decided direction of focus. However, unlike traditional ethnographic practices which often involve observing sensorily rich settings such as local communities or cityscapes, our field was, in this instance, very situated both spatially and temporarily, which minimized ambiguity and allowed us to focus on an extremely targeted practice (Spradley, 1980).

3.1.6 Ethical considerations

When entering the field of research, ethical challenges and considerations will arise and thus before entering the field such ethical issues must be carefully addressed. All employees who were interviewed to The Infrastructure Project were contacted and consent was obtained to include the interviews in our thesis. Prior to conducting the interviews and workshop observations the purpose of our thesis was presented to all the informants and participants. Written consent was obtained and all informants were informed about anonymity and that pseudonyms would be given in the thesis to protect their privacy (Brinkman & Tanggaard, 2015). Prior to the interviews and the workshops we asked permission to record, where we made it clear that the recordings would only be used for our analysis, and would be deleted immediately after usage. Furthermore, all informants were informed that they withdraw their statements and consent at any time and they have all been offered to receive recordings, transcripts and the final thesis. As a condition of our thesis collaboration with DMC we all signed a Confidentiality Agreement and we were informed that DMC's identity should be held anonymous. Thus, as mentioned in the thesis' introduction, the company has been referred to as the Danish Medical Company (DMC) and the case study project has been referred to as *The Infrastructure Project* to secure further anonymity of the involved stakeholders and the organization.

3.2 Data analysis

3.2.1 Coding

Coding was the first step in analyzing our empirical data, which refers to the process of organizing and labeling qualitative data in order to identify themes and connections between ideas and concepts (DeCuir-Gunby et al., 2011, p. 138). According to Charmaz (2001), it is the 'critical link' between data collection and their explanation of meaning. To us, coding was a way of engaging in a 'conversation' with our data and 'trace infrastructural relations', like Simonsen et al. (2020) described their analytical process in their study of a health infrastructure project.

Our coding process was done in plenary and was highly iterative and reflexive and involved several cycles of coding and re-coding as well as many hours of discussions about the collected data as well as the thesis', theoretical framework and research questions. Furthermore, the data collection and analysis were undertaken concurrently, allowing us to identify areas where we might need more data and plan accordingly, and compare new data to what had already been coded to discover new perspectives, ideas, and connections.

We used the qualitative data analysis software Delve to code our data. This helped us streamline the process and track our codes across transcripts, allowing for a more efficient and flexible process.

Besides the coding software, we kept an analytic memo similar to a diary with dates to document choices, reflections, and general thoughts pertaining to the coding process. This served as a tool to help us keep track of our journey toward building an analytic narrative.

An example from our analytic memo

Today, we continued going through the material gathered from the data-driven coding. We have looked at the data related to the coding units "Mobility" and "Local configurations" respectively, and since both of these units had relatively few codes related to them, they have been nested under the "Installed base" theme/category.

We went through all codes in "Working with the installed base" and found out that many of the data units could be replaced under other more representative codes such as "Mobility".

We have further created a new code called "Sensitivity" under the theme "Installed base" which refers to informants being aware of the installed base and considering it in proposing and implementing new solutions.

Generally speaking, codes can be developed deductively from existing theory or concepts, or inductively from the raw data (DeCuir-Gunby et al., 2011, p. 137). Accordingly, deductive coding entails that the researcher defines codes based on a predetermined theoretical framework, and applies them to the data to 'demonstrate' instances of a theoretical point or concept (Saldaña, 2013, p. 54). Inductive coding, on the other hand, can be seen as a more exploratory approach in which codes are derived from the data itself (Saldaña, 2013, p. 54).

In this thesis, it was decided that the theoretical framework should serve as a guideline but not dictate and determine the analysis. Our goal was to set out on a journey of infrastructural inversion, using theoretical concepts as tools to identify and explore the sociotechnical processes and tensions behind an infrastructure. However, because our focus was the sociotechnical complexity inherent to infrastructure studies, it was important to also allow for our data to present new themes and ideas to support and add richness to the analysis. Hence, we decided on a coding strategy which incorporated cycles of both deductive and inductive coding. Such a strategy is encouraged by Fereday and Muir-Cochrane (2006), who suggest that qualitative research can benefit from a 'hybrid' approach to coding, balancing between inductive and deductive to demonstrate rigor. Likewise, DeCuir-Gunby et al. (2011) suggest a two-stage method to combine the two approaches: First, the researcher develops theory-driven codes based on the study's theoretical framework and then reviews and revises them in context of the data. Then, the researcher 'switches' to data-driven coding with the goal of iterating on the theory-driven codes and identifying themes that were not captured by these. This phase also entails reexamining the theory-driven codes to determine their legitimacy in light of new findings and whether they need to be expanded or otherwise revised to better embrace the themes emerging in the data (p. 146).

Our coding process followed a similar procedure, albeit it included several cycles and iterations of both theory-driven and data-driven code development as well as some extra steps. Figure 2 provides a simplified overview of the process.

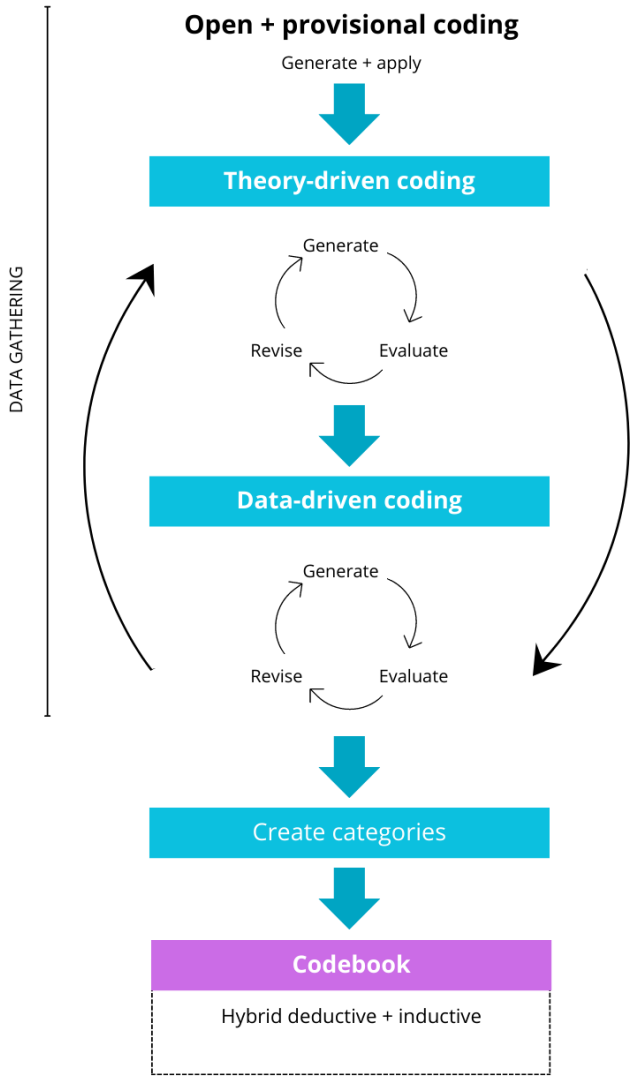

Figure 2. Overview of the coding process.

We began by using a form of 'provisional coding' as explained by Saldaña (2013, p. 144). Provisional coding entails a predetermined 'start list' of codes which may be generated from theory, research questions, and even the researchers' hunches (p. 144). We generated a preliminary list of codes which we assumed would occur in our empirical data. Afterwards we moved on to the usage of a more "real" theory-driven coding generating codes based upon theory. Lastly, we ended our process of coding with a data-driven coding where we went through all of our empirical data again with the purpose of capturing themes which had not been captured in the initial stages of theory-driven coding.

In several cases, we discovered that our theory-driven codes were too generic and possessed too much interpretive flexibility. This became evident when data units could be assigned many different codes, and when the codes only managed to capture a thematic indication of what a

data unit was about but not its actual meaning. In these cases we revisited the code's theoretical underpinnings and discussed which kinds of phenomena it sought to reveal. Then, we reread all the data units which had been assigned the code and either renamed the code, or created new ones which we felt better captured the data units' meaning. In this way, we constantly moved between theory and data, gradually developing codes which were relevant to our theoretical framework yet also recognized empirical nuances.

To exemplify, we had created the theory-driven code 'Breakdown', which we applied to data units where informants addressed or alluded to problems with using infrastructure, since we reasoned that such problems represented instances of an infrastructure which had become visible. However, as we were applying this code to data units, we realized that we might, in fact, be moving too fast in our interpretation of the data by using this rather 'abstract' code: all the data units that were coded as "Breakdown" were in fact expressions of *frustration* with DMC's infrastructure, which might in turn be symptoms of an infrastructure that has failed to seamlessly support tasks. In accordance with this discovery, we renamed the code to "Frustrations".

As we created and revised codes, we developed our codebook (Appendix 13). Our codebook was designed with inspiration from DeCuir-Gunby et al. (2011, p. 138) and is a chart with three vertical columns. In the first column all codes are listed, in the second column a description of the horizontal code is provided and lastly an example of the code is given.

Perception of UX	Denotes informants' (or their explanation of other actors') perception of and attitude towards UX and its role, function and legitimacy in DMC and in general.	*"And I'm kind of across the board, but there is also an overall strategy now that we should also be able to support other areas in DMC".* *"You have to find something where they can see that the boring IT system is actually better because there was some user involvement and the users couldn't figure out how to type through the form before UX came in, but when they did so and so of the UX methods, it got better"*

Figure 3. An example from the codebook (Appendix 13).

3.3 On studying infrastructure

Where and when is an infrastructure? Just like the notion of networks as they are conceptualized in ANT, infrastructures can seldom be grasped in their entirety; much less in a study spanning but a few months as the work with this thesis as well as The Infrastructure Project reflects. Infrastructures are infrastructures largely by virtue of their vast spatial and temporal scales (Langstrup & Winthereik, 2021). This also - especially - applies to information infrastructure, which is the focus of this study. This makes it a rather elusive and often intangible object to study, a reality we were faced with as we ventured out with the bold intention of capturing and scrutinizing 'the infrastructure' in our partner organization. Infrastructure, as a whole, resists close scrutiny because every little part of it potentially opens a Pandora's Box of analytic potential. According to Hanseth and Monteiro (1997), "[t]he size of an information infrastructure makes detailed studies of all elements practically prohibitive [...] A systematic, comprehensive empirical study is prohibitive" (p. 190). Instead of attempting to study the entire infrastructure, one must be selective.

Where and when to begin, then? Where and when do we stop? The answer turned out to be determined not only by our own curiosity and attempts at identifying the scope of our research, but just as much by time, resources and the fact that we were collaborating with a Behemoth of an organization. We were, in other words, limited in our freedom to decide. As we also hope to show throughout our analysis, the growth and reconfiguring of an infrastructure is an organic, continuous and often messy process. It involves twists and turns and it requires many resources - human and otherwise. Furthermore, a comprehensive story of the activities, decisions, conflicts, and circumstances driving the cultivation of an infrastructure would require constant physical presence and observation of the infrastructure project we are studying as our case.

Our story, therefore, is built on fragments and glimpses into the infrastructuring work undertaken by members in the actor-network forming around this process. It does not provide an account of every program and anti-program and every translation taking place on 'the battlefield'; and while we, importantly, recognize the fact that design and configuration of an infrastructure happens just as much in use as it does in deliberate design activities (Pipek & Wulf, 2009), this story only lightly touches upon the users' actual interaction with the infrastructure. This is partly because our focus is directed at the role(s) of UX in infrastructuring work, and partly because the imagined infrastructure, as the product of the local case we are

studying, did not yet exist at the time of writing. This is not a disadvantage, but simply a precondition, for infrastructure studies: infrastructures are always "partially existing" since their many realities cannot be meaningfully squeezed into a single framework of understanding (Langstrup & Winthereik, 2021, p. 187).

In our analysis and discussion, we use the term *(the) (information) infrastructure* primarily to refer to the assemblage of systems, as well as conceptualizations of new systems or components, which are addressed in our case, The Infrastructure Project. However, it is important to avoid the misconception that these systems constitute a closed ecosystem. Rather, as we will also demonstrate in our analysis, they constitute but a small part of a much larger infrastructure, the limits of which it is neither meaningful nor possible to pursue and map in this study. To recite Hanseth and Monteiro (1997), we have opened some, but far from every, black-box; several are left unopened (p. 190).

We do not claim to tell the full story. But we do hope that we, with our contribution - however modest - can help shed new light on some of the battles that infrastructural change involves.

4. Analysis - Infrastructure as battlefield

We now present our analysis, which is based on the collected empirical material from the seven user interviews, two interviews with DMC's UX manager and a UX employee from the team, observation notes from two internal workshops, and additional material from The Infrastructure Project. Our analysis aims to trace and account for the practical-political process of cultivating an infrastructure in DMC, and as such we analyze our attempt at performing an infrastructural inversion in order to explore the technologies and arrangements that otherwise tend to "fade into the woodwork" (Bowker & Star, 1999, p. 34).

The analysis is divided into three parts that present central themes in the 'infrastructural battle'. Each part ends with a sub-conclusion of which parameters have played out in the battle for cultivating the infrastructure.

Following the analysis, a discussion will be presented which contains an interpretation of what role(s) the UX team were observed to enact based on their contributions to infrastructural cultivation and change in DMC.

4.1 Part I - A sociotechnical breakdown

In the first part of the analysis, we shall look at the breakdown in the infrastructure of DMC and how the infrastructure has become a battlefield with conflicting values and needs. The

reader will be presented with the user's experiences and strategies when approaching the infrastructure during their workday. Furthermore, this section aims to present which role the UX team had when attempting to 'repair' the breakdown by modifying the infrastructure and which actors and practices they had to consider in this endeavor.

4.1.1 Navigating the infrastructure

The initiative behind The Infrastructure Project stemmed from a growing frustration among DMC's employees since the existing infrastructure did not support their ability to search for information and material related to internal professional learning and development. Furthermore, the employees were lacking a clear overview of similarities and differences among the many available IT systems in the infrastructure. Thus, a project group in DMC was formed to solve these issues and reached out to the UX manager, who connected them to a UX consultant from the team.

From the user interviews, it became evident that one of the most - if not *the* most - difficult challenge and biggest frustrations for the users was the way in which the infrastructure was built up and the experience of having an overflow of systems and the lack of clarity as to what content could be found in which system, how the systems complemented each other and when to use one system over another. One user, who had been an employee at DMC for 30 years, stated:

"I think I've given up, to be honest. There have been standard things that I couldn't relate to. I have not been able to see the whole picture. What do I have to choose from? I love the helicopter view in all possible situations and that you can then dive deeper into an area. I haven't had the opportunity to do that here (...) I find some of the systems too difficult to understand and I don't know who can help me figure that out." (P7)

A lack of coherence between the systems also meant that employees not only had trouble locating them, but also might not even recognize the purpose of them:

"It's like the systems do not communicate with each other. And from my professional experience, I also know that there are many who have no idea what Degreed is and do not

know how to find it. And I also think that there is a lack of coherence between the systems." (P2)

Another frustration among the employees was that there was no time allocated for training and onboarding into the systems, so that they were equipped to be able to navigate the various systems and find the material they needed in the first place. This had ultimately resulted in a feeling that the responsibility of getting acquainted with the systems laid with the employees as an extra burden. This concerned the responsibility and their resources for learning to interpret the possibilities of the different systems and for learning to navigate and understand the systems, both in terms of content for learning and development but also specifically how they were to navigate the systems. These resources - or lack thereof - were not something the employees felt equipped with or had the time capacity to incorporate into an already hectic and busy working day. This point of view can be exemplified by a statement from a user who said:

"I know there's a lot out there. But I think it's also about finding the time to dive into it too... You're busy in general. Then I tried to throw "Degreed 1 hour" into my calendar.. But when I finished my work, I'd rather go home anyway. So, it was - in my view - kind of 'free time research'. And then it was not a priority in my calendar. Maybe if management said that now you must use Degreed, or we would like you to use these materials... Then maybe we would have used it a bit more.. Whereas here, it feels like.. Then I might as well spend the time on my "real" work and approve my analysis and spend time on that." (P1)

While it is a tacit expectation that employees seek out relevant training and development opportunities in DMC's digital catalogs, it is not an integrated part of the workday and the employee's 'official' responsibilities, the completion of which is likely to lead to a higher sense of professional accomplishment. As a result, the interaction with the infrastructure, and the cumbersome process of extracting individually relevant content from everything available 'out there', might not be considered by the user as 'real work', but rather an extraneous task which they would need to plan around, or even spend out-of-office hours doing 'research' to figure it out.

In their study of a project concerned with developing an e-Infrastructure for scientific work, Ribes and Finholt (2009) noted how the scientists, who were both users and 'co-engineers' of the infrastructure being developed, experienced conflicting demands from work that would satisfy their (professional) individual needs and that would contribute to a functioning

infrastructure. Work that was primarily directed at contributing to the development and implementation of the infrastructure tended to be perceived as a waste of time because it did not correspond to the participant's idea of professional productivity. In our example above, we see a similar yet slightly different issue. While regular employees in DMC are not assigned 'engineers' in the sense that they do not have work tasks aimed at contributing to the technical and practical development of the infrastructure, the act of *using* the infrastructure becomes, in itself, a task *in addition to*, and not *supporting*, primary work tasks because it is not intuitive, is not perceived as an integral part of the work practice (Pipek & Wulf, 2009, p. 449), and thus does not deliver enough value to justify the amount of 'tinkering' it requires of the user to adapt to it.

Information infrastructure is supposed to be invisible partially by virtue of it being intuitive and representing aligned programs that it helps achieve (e.g. by facilitating standard procedures for certain work practices, such as in Pipek and Wulf's (2009) analysis of the implementation of groupware to manage information flow in the German State Representative Body's legislative proceedings). However, Star and Ruhleder (1996) also argue that people must learn to use infrastructure through membership in a community of practice. Arguably, such a condition requires that the infrastructure is either an integral part of the work practice, such that the process of learning how to use it is naturally integrated as part of the daily interaction with colleagues and technologies, or that the organization in which the infrastructure is embedded provides formal and directed training. For the systems aimed at supporting professional development and learning in DMC, however, neither of those conditions seemed to be met, resulting in poor user adoption and, according to the UX manager, revealing a 'silo-based' approach to developing and implementing infrastructure:

"Every single system, if you look at it, is super complex in itself. For what do you need to use which systems for, and how does the user know that? And the opportunities for learning and development in the different systems are different. It clearly shows that there is a silo-based thinking around thinking in systems and an expectation that as an employee in DMC you must learn that behind the systems there are some processes (...) It's a bit of a stretch but you have to teach yourself to understand the process, there is no one serving it for you." (UX Manager)

The tendency to 'think in systems' removes the focus from the user and, in the UX manager's experience, users are not properly equipped to navigate the complexity of the systems and their content. The expectation that the employees learn to understand the processes behind the systems stems from an apparent disconnect between the 'experts' in charge of implementing the infrastructure and the users' capacity, or willingness, to incorporate the infrastructure, including its purpose, into their work routines.
As a result - and as several of the examples we have presented thus far show - new functionality may be ignored or only partially perceived and integrated into users' practices (Pipek & Wulf, 2009, p. 457). As one user articulated it:

"We know that there are many who don't use Degreed in their day-to-day work. So it requires that someone guides you in your learning. You [obviously] can't look for something you don't know about." (P2)

For infrastructures that either universally support work across departments and roles (such as messaging applications or calendar systems) or support and organize specific domain practices (such as digitally connected whiteboards displaying patient information, as described by Simonsen et al. (2020)), learning is likely to be a natural and integrated process because becoming a member of the community of practice requires you to use the infrastructure to perform your job tasks. However, in this case, the infrastructure in question was both contested and disconnected from users' perception of 'real work', also due to the fact that it was not mandatory for the employees to actually use the systems when seeking for material related to learning and development.

To overcome the challenges that employees met in their encounter with the infrastructure, they might develop strategies and workarounds to navigate both *with* and *without* the existing infrastructure. Such strategies can further be related to the concept of 'user-driven infrastructuring' described by Edwards et. al (2009) which aims at capturing the ways in which users actively shape and transform infrastructure through their everyday practices and interactions (Edwards, 2009). The following quote shows how one user's strategy was to combine external resources and physical resources with the existing infrastructure when in need for material for learning and development:

"If I need information on some procedure or need to find a specific course, I would usually ask people in my department or just go on Google and find videos there or on YouTube in combination with our own documents." (P3)

Users might also take a somewhat more analogue approach and might prefer to use their physical network when seeking for development and learning, leading to poor incentives for using the infrastructure:

"It is very often that it is the work itself and the consultants I work with who bring us some knowledge that we do not have, and can help us work with it. In that way, I am not the big system user in this sort of thing in their training here in the company." (P7)

These statements portray that among the employees there was no 'consensus' regarding how they preferred to approach the material for professional learning and development. Furthermore, not all employees were interested in using a digital infrastructure to support their professional development - hence, the preferences for these development opportunities were individual, and not all employees necessarily agreed that the *digital* information infrastructure was the right approach to support them in their professional development. As a response to that, some employees enrolled other actors such as colleagues and external digital platforms to make the infrastructure meet the needs and suit their way of working.

These statements can also be explained through the lens of the Actor-Network Theory and ANT and Latour's (1990) scenario about the hotel manager and the keys. DMC's programs consist of getting their employees to engage in self-development through the infrastructure, however this does not seem to be accomplished. In Latour's (1990) scenario, the hotel manager employs different scripts to get the guests to leave their key at the counter - some scripts are weak resulting in a failure of the program and some are stronger resulting in an accomplishment of the program. Drawing parallels to the program of DMC it can then be argued that the IT systems in DMC are inscriptions which are supposed to make the employees behave in a specific way within the area of development and learning. However, the employees did not necessarily comply with this inscription due to their difficulties with navigating the infrastructure. One may therefore argue that the scripts implemented by DMC for the employees to enroll in the network were simply not strong enough resulting in a failure of DMC's program. Instead of enrolling in the network, which was the purpose of DMC's program, employees enrolled different and sometimes external actors, strategies and

workarounds with the aim of getting the infrastructure to work or to avoid it. As a result, these users came to represent anti-programs, which in turn added to the breakdown of the infrastructure. These anti-programs represented a dual challenge for the UX team who simultaneously were tasked with 'repairing' the breakdown by way of ensuring the enrollment of the users' anti-programs into DMC's program, yet also had as their core function to represent the users' needs and realities. Below we turn our attention to this issue.

4.1.2 Inscribing behavior and constructing (work) realities

Infrastructural change always involves choices; whether deliberate or not, the choices that give shape to infrastructure will represent the social world in certain ways and silence others. As a consequence, users may be more or less able to relate to the form an infrastructure takes. Relatively early in The Infrastructure Project, a tentative prototype was designed and tested on a handful of users with the primary aim of assessing the logic of the user interface. The prototype showcased a makeover of the current SharePoint interface where the portals to learning and development resources had been grouped according to logics based on roles as well as two 'tracks': one called 'Your Development and Learning', and one called 'Your Career and Leadership'. While some users felt such a distinction was meaningful, and some had more trouble telling them apart, a third prominent reaction questioned the very premise for such a categorization:

"(...) I am a specialist, so 'career' is a strange expression in my world because it is more about having exciting [work] tasks. I've never thought that I was on a career journey. But I know that if you want to, this is where it happens." (P2)

For this user, conflating work with career indicated a perception of purpose that did not align with his own reality, and so he could not identify with the reality imposed on him by the system. A parallel can be drawn to Star & Bowkers (1999, p. 255) study of nursing classification systems which talks about professional work and hierarchies and how infrastructure can change the way work, roles and purpose are perceived. In this study, nurses experienced the same unalignment as in the statement from the user above as they were concerned that their practices, routines and ways of employing discretion as a strategy to solve problems, were at risk of being forced to change in order to meet the requirements of the information system (Ibid, p. 272). In the Infrastructure Project it was the role of the UX team to mediate the work, role and purpose and the IT systems.

The fact that the choices and values that are built into the infrastructure - and, in this case, into the very infrastructural outlet (Pipek & Wulf, 2009) - have so potentially powerful redistributive effects (Edwards et al., 2009, p. 371) emphasizes how infrastructure is also a fluid network that can take on multiple forms and meanings depending on the context and the eyes gazing at it (De Laet & Mol, 2000). It also serves to remind us that "it could have been otherwise" (Star, 1990), and as we will see, the UX professionals sought to operationalize this motto.

At the workshops it also became clear that the overall purpose of The Infrastructure Project was to create a new platform and thus create a better overview and navigation options for the employees. The final project report stated that one of the high-level UX recommendations for a new solution was to organize the content around the end-users' needs and understandings, as opposed to the organizational structure, to provide the employees with an easier navigation and understanding of the information they were seeking. Which for some employees would also be what they needed in their everyday work life. However, the issue about whether the employees really wanted to access learning through a platform was not addressed at the workshops nor in the final report from the UX consultant.

4.1.3 Sub-conclusion

The first part of the analysis has presented the existing battle that took place in DMC which emerged from and became visible due to a breakdown in the existing infrastructure. Furthermore, the analysis highlighted the complexity of battling with values and needs from the people affected by the infrastructure and how different points of view and interests might be silenced and marginalized in the infrastructure struggle.

The notion of a breakdown leads the mind to broken wires and failing internet connection. However, as this part of our analysis has shown, it may be more suitably recognized as a result of sociotechnical clashes. One may argue that the current infrastructure failed to meet the users' values and needs for learning and development in DMC. The Infrastructure Project arose because of a breakdown in the existing infrastructure, which made that exact infrastructure visible. The breakdown in the infrastructure concerned a misalignment with what the infrastructure could offer the employees - i.e. a lot of disparate systems without consensus about what the systems contained and how the employees could benefit from them - and what the employees really needed - i.e. an overview and easy navigation as well as a user-friendly and easy-to-understand interface or even, for some employees, no system at all. One may

thereby argue that a breakdown is inevitable if you do not align the expectations and needs of the actors involved in the infrastructure.
Moreover, as a result of this misalignment, users employed strategies and workarounds in an attempt to avoid being burdened with extra work that was imposed on them due to the expectation of devoting scarce time to learning to understand the purpose and functions of the systems.

As previously stated, the purpose of The Infrastructure Project and thereby also the purpose of the UX team, was an attempt to 'repair' a breakdown by modifying the infrastructure, and to offer DMC's employees better and more streamlined opportunities to further develop and build their careers.
But on *what* and *whose* terms, and *how*? Had it been ensured that this goal was also consistent with what the employees themselves need in relation to their work practices?
A central point from the work done by Star (1999) is that infrastructures always involve choices that have normative and ethical consequences for all those who are in contact with the respective infrastructure, and that certain types of practices are supported, whereas others are marginalized and subject to hidden work. The UX team played a crucial role in investigating, uncovering and articulating the employees' needs through their research to support and provide the project team with insights about the users, their needs, problems, and behavior. And as the users' spokesperson and representative, it can thus be argued that the UX team had a role as negotiators as they attempted to create a balance in the infrastructure to help the users to survive a not always optimal and intuitive infrastructure and furthermore to build a common reference frame between the users and the project team.

4.2 Part II - Working with the installed base

An information infrastructure is, conceptually, a quite literal and exemplary instance of a complex and heterogeneous actor-network: it consists of numerous human and non-human actors, and only through their mutual interaction can one meaningfully talk about an infrastructure. It is through their relations the infrastructure comes into being. In this regard, the installed base becomes an expression of a long chain of translations leading to black-boxed infrastructural layers. In DMC, this had significant implications for the infrastructuring work undertaken by various actors, including the UX professionals' responsibility to ensure a stable relation between users and systems.

4.2.1 Who sets the scene?

DMC's 'huge and messy portfolio of IT systems' (Aanestad et al., 2017a) made for some of the most obvious constituents of the installed base and was, in turn, testament to the vast and expanding underlying network of practices the systems were meant to support. Accordingly, the portfolio of systems was extremely diverse and included systems targeted at highly specific tasks or domains - ranging from internal operations such as accounting to domain-specific activities such as product development - as well as systems supporting more 'universal' and often cross-departmental practices, such as professional development and learning (the focus of The Infrastructure Project). With so many systems integrated into the organization, they ordered the work life within DMC and were, accordingly, also at risk of disrupting it. The UX team was established as one means to safeguard against this by securing that the infrastructural environments facilitated intuitive user journeys, but the magnitude of systems also represented challenges which, almost paradoxically, slowed down the pace with which UX could be applied to them:

"[...] It's definitely our ambition that what we do become more strategic. But there are thousands of IT systems in [DMC], and processes [...] Last year, within our department with 400-500 people there were 100 IT systems [...]" (UX Manager)

The sheer amount of systems and processes spanning across departments and practices also created a significant distance between groups of actors and their individual infrastructuring activities, including reasoning and decisions pertaining to which IT systems to implement. While it is an intrinsic property of infrastructure that it is continually negotiated and appropriated in use, some initial decisions must be made about the scaffolding; something must be provided for there to be something to negotiate. In large organizations, such decisions are likely to be distributed according to the formal structure to streamline and centralize the process. In DMC, most IT systems were purchased as licenses from external vendors offering various enterprise solutions. Decisions about which systems to purchase were delegated to specific functions, apparently far removed from the users as well as the UX department:

"[I]f you go out and investigate "where is it decided", it will probably be decided in Procurement [...] especially if they are huge contracts. But you have what is called an RFP process. Request For Proposal. It is a very long, complex application process where you

have to answer an incredible number of questions, make small business cases and analyze what is the need and choice of product... There are a whole lot of criteria. I haven't tried making one myself. I have only looked through them. And I don't think UX is a parameter there. I don't think anyone is asking: is it a user-friendly system?" (UX Manager)

Delegating the decisions about which systems to build an organizational information infrastructure from to a central organ is, of course, immediately a matter of pragmatism and logistics. However, in DMC it was evident how such an arrangement also meant that the 'starting point' of introducing new systems into the organization's infrastructure had little transparency and made the premise for infrastructural change a bureaucratic matter dependent on formalized and top-down decision processes. Furthermore, it became a strategic matter of choosing products that, first, were suited to ensure a future-proofed infrastructural landscape transcending current or individual agendas (Ribes & Finholt, 2009) and second, were compatible with the installed base of existing IT systems that were already embedded and "sunk into, inside of, existing structures, social arrangements, and technologies" (Star & Ruhleder, 1996) within the organization. The same future-proofing and institutionalization of previously implemented systems had created a multi-layered foundation into which all new systems must be able to 'plug in' (Star and Ruhleder, 1996), and which all changes and improvements to existing systems must, in turn, take into consideration. Additionally, the choice of systems was governed by, and had to reflect, organizational and regulatory liabilities, including organizational identity, culture, and domain. For instance, DMC being a large and continually expanding pharmaceutical company placed crucial demands on the systems supporting its business in terms of capacity and data management:

"You can't just bring anything in. It must be able to handle a certain volume of employees [...] When it is a pharmaceutical company, there are an incredible number of things that must be observed in order to be 'compliant'. So if we are not, we can shut down production when an audit comes from those... FDA from the USA, for example, who determines what kind of medicine can be released on the market. There are a lot of things we have to comply with. Not all systems can handle that." (UX Manager)

Thus, expensive contracts, infrastructural planning, and procedural and regulatory compliance must be continually maintained and nurtured, creating continuous lock-in effects resulting in increasing rigidity and irreversibility. Therefore, these conditions became the driving force for

decisions about infrastructural trajectories. The user and the user journey, on the other hand, were not a salient parameter according to the UX manager. This observation is substantiated by the fact that, while the Procurement department was responsible for the formal application, decision, and procurement processes, the technical implementation of IT systems was carried out by the IT department who were also not in direct contact with the actual users, but worked according to the directions of the Sales department overseeing Procurement:

"If IT begins implementing some system, then someone in Sales– say we're implementing a procurement system. Then IT is responsible for the actual implementation of the system, but Sales usually has the process of, you have to purchase some consultant in some system, then there's a process for that, there are some legal requirements, there are all kinds of things that have to work together. Then the impression is that Sales is the user." (UX Manager)

A UX employee who had recently been employed in DMC agreed with this observation:

"I think that's important when talking enterprise-UX. Because if you're creating your own startup or making an app or a webshop, then it's pretty obvious who are your customers and who are your users. They're the same. [...] But here, someone pays you to do something, but those who are actually going to use that system are not the same as those who pay you to do it." (UX Employee)

The standardized, transactional process of bringing new IT systems into DMC thus fabricated a static and faulty image of 'the user' in which it would become synonymous with 'the customer', further solidifying the distance between users and the 'designated' decision-makers. As a consequence, in the words of the UX manager, "nothing has been built around the internal user journey". Adding to this observation, she noted how 'UX' might in some cases be used as a sort of one-size-fits-all stamp seemingly capable of traveling and staying intact across contextual borders:

"I would like someone to sit down and say 'what would be the ideal?', to challenge the people who are selling it on the user experience. Because they will always claim that they have done that, they have a UX team that has worked [on it]. [...] Maybe it's true, but it can be a long way from that to the context in which it's going to be used, in the company it's going to be used in." (UX Manager)

The argument here is that while the development of a system might have included UX work such as user research and user testing, it has happened separately from the specific use context within DMC, essentially rendering promises of user friendliness irrelevant. For instance, a system that orders information into specific taxonomies may not accommodate the local routines and tacit ways of engaging in knowledge sharing in a community of practice (Hepsø, Monteiro & Rolland, 2009). It also might not take into consideration the diverse and sometimes conflicting needs that exist between domains and niches, which is especially crucial for a subset of an infrastructure that attempts to support organization-wide activity. For instance, a chemist in DMC explained how the infrastructure failed at supporting his work because it was geared towards other, more generic work areas. For that reason, he was one of the users who found it necessary to seek other, external resources.

"For example, once I had to do some research on an instrument for my work to develop a new methodology. So I need some theory about it. And that was not something I could find through Degreed. Because it was kind of too specific and too theoretical, maybe. But if I searched for something about communication, for example, lots of things came up. So it's maybe more the soft stuff, where you can find your stuff... But [technically], I think it was limited how much I could find." (P1)

"I think there's a lack of scientific material in [DMC's] own systems [...] And it is generally very time-consuming to navigate and find materials in the systems [...]" (P1)

Similarly, users may employ different technological frames, or 'plans' as they attempt to interact with a system. Again, the ways information is stored and accessed might have a significant impact on users' ability to successfully complete their tasks, and inscribed use patterns may fail to accommodate local and individual technological frames - that is, the underlying assumptions, expectations and knowledge that people have of technology (Orlikowski & Gash, 1994).

"What I do is, if I have some things that I use regularly, then I bookmark them. There was a period where those links became outdated - so that's why it should instead be possible to search for an obvious structure and here I think the SharePoint frontpage is often a good start." (P7)

In contrast to a technological frame in which a central search mechanism is favored, others might favor menu- or recommendation-based navigation which demands that large amounts of information is organized intuitively (which may be a matter of relativity depending on the specific user). One user explained how they depended entirely on the information displayed by the infrastructure to navigate it:

"I just look in the search box and then I click it and then I check with the search results that come up." (P4)

"I always like when you can type into your browser one word, and then it takes you somewhere. So, like, if you can just type into your browser, like, 'development' or something, and then you get taken there directly, rather than having to find it on a landing page or search SharePoint or anything like this." (P4)

For others, however, experience and knowledge transfer might be crucial in order to locate and access relevant information. When asked whether his ability to navigate the infrastructure for professional development and learning could be accredited to his many years of employment in DMC, one senior manager said:

"Yes, I think that's probably one of the reasons. I share the knowledge I have with my employees, and typically they get assigned a 'buddy' to link up with. That's typically the way we do it." (P9)

Orlikowski and Gash argue that where technological frames of key groups in an organization (such as managers, designers, and users) differ significantly, difficulties and conflict may arise. Arguably, UX constitutes an obvious means for identifying and consolidating different technological frames by centering infrastructural planning (including choice of IT systems) around local user journeys, i.e., enrolling UX as an actor *before* enrolling new systems. Yet, instead of incorporating such a logic into system procurement processes, internal UX was only enrolled as a change agent in infrastructuring processes *after* the systems. This also emphasizes the temporal scale of network formation, since actors' room for maneuver are invariably determined by the sequence of translation effects caused by the previous gradual enrollment of

other actors. It attests to a kind of path-dependency that the UX team had to resist to increase their influence.

By imposing structure through the implementation of systems that have been selected based on top-down initiatives, DMC thus takes what Hepsø et al. (2009) call a control trajectory, rather than a cultivation trajectory aimed at deliberately cultivating existing work practices. Of course, that is to put it bluntly: the introduction of new systems may indeed also help cultivate existing practices. However, this requires that space is provided to evaluate such existing practices in heterogeneous domains (Ibid., p. 444).

These findings also constitute an important point about how and at which points human and non-human as well as 'internal' and 'external' actors assemble, interact and may be either included or cut off from crucial and defining moments of infrastructuring. DMC's organizational structure centralizes and gatekeeps such formative moments, imposing the use patterns inscribed in the systems developed by external vendors rather than attending to local user journeys. External IT vendors assert dominance and become powerful actors in the shaping of DMC's internal information infrastructure by translating themselves into licenses and contracts that will reach into the future and, thus, continually shape the installed base.

The installed base, being a complex, dynamic, and yet rigid amalgam of systems, conventions, practices, roles, objects and whatever else is 'already there' (Aanestad et al., 2017a), becomes a central and self-reinforcing actor around which all infrastructuring work happens - whether such work entails resisting (parts of) the installed base by, for instance, working around it by associating other actors, or allying with it out of necessity or tactics. This observation brings us to the next part of the story.

4.2.2 The art of compromising

Decisions about which IT systems should support work practices in DMC are based on an organizational structure and ingrained values and practicalities that translate into particular conditions for the shaping of the installed base. As the systems have been purchased, implemented, and 'trickled down' to the actual user realm, however, new struggles and negotiations begin. Managerial decisions have been made, and whether they concern the direction of work practices or the ordering of them through new or changed systems, they are a reality that other organizational actors must now deal with in some way or another.

Users might resist the programs imposed on them by the infrastructure, and it might cause - or perhaps rather, reveal - breakdowns, but that does not change the fact that the systems are there,

and they are embedded in or gradually fusing with the installed base - or attempting to. So, what to do? For the UX professionals, it would be a matter of attempting to reach compromises. As we have seen, DMC's infrastructure contains a large installed base of IT systems purchased from external vendors. As opposed to having systems built from scratch, tailored to the specific needs of the organization and its employees, the technical infrastructure is a patchwork of *off-the-shelf* systems offering standardized architecture and functions. Such systems are often designed to streamline, categorize, and standardize workflows and practices to reflect the modern workplace; indeed, they are a fitting example of Akrich's (1992) concept of scripts, since they inhabit rather specific visions and predictions about the world and the users and inscribe certain use patterns imagined by the innovators. For example, team collaboration and communication infrastructures such as Zoom and Microsoft Teams have, in the past years, fundamentally changed and instilled a new normal for the way people work and communicate. They have reconceptualized the notion of 'the workplace', which can now be the individual's own couch, and they have constructed new behavioral codes and routines. Today, these infrastructures have become the standard and part of the installed base in most organizations.
Another example, central to The Infrastructure Project, is SharePoint. SharePoint is a collaboration and document-sharing platform widely used in enterprises as a solution for organizing, storing and accessing information. Such a system offers convenience, predictability and stability through its more or less standardized architecture and structure. From an infrastructuring perspective, however, this apparent 'convenience' might also present barriers due to the additional limited customizability such systems provide. As such, the rigidity of these off-the-shelf systems had a profound impact on possible trajectories for infrastructural change in DMC, which was also reflected in the UX team's profiles. Addressing the nature of DMC's technical infrastructure, the UX manager said:

"And it is actually systems that you can't do much about. You can't go in and redesign it. So those in the [UX] team also aren't hardcore designers. They are researchers. I think all of the profiles are." (UX Manager)

The distinction between designer and researcher was significant here because, for the most part, the UX professionals working on internal systems were not in a position where they could make major design changes. Experimental and participatory approaches to the development of systems, in which UX designers might make use of prototyping and storytelling exercises and (co-)create designs rooted in the user's context, was not an option; instead, it was a matter of

researching users and their needs, problems, and behavior, in order to reconfigure systems, and assemblages of systems, to better fit with such representations and to help integrate them in the installed base. Such a task, however, might pose a challenge especially if systems were already embedded into parts of the installed base yet were not compatible with other parts of it. The UX manager noted how the UX professionals' work often became a question of what was realistically possible, rather than what would be ideal for the users. Often, making changes to the architecture or the design of an off-the-shelf system would require negotiating with the vendor, and equally often the vendor would be unable to make changes that would cater to DMC's needs because such changes would be global and affect all of the vendor's customers.

"So, often you will end up making some recommendations for a system and then they will be queued up by the [vendor] as ideas for improvements to the system. So it is very much about finding out: what can we do ourselves? And if you can't do anything or can't do enough, we sometimes put a software on top which is a kind of 'guide me' tool that can help users through, when the system is as non-intuitive as it unfortunately often is." (UX Manager)

Due to very limited mobility in the design space, the UX professionals often had to resort to workarounds and strategies not unlike those employed by the users in their encounters with infrastructure that did not meet their needs or expectations. In such instances, working solutions might take the form of 'survival guides' to help users overcome the difficulties of navigating non-user friendly systems, because their inflexibility made any fundamental design changes to the actual systems prohibitive. As actors representing the needs of users, however, the UX professionals would not necessarily perceive such a 'fix' as a satisfactory solution. Instead of providing order and direction, it might rather evoke a sense of added chaos due to the multiple layers of infrastructure that the user would now have to navigate. The UX manager explained:

"[...] putting software on top of systems isn't a great thing, because systems that are supposed to be user friendly– It becomes kind of a big spider's web of other things that the user, after all, also has to deal with. So it's not like we're sitting there blindly and thinking 'that is the solution to good UX'. It's an emergency solution, I'd say." (UX Manager)

However, while such 'emergency solutions' were clearly not the ideal in the eyes of the UX manager, it was also evident that she favored a pragmatic approach to the hand dealt to the UX

professionals and, by extension, the users. As such, infrastructuring also became a matter of joining forces with other actors, and of recognizing the installed base, including its strengths, limitations - and possibly where it might be exploited.

"[...] when a UX'er gets started, it will always be in close collaboration with a person who takes care of configuring systems and understands the system's technical capabilities. And its limitations. That is - the UX'er does not sit down and start drawing prototypes that do not relate to the real world. And comes up with something super nice that would be incredibly cool. It would be in close collaboration with the profile in [DMC] who knows what this system can do. And what it can't do." (UX Manager)

Returning to The Infrastructure Project, mobility - or the lack of - also became the center of discussion, and it ultimately ended up shaping both the scope of the project as well as the outcome. In the beginning of the workshop where current and future user journeys were discussed, the UX consultant attempted to frame the discussion by encouraging the participants to let the users' issues shape the agenda, rather than just stating what the project team thought was 'the right scope'. She also stressed that it was important that the project team had a clear understanding of what the problem really was. In doing so, she not only took on the role as an intermediary between the users and the rest of the project team as the designated decision makers, she also attempted to mobilize a collective aspiration towards increased user empowerment, which might work as a way to reconcile competing visions. However, during the workshop it was striking how the discussion seemed to continuously circle back to focus on *what was possible* in terms of redesigning the infrastructure, and, as a consequence, 'the scope' was repeatedly defined in relation to the degree of mobility as it was perceived by the different participants. By extension, the different ways of framing the project scope, and the subsequent solutions proposed by the participants, also implied different ways of relating to the installed base. For instance, while it seemed to be an uncontested fact that the infrastructure for professional development and learning consisted of too many separate systems, which resulted in a fragmented and confusing user journey, the Product Owner was insistent that it was outside of the scope to 'clean out content' and that discussing whether the individual systems earned their keep was redundant because they were constants that were going to keep being a part of the infrastructure. He also asserted that it was 'part of the infrastructure' for a user to, e.g., use Degreed for one task and then switch to LearnIT for the next. Moreover, when the issue was raised that Degreed was not user-friendly, he argued that the process of getting

the vendor to make changes to the system was 'an ongoing dialogue' but, in his view, it was a user-friendly system compared to other learning platforms. According to him, complete user-friendliness was an 'unattainable goal'.

In the Product Owner's view, accordingly, the solution was to *structure* content in a more cohesive manner while honoring the established infrastructural landscape. This positioning seemed to testify to a particular sensitivity, or even loyalty, to the installed base - implying a logic according to which fidelity to existing structures would yield more fruitful outcomes of the infrastructuring work (Aanestad et al., 2017b). Seemingly as a way of operationalizing this logic, the Product Owner would also frequently interpret user issues as validations of the steps that had already been taken towards change in the project.

The Associate Director, on the other hand, was more occupied with identifying areas where it would be possible to configure the systems to DMC employees' needs. She emphasized that while it was not possible to change technical and functional aspects of the infrastructure, they would be able to act on user frustrations regarding how content was presented and organized across the systems. In her view, the actual *content* - as opposed to the infra*structure* - could provide a solution to enhancing the user experience, and, by extension, it could help reflect 'the behavior they wanted the user to adopt'.

As a response, the UX consultant argued that there seemed to be a 'wall' between the users and the content managers, i.e. those responsible for curating and organizing content, such as courses and course descriptions. Because the content managers were often unaware of what the users wanted or what other content managers were doing, they had reported an impression of working in 'silos', meaning that the content would end up being unaligned and inconsistent. To the UX consultant, *alignment* between actors became the most crucial aspect.

Despite variations in how the project was perceived, however, the common denominator that made the participants reach agreement was the fact that the infrastructure did not offer enough flexibility to customize it significantly, and, since the practices it was supposed to support were already distributed across several systems with different architectures and functions, it would not be possible to ensure a uniform and consistent user experience by, for instance, providing all functionalities on a single interface.

Thus, the project team agreed that The Infrastructure Project's focus would be *navigation* - that is, pursuing a streamlined and consistent user experience for accessing content and information from the various heterogeneous sources embedded in the infrastructure. A portal solution, the project team reasoned, would make it easier for employees to find the information they were

seeking and take the right action, by acting as a unified entry point into the content provided for professional development and learning. This was also seen as a way of strengthening the coherence between, for instance, Degreed and LearnIT, which some users had trouble telling apart. Interestingly, this issue was at first a source of confusion for the Product Owner and the Associate Director, who argued that those were 'completely different systems'. To them, it was obvious that the two systems constituted different parts of the infrastructure; however, on the user side, they were similar tools (both of them provided resources for learning and development, e.g. courses) so users expected a logical interplay between them.

Narrowing the scope of the project down to a matter of navigation could also be seen as a strategy to 'weed out' user representations that would be challenging to incorporate due to the rigidity of the installed base and its embedded, inflexible systems. Navigation was, according to the user research, a legitimate and important issue to attend to, and, as the UX consultant expressed it, key to help users build a mental model of the systems. However, by focusing solely on navigation, user needs and issues that might genuinely affect the ability to use the infrastructure could more easily be disregarded, allowing the project team to focus on their available room for maneuver. For instance, some users had complained that it was no longer possible to use their credit card to pay for courses. While this would obviously constitute a barrier between the infrastructure and the user with the credit card, this issue was quickly brushed off as irrelevant because it was not something the project team had mandate to change, and so it was not regarded as a priority.

The solution to 'the navigation problem', thus, became the reconfiguration of the way the various heterogeneous information sources related to each other by establishing a *gateway*. Conceptually, such a solution is no news: Through their evolution and distribution, infrastructures will often integrate many heterogeneous components by means of socio-technical gateways (Plantin et al., 2018, p. 299). In infrastructure studies, a gateway is a point of entry or interface between different parts of an infrastructure. The term highlights the interconnectedness and interdependence of different parts of an infrastructure, but it can also denote an extension to the infrastructure which allows for new modes of accessibility and, as a result, shifts in practices, conventions, and relations. As an example, Edwards and colleagues (2009) point out how Google Scholar functions as a gateway between electronic journal publishers, university libraries and individual researchers. Moreover, gateways are common mechanisms for establishing order between competing systems, and as such they are key drivers for the evolution of infrastructures. However, Edwards et al. also argue that seamless

interoperability often remains elusive and rough patches must be smoothed over by user action (p. 367).

In any case, it was decided that the SharePoint platform would become such a gateway by acting as an *information platform* linking to all other sources and resources and thus removing layers of complexity that the users had currently faced in their interactions with the infrastructure. It would provide an overview of the options available to users regarding learning and development by organizing content around the users' goals, e.g., how to become better at project management. It would link to Degreed, which would function as the primary *learning platform* containing the content that employees would consume. It would also link to LearnIT, which, on the other hand, would become a *sign-up platform* where employees would go to sign up for courses, join waiting lists, or get details about specific activities.

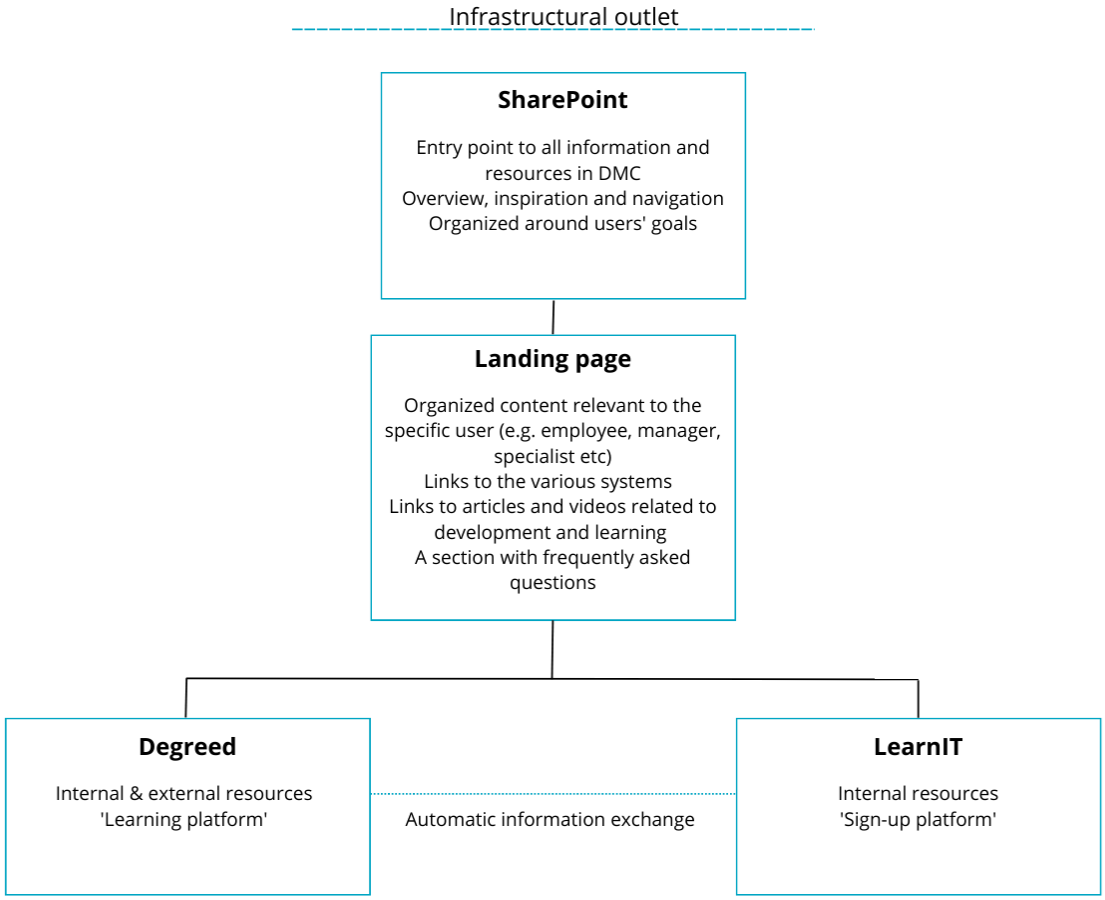

Figure 4. A simplified overview of the infrastructure for professional learning and development in DMC as proposed in The Infrastructure Project. The hierarchical structure demonstrates the attempt to create a uniform user experience for locating relevant content by reconfiguring the way the heterogeneous sources related to each other. This was done by transforming SharePoint into a gateway from which the rest of the infrastructure would be accessed.

Structuring the *relations* between systems, then, was achieved through a comparatively simple gateway logic aiming to reconcile the installed base with the users' needs. However, the structuring of *content and categories* remained a central challenge, since ambiguous and unintuitive interfaces and information might risk reintroducing the fragmentation that a gateway solution attempted to mitigate.

Visually, the issue was resolved through the introduction of ordering elements such as 'content cards' presenting information in a digestible fashion. The goal, as emphasized by the UX consultant, was to organize and categorize content according to the user's reality rather than the organizational structure. But yet again, such an ambition posed the problem of representation. This, in turn, revealed new aspects of the installed base and, despite its apparent rigidity, it alluded to a simultaneous fluidity. For instance, at one point the project team was discussing the layout of a page where content was structured after 'topics' and 'competences'. It was a concern whether the way content was organized and presented might cause confusion. The Associate Director argued, for example, that a specialist would not be able to identify with a 'for all' category because, despite the apparent inclusivity embodied in such a categorization, specialists would usually have needs and goals different from the cluster of employees representing the majority, i.e., 'all' employees. On the other hand, she reasoned that the skill 'project management' should be available 'for all', since this was becoming 'a broad and generic skill'. She also noted how she had been approached by a colleague who had asked why categories were presented as, e.g., 'specialist' and 'project manager', but not 'general manager', which she believed to be an important role in the organization. The reason, which the Associate Director claimed that the colleague was 'now aware of', was that there was a strong pull for project management development and specialists due to current organizational trends. Such observations and ways of reasoning demonstrate how categories and their meaning can change over time, and that the installed base is not immune to such changes. This has already been discussed by Bowker and Star (1999), such as when they illustrated how analytic readings of phone books might reveal historical changes to social order and norms: for instance, by the time they wrote their book, drug addiction support groups were likely to be listed under 'emergency services', whereas several years before they were usually listed under 'rehabilitation', if at all (p. 57). However, in our example, it might also be an indication that technologies and local practices may not always develop at equal paces, and as such may cause disruptions to the installed base.

4.2.3 Sub-conclusion

The second part of the analysis presented the battle between the installed base, the off-the-shelf systems and the UX team's ability to modify and influence the infrastructure.

As presented in the analysis, the infrastructure in DMC grew upon a complex installed base of off-the-shelf systems that provided various degrees of flexibility and customizability for the involved actors. The lack of flexibility and customizability thus hindered the UX team's mobility - i.e. their capacity (or lack of) to modify parts of the infrastructure, where the off-the-shelf systems 'dictated' what was possible.

The UX team's immobility in relation to modifying the infrastructure also stemmed from a missing involvement in the RFP-process, where the procurement of systems was based on top-down initiatives. One may argue that by not involving UX in that process and by not incorporating the users' perspective ultimately resulted in an installed base ignorant or even hostile approach to infrastructural development (Aanestad et al., 2017b).

The missing involvement in the procurement of systems posed a risk of neglecting the user journey and instead favoring other actors in the installed base such as procedures and other systems. This approach could potentially marginalize the users and result in poor user experiences.

Our analysis also shows that the installed base is a central and powerful actor that has a significant influence on how the infrastructure looks, evolves, and potentially stabilizes. And further, it shows how the various actors involved in the project all had different ways of relating to the installed base depending on their individual objectives and perceptions of what the infrastructure should be able to accommodate - showing either loyalty, hostility or creating a strategic alliance with it and acknowledging its power.

The UX team's role revolves around improving the user experience by negotiating with the inflexibility of the installed base and the off-the-shelf systems. By acknowledging these non-human actors' weight in the infrastructuring work it enabled the UX team to create strategic alliances with them. It may therefore be argued that the UX team had a negotiating role between the users and the experts (the project team), between the installed base and the off-the-shelf systems, and lastly between the users and the infrastructure to create contexts and interactions that can better support the users and their practices and routines.

As a strategy, the UX team acknowledged the power which the installed base had and sought to help the users 'survive' by appropriating poorly integrated and non-configured systems. The UX team also aspired to take a stand from its dictating behavior which was exemplified when the team had implemented navigation strategies for the users such as software overlays and gateways such as transforming SharePoint into a gateway for the infrastructure supporting learning and development.

4.3 Part II - An actor on a mission

In this third and final part of the analysis, we shall turn towards the UX team as an actor on a mission.

The reader will be presented with the UX team's strategic work, choices and considerations around demonstrating the value and importance of UX across the organization. Furthermore, this section aims to present how the UX team seeks to change the organizational culture around the perception of what UX and sufficient user involvement are and when it might have the greatest value and impact for the UX team to be involved in projects across DMC.

4.3.1 Getting a seat around the decision-making table

As presented in the introduction chapter, the respective UX team in scope for this project was established in 2020, where the initiative behind the creation of the team stemmed from an organizational change. Prior to the establishment of this UX team, historically there had not been a natural approach and way of thinking about UX and user involvement in the development, redesign or purchase of internal standard IT systems. Therefore, it entailed greater strategic work for the UX team in having a say and getting a seat at the decision-making table in the organization. A task which, at the time of writing, is in continuous and constant development and which, partially due to DMC's large size, has been and is a laborious task for the UX team's manager and its employees. Thus, the UX team has had to act strategically when deciding where they create most value for the employees in DMC, but also in relation to assessing which projects would in the long term benefit the team's opportunity to have more influence and impact on the overall processes and procedures related to the development, adjustment or procurement of DMC's IT systems.

In this strategic work, there was first and foremost a task for the UX team to partly understand how DMC perceived UX and user involvement on internal IT systems and partly to try to

spread knowledge about the value and possibilities in incorporating UX on internal IT systems. A task which the UX team's manager referred to as being on a 'cultural journey':

"So I would say, from a UX perspective, it quickly dawned on me that we have a cultural leg - we must change a culture, we must change a mindset, a way of thinking about how we work with IT and with users - and then there's the question: what is UX? We need to embark more on a cultural journey and explain why this creates value, and what it means to do UX." (UX Manager)

"So I think it's also a question of - where are they? I think we have to join the process early, because otherwise we simply have to be a requirement - as part of the RFP [Request For Proposal]. The templates that must be filled in.. That X, Y, Z must always be done (...). The systems may not fit into the user journeys at all, it may not be integrated and it may also be that they oversell it. And therefore it would be great if you started to be allowed to challenge that. And that can only be to everyone's advantage, I think." (UX Manager)

The team's mission to make UX become an integrated and natural part of the installed base thus included many components from changing the organization's perception of UX when it comes to off-the-shelf systems to changing the practical and structural procedures for what happens when new systems are purchased for DMC through the RFP process. They did not want to figure merely as a rescue team that had to repair breakdowns - a core mission for them was to be involved from the start in the innovation and idea phase of the development or redesign of (parts of) the infrastructure. And by shifting away from only being able to make adjustments and recommendations for changes for the installed base, they wished to become an integrated part of the installed base to achieve enough influence and strength in the infrastructure network.

On the RFP process, the UX manager further explained:

"And I don't think UX is a parameter there. I don't think anyone is asking: is it a user-friendly system? And that's something that's on my radar as something.. another place we could go in and try to make sure the right systems get brought in (...). Strategically, if we could be part of that process and become a mandatory step in making IT architect principles, for example. If it was mandatory that you need to follow some IT architect principles when installing a new IT system and one of the principles was that you must always have a user journey focus, then that might change something". (UX Manager)

The UX manager had also observed how there was a misunderstanding among the employees in DMC regarding what user involvement really entailed, and how UX was sometimes reduced to, for example, merely doing a user satisfaction survey or involving the users at the end when making changes to the infrastructure. She argued that this misunderstanding stemmed from a prevailing assumption that UX was something that was primarily to be applied at the end of a development or implementation phase as 'glitter on the cake':

"And UX, in many people's worlds, because they do not know what it is, it's just a little glitter on the cake. We just do that afterwards. Some people think it is something completely different than it is. That it's communication, training. They don't know what it is." (UX Manager)

An example of the lack of understanding of the UX team's purpose was also observed at the kick-off meeting for The Infrastructure Project. Here, it was observed how the project team assumed that the UX consultant - besides having the responsibility for doing in-depth user research, for developing recommendations which both aligned with the user's needs and the infrastructure's capabilities - could also function as a graphic designer and design the infrastructure's visual identity within the relatively short timeframe of the project. Here, the UX consultant pushed back and emphasized that the visual identity should be done by a graphic designer if major changes were to be made. This argument was accepted by the project team, but showcased the lack of insight into the work involved for the UX consultants and UX in general.

The UX manager further argued how there was a tendency in DMC not to 'think across the organization' in regards to implementing new IT systems. And how those involved in the implementation of the new systems had not yet succeeded in developing the systems for the wider context of DMC to be used across the organization:

"Some think: we are implementing a system, now it can solve 'this task'. And that may be true. They believe that the job is then over for them - and then there are others who take care of what's next. And that's the mentality we work with and try to do something, so that you start to think a little bit across the organization. So instead of thinking that you have solved it in your own part of the organization and part of the system you have taken partial

responsibility for, understand that it is only part of it. But that's not where we are at all." (UX Manager)

From these observations, it might be argued that the UX team and the employees of DMC as actors were quite far from each other in their perception and approach to what UX was and could do, and thus that the UX team also had an important role in uniting the different actors' mindset around UX and user involvement so that the potential of user involvement for the future could be adequately harnessed and leveraged.

The following statement from the UX manager also underlines an argument about how the existing business model in DMC, as part of the installed base, was a powerful actor that counteracted or complicated the UX team's room for maneuver, since departments and teams across DMC must themselves allocate financial funds and resources from their internal budgets in the departments for the UX services, which ultimately affects the UX team's work:

"But it is not us who make the decisions. It's the business model we have that does it because they kind of have to pay for it. So they have to both understand that it makes sense to work with UX and of course not everyone has grasped what it's all about, because it seems foreign to many - so there is the cultural part of it, that is, the project-cultural, to be integrated into the way people work (...) And then secondly: Then there is the matter of being involved when something new starts up. And there the challenge is that teams need to want to budget for something where they don't quite know what the fuss is about." (UX Manager)

The UX team's challenge with the existing business model also became clear during the kick-off meeting for The Infrastructure Project, where the Product Owner and the UX consultant discussed the scope for the project. Here, the Product Owner ended up arguing that, although all the elements presented were important, it was out of scope due to the financial budget allocated to the project and thus, they needed to prioritize the most important elements.

As mentioned in the second part of the analysis, the RFP process is a complex application process with multiple criteria. Its purpose is to support the process of screening IT systems, and ensuring that procurement of new systems happens on an informed basis. However, the notion of user friendliness as well as streamlined and intuitive user journeys and a perhaps more critical reflection in relation to whether an off-the-shelf system would fit into the context of DMC's employees and their needs and work practices seemed to be largely absent.

Furthermore, a discussion on if and how the off-the-shelf systems could potentially be modified to DMC's context also did not seem to be part of the screening procedure. Thus, it might be argued that the absence of these considerations might result in an increased risk of purchasing an IT system which could lead to a breakdown in the infrastructure by not supporting the needs of the employees at DMC and thereby ending up becoming a burden and obstacle to their work practices. Furthermore, the UX manager's statement about the RFP process additionally indicates that there was a desire from the UX team to be included in that process as early as possible and as a 'golden standard', thereby enabling the UX team to shape the cultural journey towards a shift in the mindset around UX within DMC.

However, it disregards the UX team's lack of influence on general processes in DMC, i.e. the RFP process, the authors observed how the UX consultant at the kick-off meeting for The Infrastructure Project had large influence on which issues were chosen to focus on. At this meeting, the UX consultant presented what she assumed was within the scope. Here, the UX consultant advocated that it should be the user's issues that should shape the agenda of the workshops instead of just stating what the project team thought was the right scope.
At this meeting, there was another situation where the project team tried to get certain functionalities incorporated into the redesign of the infrastructure - i.e., the proposal to be able to click on menu items instead of scrolling to them - to which the UX consultant pushed back and argued that they would break usability conventions by making it more difficult to navigate, which the project team accepted.
These observations support how the UX consultant specifically in The Infrastructure Project became a moderator who had the power and influence to manage the project towards the user's premises and not solely based on the project team's stakeholder premises and what they thought the scope and direction of the project should be. Furthermore, it showcases how the UX consultant was the user's advocate and how she positioned herself in relation to UX in the organization.

4.3.2 Employing tactics

As part of their strategic work to gain more influence on the development or adjustment of the infrastructure in DMC as well as showcase the value of UX and user involvement, the UX team established some objective measurable parameters to help them determine when it would be beneficial for them to enter into a collaboration with a respective project team.

"When is it a good investment for the UX team to solve something? When is it a service we are out to solve that we benefit from?Funnily enough, nobody comes and asks me for the service of applying UX to the Procurement model when [DMC buys] new systems. Although that would be nice!" (UX Manager)

The screening framework developed by the UX team served as a means to *facilitate* influence by establishing pragmatic strategies for intervention. The parameters in the framework included 1) *Number of total users:* how many of the DMC's employees are using the respective system, 2) *Daily users:* how many are using the system(s) on a daily basis, 3) *Yearly support cases,* how many support cases does the IT service department receive from the employees across the organization, that they need to solve, 4) *System criticality*: what is the importance of the system, and finally 5) *Customizability,* what can - or cannot - be changed or modified in the system.

The purpose of these parameters was to provide the UX team with an overview of where they would have the opportunity to have the most influence in order to shape and modify the system based on the potential of UX as well as the UX professionals expertise and experience. Furthermore, the parameters served as means to help the UX team assess how they could create the most value for DMC's employees and users of the infrastructure. Through data-driven decisions and by prioritizing their efforts, the UX team were able to position themselves strategically in terms of which projects to focus on. For instance, by targeting systems with a higher number of users and daily usage, they aimed to make an impact on a larger user base, potentially improving the user experience and, at the same time, demonstrating the value of investing in UX 'services'. Additionally, considering support cases could help identify areas where user experience issues may be more prevalent and require immediate attention. Furthermore, the emphasis on system criticality and customizability could help ensure that the UX team's resources were invested in areas where their expertise can be most effective and where changes can be made to align with user needs.

The previous year, the UX manager had a UX consultant do an internal UX review of more than 100 IT systems over the course of three months with the purpose of determining which systems and projects would be most beneficial and create the most value for the UX team to engage in based on the screening framework. The UX manager explained:

"[He] interviewed over 100 people to find out, if we just look within our own framework [the 5 parameters], what are some systems that will be the most interesting to have a look at in relation to improving the user experience. We reduced them down to a top 20 and some of them were able to say on various other parameters what is urgent in relation to capacity etc. Are there any UX'ers who are already working on this? Or is it a system where they are in the process of replacing an old one, because then we have to be involved from the start - then there is an urgency to it. Based on that, we landed on a top 4." (UX Manager)

From the above statement, it can thereby be deduced how one of the UX team's strategies was to try to get the opportunity to work on the systems they saw as being the most critical in relation to how embedded the systems were in the installed base. This embeddedness would have a large influence on the degree to which UX tools and methods would be able to change the infrastructure, but it would also serve as an indicator of how much of the organization, including its employees and their local practices, would be affected by breakdowns and changes to the particular system(s).

The strategic considerations and deciding with projects to engage in can be related to the work by Grisot et al. (2014) on which conditions enable successful information infrastructure innovation. According to the authors, three types of infrastructure innovation—innovations of, in, and on infrastructures—are interconnected and require comprehensive strategies to achieve successful outcomes (Grisot, 2014, p. 214).

Innovations *on* infrastructures occur by adding new components on top of existing infrastructures, i.e. the installed base - for example, creating a gateway. Innovations *of* infrastructures, on the other hand, involves the creation of new infrastructures or the re-conceptualizing and redesigning of existing infrastructures - for example, creating a high-speed rail network. Finally, innovations *in* infrastructures involve replacing or modifying existing components of an infrastructure without changing its overall architecture - for example, upgrading computer servers in a data center (Ibid).

With the above statements from the UX manager, one may argue that the UX team wishes to expand their impact from simply innovating *on* the existing infrastructures by adding new components or expanding the existing infrastructures in DMC towards having the influence to become actors in innovation *of* new infrastructures in the initial phases of the development. By being a part of the initial procurement and development process it would thereby give the UX

team the potential of cultivating the installed base in the initial stages when new infrastructures are being developed.

4.3.3 Sub-conclusion

In this third and final part of our analysis, we focused on the UX team's strategic choices and considerations in order to achieve their goal to become powerful actors in the infrastructure battle and thus, obtain more influence and impact on the decision-making processes in DMC in relation to procurement of new systems or making changes to existing ones. Furthermore, the reader was presented with the 'cultural journey' which the UX team is currently on to change the mindset across the organization about the perception and assumption of what UX is, and the value of user involvement both from the outset of infrastructural change, and all the way through these processes.

Thus, the battle that outplayed in this part of the analysis was the struggle for a seat around the decision-making table and, from the UX team's perspective, to gain influence both on the overall processes in DMC, as well as on the 'project-cultural' processes such as The Infrastructure Project, and the battle to change the general mindset around UX and the value of early user involvement.

Through their strategic choices and considerations the UX team did systematic and thorough work to gain more influence. This could make one reflect on what it would really mean for both the UX team, but also employees and stakeholders across DMC, if the UX team were to achieve their mission of greater mandate and more influence.

By being involved in the procurement process as the user's representatives, the UX team could potentially ensure that systems that are chosen to purchase are the once most suitable and aligned with the user's needs. This would align with the team's mission of enhancing the user experience, increase the employees productivity, and thereby raise the general satisfaction among the employees by decreasing the extra time spent on trying to make the infrastructure work.

The involvement would further feed into their aspiration of becoming a 'golden standard' as an embedded part of the RFP process and to support their goal of contributing to the assessment and evaluation of the IT systems, thereby helping them to mitigate the risk of unnecessary costs resulting from the implementation of systems that do not meet employees' needs or require significant customizations later on.

By being involved early the UX team could help to identify, uncover, and understand the user's needs and requirements before the development of the systems begins. This could allow for the opportunity of designing and adapting solutions that would better meet the user's expectations and requirements, ultimately leading to better outcomes and a more streamlined workflow for the employees.
Furthermore, the UX team could help to identify potential issues, challenges, or misunderstandings before they become too expensive or complex to address later on and instead make early adjustments to minimize costs and the potential risk of errors.

Finally, one may argue that early involvement could result in an increased opportunity for collaboration and communication between the UX team, the IT specialists, and other relevant stakeholders. This could create a more efficient and integrated workflow where all parties would have a shared understanding and ownership of the project as well as a more in depth understanding of UX and its potential on the systems.

When trying to change the mindset and assumptions about UX, the UX team once again had a crucial role - this time as an activist, advocating for the value of UX and early user involvement.

5. Discussion

Throughout our analysis, we have explored the practical-political process of establishing an infrastructure in DMC through an endeavor of infrastructural inversion (Bowker & Star, 1999, p. 34), which have revealed essential themes, including infrastructuring activities, battles and strategies. The infrastructure as a battlefield has been an ongoing theme throughout our analysis and emphasizes the complexity of building a successful infrastructure which is addressed in the theoretical framework.
The three parts of our analysis each uncovered and presented different parts of the 'battle'. In the first part of the analysis we focused on the battle between the users and the infrastructure which led to a breakdown due to conflicting values and needs for learning and development in DMC. The second second part of our analysis revealed a battle between off-the-shelf systems and the installed base due to rigidity of the installed base and lack of customizability in the modification of off-the-shelf systems, which presented specific challenges related to mobility, configurability and adaptability to local needs and practices. Lastly, we saw how a strategic battle between the UX team and DMC had been initiated by the UX team to achieve their goal

of getting a seat around the decision-making table and thereby getting more impact and influence on the infrastructuring work in the organization.

Throughout our analysis we have identified actors and their programs and agendas to examine the activities and contributions triggering translations in the infrastructure actor-network. This approach can be supported by the work of Pipek & Wulf (2009, p. 455) which emphasizes a need to focus on mapping and describing the actors and activities with the purpose of acknowledging their contribution to the infrastructure. Actors bring different resources and strategies for cultivating infrastructure to the 'battlefield'. As we have seen, they will also have diverse objectives to do so, as well as different ideas of when an infrastructure is working. Thus, it is important to look beyond immediate ideas of what a particular actor contributes with, based solely on their designated function. This argument should also be understood in relation to infrastructure studies' aspiration to move away from the traditional impression that infrastructure is something that is 'built': while its material elements are obviously constructed by domain experts such as engineers and IT architects, the arrangements and configurations that lead to a *working infrastructure* requires intricate and often less specific (or categorized) modes of infrastructuring work carried out by many diverse actors. For that reason, we have mostly referred to this process as *cultivating* infrastructure throughout the thesis. Borrowing from the social construction of technology framework (SCOT), we can fittingly conceptualize the actors performing such work as *relevant social groups* (Pinch & Bijker, 1984). These groups can be both organized and unorganized groups of individuals, but their defining property in this regard is that they influence the technological trajectory because they engage with (and possibly resist) the technology in ways according to their specific realities and interpretations of a given technological concept. Such different interpretations may give rise to conflicts between criteria that are difficult to resolve technologically - just like we saw in our analysis of The Infrastructure Project, where different problems and interpretations of work and purpose resisted a smooth and universally agreed-upon resolution. Contrary to ANT, this approach understands technological transformation as an inherently social process, and as such it emphasizes the struggles between groups of human actors that shape technology and eventually trigger closure mechanisms that lead to blackboxing. For instance, in their historical reconstruction of the origin of the modern bicycle, Pinch and Bijker showed how its current form was a result of struggles between different social groups' interpretations and expectations for what a bicycle should do and look like.

In this thesis, we have focused more on the heterogenous relations that are continually translated and negotiated in the infrastructural network, demonstrating how powerful non-human (or hybrid) actors like the installed base contribute to the struggles between chaos and order, and restrict room for maneuver for other actors (Callon, 1984). However, constructivist and relational ontologies are not mutually exclusive; they simply approach the nature of reality from different perspectives. Thus, we contend that perceiving UX professionals as a relevant social group is useful for the present discussion, because it helps us to redirect our attention to and reimagine what the UX team, as a relevant social group in DMC, contribute with in the heterogenous infrastructural battle. In doing so, we may get a better understanding of what is actually going on in the battle, and it may enable diverse groups to devise more informed strategies for infrastructure cultivation.

With that in mind we shall now move on to the roles of the UX team which we have identified based on our analysis of the practical-political process of establishing and cultivating infrastructure in DMC. As we will show, these roles also differ in whether they are roles that the UX team *gets*, *plays* and *takes* in their infrastructuring work.

5.1 The multiple roles of UX

5.1.1 The Rescue Team

First, we shall return towards the most apparent role which was imposed on the UX team as they were assigned to The Infrastructure Project and which was also observed as a general tendency in the way the UX team was perceived by DMC.

Based on the thesis' empirical basis and our analysis, it can be argued that the UX team was perceived by DMC as having a role as a *rescue team* with the purpose of 'saving' projects from

potential failure and to repair infrastructural breakdowns. A rescue team that was first called into the battlefield with the expectation of having to repair or fix the ‘holes’ in the infrastructure - either only after a breakdown in the infrastructure had occurred or right up until a breakdown might occur as a patchwork solution and, as the UX manager stated the UX manager stated as 'glitter on the cake'.

Thus, the UX team was expected to 'fix' breakdowns in the infrastructure by way of improving the employee’s user experience. And when systems or processes failed to meet user needs, the UX team was expected to step in to identify and address these issues. Although the role of a rescue team can be seen as being reductionist and lacking facets of the UX team's full potential, they were also acknowledged as having the expertise and skills to analyze the root causes of usability problems and propose effective solutions. Furthermore, they were acknowledged as having the skills to understand and uncover the user’s perspectives and translate them into actionable improvements and recommendations which ultimately could enable them to ‘rescue’ the employee’s user experience from potential frustration, inefficiency, and lack of coherence in the infrastructure. However, the UX team's mission and strategic choices presented throughout the analysis supports the argument that they are more than *just* a rescue team. Being a rescue team entails more than just saving the employees from poor user experiences. It also involves preventing the development or procurement of systems that are not user-friendly or does not meet the user’s needs. By being involved in the decision-making processes, the UX team could have the potential of advocating for user-centered design principles and ensure that the infrastructure will be developed or systems are being purchased with the users’ needs in mind relevant to the context of a pharmaceutical company like DMC. However, at the same time DMC’s perception of the UX team's abilities and value often relegates them to being brought in as a rescue team for last-minute fine-tuning.

To illustrate this observation, one can draw inspiration from a firefighter analogy. While a firefighter's role is vital in extinguishing fires and saving lives, it is not an optimal solution to rely solely on firefighters to put out fires; where possible, the most sensible strategy would be to take preventive measures. Hence, perceiving the UX team as a last-minute means of doing ‘damage control’ may overlook the potential for proactive involvement in the early stages of projects. Such a visualization can be supported by the UX manager's statement about how

overlay software is not the ideal solution, but more of a 'band-aid' plastered on top of an unfunctional infrastructure.
It is important to recognize that the UX team's role extends far beyond this reactive approach. Instead, they are critical in repairing breakdowns by establishing collaboration between users (the employees), the experts and the installed base and their insights and recommendations serve the potential of ensuring that the user's perspective is considered, and solutions are designed to meet their needs more effectively.
By incorporating UX expertise from the outset, the UX team could potentially help identify and address potential issues before they turn into major breakdowns, saving time, resources, and ultimately, ensuring a smoother project execution.

While the UX team may be seen as a rescue team within the organization, their role is multi-faceted and goes beyond fixing breakdowns. They play a critical role in directing the trajectory of infrastructural change through proactive advocating for being involved in the early stages of projects, and for user-centered design as well as bridging the gap between users, experts and decision-makers.
Furthermore, in the context of infrastructuring, the UX team seeks to become enablers of user-oriented infrastructural cultivation by actively participating in the design, implementation, and continuous improvement of the internal IT systems.

This part of the discussion aimed to present how DMC views the UX team's role in the battle for the infrastructure. In the following sections, it will be presented which roles the UX team themselves try to take on in their battle for influence, involvement and increased impact.

5.1.2 The Negotiators

Above, we discussed how the perception of UX professionals and their function imposed on them the role of a rescue team that was summoned primarily as a response to infrastructural breakdowns revealed by problems resulting in poor user experience and decline in use. While this is a legitimate and crucial role that entails important work necessary to get a broken infrastructure back up and running, it also risks instilling an impression of UX work as a straightforward, mechanical, and uncomplicated endeavor. It effectively becomes an echo of the UX manager's observation that the work carried out by the UX team is regarded as a distinct - and mostly voluntary - phase separated from all other processes leading to infrastructural change.

We argue that such a simplistic view is far removed from the reality and breadth of the infrastructuring work that the UX professionals also engage in. Our analysis of the practical-political process of infrastructural cultivation in DMC revealed that the UX team also takes on the vital role of *negotiators* positioned between various human and non-human actors. This role was observed to operate around several constellations.

First and foremost, the UX team acted as negotiators *between the users and the designated decision-makers*. Being advocates for, on the one hand, organizational objectives and visions and, on the other hand, employees with vastly diverse needs, routines and tasks to solve, attempting to reconcile ensuing tensions and find common ground became a main concern. This might be a challenge because DMC's organizational structure and culture would often prevent the UX team from having a seat at the table where decisions vital to the fundamental shaping of the infrastructure took place. However, by combining extensive organizational and professional knowledge (for instance from monitoring systems and their purposes across the organization and sharing knowledge with other actors) with their discipline's 'tools of the trade', such as user interviews, UX design principles and prototypes, they sought to identify and extrapolate different - and possibly competing - visions into their opposing realms and, by extension, seek "some practicable accommodation between these contradictory concerns and exigencies" (Edwards et al., 2009, p. 371). This was, for instance, done by organizing the information presented on the platforms according to logics that would resonate with both users and organizational objectives. Moreover, this type of negotiation work involved shrinking the gap between users and experts by championing user-oriented practice:

"So it's really about helping those sitting behind the users and the processes and help them see the complexity they give the user. Because they can't always see it themselves. And what kind of user is it they're addressing? A leader? An employee? There's often a big difference in what each of them are supposed to see in the system." (UX Manager)

By facilitating such decentralized negotiation between the interests and expectations of employees and managerial actors, the UX professionals effectively act as boundary spanners (Tushman, 1977). While the idea of boundary spanning work usually pertains to mediating between different *social* worlds, our analysis shows that infrastructuring work also entails *sociotechnical* boundary spanning between heterogeneous actors. Accordingly, the UX professionals also engaged in negotiation *between the installed base and new off-the-shelf systems*, or systems that were subject to reconfiguration and change. Such changes to the infrastructure requires careful consideration of both technical and social elements that already exist, since ignorance or even hostility towards them is likely to result in incompatibility, conflict, and even breakdown (Aanestad et al., 2017b). At the same time, Aanestad et al. (2017a) argue that "an organization-wide information infrastructure that is deeply embedded into work routines across several departments will be difficult to change, however, careful analysis of all its aspects can inform change strategies" (p. 26). In DMC, this challenge was increased due to the often inflexible nature of the IT systems, which might struggle to integrate with both the technical and the social dimensions of the installed base. In many cases, this meant that the UX professionals must form alliances with the (technical) installed base, even if it presented barriers to change that might provide better user journeys. This testified to a fundamentally pragmatic, yet tactical approach to infrastructuring work. For instance, rather than 'dreaming up' solutions that might seem to tick all boxes for the user, they would incorporate the installed base by 1) uncovering existing practices and behavior on the user-side, and 2) collaborating with technical experts to ensure that (the reconfiguration of) a system takes into consideration technical constraints and to make it more likely that the solution corresponds to 'the real world', as the UX manager expressed it.

The final - and perhaps most crucial - constellation around which the UX professionals had to facilitate negotiation was that of *the users and the infrastructure*. More specifically, they had to negotiate between, and on behalf of, the employees on one side, and the systems embedded in the infrastructure on the other. This challenge especially concerned the inflexibility of off-the-shelf systems and their occasional incompatibility with the parts of the installed base that

represented the diversity of work practices, routines, and general realities of the employees. Whereas negotiations between users and organizational or managerial objectives depended on finding common ground that could support and accommodate both sides, this type of negotiation specifically involved the simultaneous activities of appropriating the systems to get around the use patterns inscribed by the vendors when they were oppressive to the users' needs, *and* finding ways to help the employees to appropriate the infrastructure. Practically, this often became a matter of helping the employees 'survive' an infrastructure that might not always succeed at supporting the multitude of existing practices, needs, expectations and technological frames. This holds especially true for 'universal' infrastructures such as the one supporting professional learning and development, since such an infrastructure must be able to cater to and accommodate vastly different realities (e.g., highly scientific work, project management roles, patient relations roles, and so on). Strategies for such negotiation might take on different forms. In some cases, it might be quite literal 'survival guides' in the form of software overlays applied to systems that, due to their rigidity, cannot be 'salvaged' through design interventions to improve their usability. Sometimes, it might also be by taking a step back from the hands-on work to mediate knowledge. As the UX manager stated:

"UX is many things. It isn't just a system. It's also about bringing the knowledge we can't do much about to the right people so they can do something about it." (UX Manager)

In other cases, such as in The Infrastructure Project, helping users appropriate the infrastructure might entail improving accessibility and decreasing fragmentation by 'collapsing' several components of the infrastructure behind one system serving as a gateway. Such solutions might, in themselves, inhabit or create additional and even counterintuitive challenges, for instance when 'emergency' software introduces additional layers of complexity that the user must also deal with. For the UX professionals, then, it becomes a constant feedback-loop of negotiation. Such solutions might, in themselves, inhabit or create additional and even counterintuitive challenges, for instance when 'emergency' software introduces additional layers of complexity that the user must also deal with. For the UX professionals, then, it becomes a constant feedback-loop of negotiation.

Pipek and Wulf (2009) suggest that people who help others access and appropriate infrastructures might be regarded as part of the infrastructure. By engaging in this type of 'assistive' infrastructuring work, these actors "become 'social infrastructures' in work settings, contributing significantly to establishing technology usages" (p. 456). Such a perspective fits

well with the negotiating role assumed by the UX professionals as they attempt to 'smooth over' rough patches and improve user journeys and usability by configuring resistant systems to the best of their ability.

In summary, the UX professionals balance at least three configurations of actors between which they must act as negotiators. As we have also seen, these efforts are often crucial to cultivating, or reestablishing, a working infrastructure. In this regard, it is important to remember that a working infrastructure is, as Star and Ruhleder (1996) remind us, a question of relations. Technically, the systems embedded in it may work in the sense that the hardware and software run according to the technicians' expectations. However, if these components fail to connect with, and support people's organized ways of 'doing things', they do not work as an infrastructure (Star & Ruhleder, 1996, p. 112).

From these observations, we might argue that a substantial amount of the infrastructuring work carried out by the UX professionals entails building - and negotiating - relations between a complex network of heterogeneous actors and finding ways of translating between them. We might consider such network building as attempts at transforming the internal infrastructure into a *boundary object* in which organizational and managerial interests, technical capabilities, information flows, work practices and routines and, by extension, employees' needs and realities are integrated into a cohesive user experience. Boundary objects are defined by Star and Griesemer (1989) as an object that is part of multiple social worlds and transcend the barriers between different actors and domains because they inhabit fluidity and interpretive flexibility. While it is not a novel idea in and of itself to view an infrastructure as a boundary object (e.g. Star, 2010), the point we can add here is that it is *not* a boundary object until it works in its relational sense. The negotiation work carried out by UX professionals between human and non-human actors can contribute to the establishment of infrastructure that allows for the coexistence of multiple perspectives (such as various perceptions of work and purpose) and that different groups can interpret and engage with in ways that align with their specific needs, practices, and interests.

5.1.3 The Strategists

We now move on to present and discuss a third role that was observed to be enacted by the UX team. This role demonstrates how the UX professionals engaged in tactical work to reach their professional goals and influence infrastructural development and change processes. We define this role as one where the UX team acted as *strategists*.
As explained in the first section where the UX team is perceived by DMC as having the role as merely a rescue team, arguments for why the UX is much more than *just* firefighters who 'put out fires' will be presented. Accordingly, in this part of the discussion, we will consider how the UX team strategically plans how to intervene.

Moving away from the analogy where the UX team were imagined to act as firefighters, we now imagine the UX team as being more like a chess player, carefully considering the steps they take and calculating which moves will make the greatest impact. In this metaphor, we can imagine the UX team sitting in front of a chessboard representing the infrastructure of DMC and the chess pieces representing the projects they strategically choose to engage with. They strategically move the chess pieces back and forth to 'win' the game - i.e., to prevent infrastructural crisis and potential breakdowns by employing a user-oriented approach to infrastructural change.

This analogy helps to illustrate how the UX team can be seen as having a role as strategists and further that the UX team, in the context of DMC, not only had the responsibility of putting out fires, but also to a great extent prevented the fires from happening - 'fires', for the sake of our narrative, representing infrastructuring crises and potential breakdowns. This was done - or at least attempted - by strategically positioning themselves and prioritizing projects according to where they deemed it was most critical, and as such where their interventions might have the most influence. This became evident from the screening framework of five parameters the UX

team used to evaluate and assess individual systems. The metaphor of the chess player can again be drawn upon and put in context of how such screening helped the UX team to strategically choose which 'chess pieces' to move at which point so as to potentially fend off infrastructural crisis. As mentioned in the third part of our analysis, *customizability* was one of the parameters and proved to be a crucial factor when strategically choosing which projects to engage in, representing the degree to which it would be possible to actually change the system. Many of the off-the-shelf systems only allowed a very limited range of customization which had an impact on the UX team's capacity to influence the infrastructuring work. This limitation was observed in one of the workshops when the UX consultant asked whether it was possible to make the menu bar floating in the system - a property she regarded as being a standard UX recommendation - and the response was that it was not possible because the system was owned by an external vendor.

Another parameter was system criticality. In accordance with our theoretical lens, we might conceptualize this parameter as the degree to which a system is sunken into the installed base and thus has a large potential impact on work practices, experience, etc. This parameter has been important in the UX team's selection of which project to get involved in since the earlier the UX team can participate in the infrastructuring work, the better chance they have to fend off infrastructural crises *before* they happen. In their strategic work of doing so they cooperated and allied themselves, to varying degrees, with the installed base in order to be able to push it and make changes to it. The cooperating and alliance with the installed base was evident in The Infrastructure Project where the UX consultant worked closely together with the project group behind The Infrastructure project and showed respect towards the scope of the project and made sure that it formed the basis of the work done by the UX team. By acknowledging and displaying 'strategic fidelity' for the installed base the UX consultant was able to come up with recommendations which then shaped the outcome of The Infrastructure Project.

Besides forming such strategic alliances, the UX team also positioned themselves strategically to have an influence on the cultivation of the installed base and thereby being able to act if misalignments and conflicts occurred. This could potentially have an influence on how work practices and the understanding of work and learning are being portrayed which did not always correspond to the user's reality. One user stated that she preferred to talk to colleagues instead of using the systems and another user stated that he could not relate to the wording 'career', demonstrating fundamental misalignments in the programs of different groups and individuals.

It further showcased the way job roles/titles and responsibilities were represented in The Infrastructure Project as a result of classification and standardization, dictating how work is conceptualized and perceived in DMC. It is then reasonable to imagine that, if the UX team manages to position themselves strategically in relation to which projects they get to work on and further their strategic goal of becoming an integrated part of the FRP process, they might to a larger degree be able to obtain an influence on how the reality of users and their work practices are aligned with the changes in the infrastructure. A parallel can be drawn to the text by Star & Bowker (1999) about misalignment of the reality of the nurses and the information infrastructure, which raises an important question and task for the UX team to deal with: How do we respect the users' work practices in infrastructural change processes? From the interviews with the UX manager, it was revealed that the UX team strives to get on board on projects as early as possible in order to have the most impact which also represents a strategic consideration by the UX team and thereby emphasizes their role as being strategists. The earlier the UX team is involved in the infrastructural change processes, the more influence they might have on how each project stages and deals with work practices, routines and the reality of the users. The users' work practices are a part of the installed base which needs to be respected in the infrastructuring work, and by involving the UX team early in the project they might potentially be able to both respect and make changes to the installed base by having the changes in the infrastructure follow the changes in the users' work practices.

Imagining an utopia in which the UX team was granted unlimited manpower and resources - prioritizing projects would, naturally, not be an issue and further in which the UX team was an integrated part of the FRP process and thereby by default getting involved early in the process. In such a world, they would be able to carefully nurture, cultivate, *and* repair all parts of the infrastructure. However, for both pragmatic, structural and cultural reasons, DMC's UX team is yet of a size disproportionate to the size of the organization, which ultimately has an influence on their strategic process and considerations of choosing projects.

5.1.4 The Activists

In the previous sections, we discussed which role the UX team is perceived to have by DMC - a rescue team that prevents and repairs breakdowns in the infrastructure. Further, we have discussed two roles that they purposefully enact, revealing the less obvious, but just as crucial, dimensions in the infrastructuring work they engage in as professionals. It has been presented how the UX team - to ensure not only the employees but also *their own* survival in the infrastructural battle - can be seen as having a *strategic* role, aiming to gain influence and further as *negotiators* and bridge builders between the various human and non-human actors in the infrastructure, aligning the needs and values for the involved parties. But are these roles sufficient for the UX team to create the narrative that infrastructure breakdown and insufficient work practices is inevitable if UX is not incorporated as a standard in the infrastructure? In this section, we demonstrate how the UX team may also be seen to enact a fourth role as *activists*.

As presented in the analysis, at the time of writing, the UX team is not part of the standard procedure in DMC regarding the procurement of new systems as well as the development, implementation and customization of these systems. On the contrary, the UX team is most often used in the end as 'glitter on the cake' or as a rescue team by the time a breakdown has already occurred.
This differs from how UX in the another large Danish company holds a central and different role, as the recently employed UX employee explained, as he himself had worked with UX in that company for several years, where the management had decided top-down that UX was part

of the work culture and therefore rooted within the organization and thus providing the UX team in that company with greater resources, influence and manpower compared to the UX team in DMC.

The thesis' analysis tells the story of how the UX team in DMC aspires to establish and grow from being a sort of grassroot community to being a much more influential actor taking roots across the organization. They engaged on a mission and in a fight to spread awareness of the value of UX out across the organization and to incorporate UX as a golden and embedded standard when cultivating the infrastructure in DMC. This mission can further be supplemented by the UX manager who said that she would wish that a general perception about the value of UX would be if project teams would perceive UX as something they genuinely wanted as part of their project.

The UX team acts as proactive advocates for users, just as environmental activists strive to prevent environmental damage rather than just reactively responding to crises. They work determinedly to influence decision-makers, educate stakeholders about the importance of UX, and embed user-centric design practices throughout the organization.

As activists, the UX team engaged in proactive activities as seen in The Infrastructure Project, such as conducting initial user research, organizing workshops, and collaborating with the stakeholders of the project team from across DMC to integrate UX principles that fit the scope of the respective project with the employees needs in mind.

One may argue that the UX team aim to extend their influence and push the installed base to become an integral part of it and to achieve enough power within the network to become a black-boxed component of infrastructure cultivation, thereby enabling the UX team to align the interests and values of all human and non-human actors towards a certain common goal. We might view these efforts as the UX team's attempt to position themselves as an *obligatory passage point* during the procurement, implementation or redesign of systems, thereby *becoming a part of* the installed base. By taking such a position, the UX team would become a 'bottleneck' in infrastructural change initiatives, transforming their work into an inevitable step and ensuring that their contributions would always be considered as a first point of entry and as a procedural standard whenever a new system is to be bought for DMC or a redesign of a system is considered.

Thus, we might argue that a central objective for the UX team is to inscribe the shared perception that organizational goals related to the infrastructure cannot be achieved unless there has been collaboration with the UX team. And further, that without their expertise, there would

be subpar user experiences and infrastructural breakdowns. From this perspective, we might also reveal a quite literal illustration of ANT's notion of translation. Translations, according to ANT, entail the association and substitution of entities in a network, such that a connection is established between two entities that were unassociated before (Elgaard Jensen, 2003, p. 8). This could, for instance, be the thermometer displaying the temperature outside. As such, translations entail the establishment of connections that make it possible for one entity, or actor, to speak on behalf of another. In a very literal sense, it is exactly such a connection that the UX team represents and, as we have shown in our case, a connection they seek to stabilize. Thus, by positioning themselves as an *extended* obligatory passage point *on behalf of* the users, it would enable the UX team to continue to advocate for users who lack the power to be a part of the obligatory passage point themselves. We believe this might bring a new, if indeed modest, perspective to the perception of objectives and interests according to ANT's sociology of translation: the objective of an actor might, in some instances, exist as an extension of another actor's interest. The work carried out by the UX team is a fitting example of this idea, as we also argued for in our discussion of their role as negotiators.

Thus, as activists, the team UX aspires to gain more impact and influence on the infrastructural battle and further to create a successful narrative around UX with the purpose of establishing the UX practices as an embedded, natural and indispensable part of the infrastructure in DMC, resulting in streamlined and intuitive user experiences, systems that meet the needs and values for the employees and mitigates the risks of infrastructural breakdowns.

5.2 The invisible work of infrastructuring

In her research, Star (2010) claimed to be motivated by 'anomalies' that she encountered in daily life and in the field. Such anomalies, she wrote, would 'tickle her nose' and compel her to ask questions about them. For instance, how come people are able to cooperate even when they cannot reach consensus? Or, why do people say they are using an infrastructure when they are obviously avoiding it (Star & Ruhleder, 1994)? What tickled our noses and motivated our research question was also an incongruence of sorts: A UX team was engaged in the *inherently ambiguous and complex* task of making an infrastructure work, but as a resource with a *predetermined and apparently uncontested* function. A black-boxed actor-network, if you will. The presumption, it seemed, was that they could help improve the adoption of the infrastructure by making it more user friendly. This, we felt, warranted closer scrutiny. Because what does

'user friendly' really entail? By that question we wanted to move beyond theoretical definitions from design, psychology, and so on, and take a closer look at the particular ways in which the UX team contributed to the cultivation of the information infrastructure in DMC.

Accordingly, we have identified and discussed four different roles that each reveal intricate ways in which the UX team engages in infrastructuring work. They encourage us to view UX work as more than just a 'layer' in infrastructural change; it reaches far into the messy business of infrastructure cultivation, it is both practical, cultural and political, and it is fundamental to the establishment of technology usages (Pipek & Wulf, 2009).

The roles overlap and, crucially, they co-exist because they are incomplete alone. But they each tell an important part of the story about the infrastructuring work this particular UX team contributes with in DMC. Much of this work is not explicit - in the sense that it is formally part of the UX team's responsibilities - but happens in practice, sometimes as a necessary means to get the job done, sometimes due to normative convictions rooted in the discipline (e.g., the belief that user journeys should drive the innovation process), and sometimes because it just seems to be the right thing to do. In all cases, it is a constant struggle of making the infrastructure *work* by making it *usable*. It is an endeavor of carefully building and negotiating relations between heterogeneous actors.

What is revealed, then, is work that might sometimes be invisible, hidden beneath the conventional depictions of what UX is and does. The notion of invisible work was coined by Star and Strauss (1999) and refers to work that often goes unnoticed or undervalued. They argued that traditional conceptions of work tend to focus on explicit tasks, while neglecting the invisible and often intangible work that may support and enable those tasks. Such work often requires skill and effort, just like any visible task does, but it may not be explicitly acknowledged. For instance, the tactical and strategic work involved in choosing projects in order to fend off infrastructural breakdowns is not what people would usually imagine UX professionals to be doing in their daily work. Likewise, the deeply cultural-political work of advocating for user-oriented change strategies in order to integrate UX as an obligatory passage point in the organization is probably not part of any formal UX job description.

Our argument here is not that UX, as a discipline, is generally unacknowledged or discredited, or that it is not perceived as 'real work', like Star and Strauss (1999) argued that work such as housekeeping tends not to be (p. 10). In fact, the recognition for its value is only on the rise, and enjoys much recognition on the labor market (e.g., Nielsen, 2017). But this is in the sense of the *explicit* value UX work generates: sleek designs and quantifiable metrics for user satisfaction and retention, and so on. The point we wish to make is that there is *more* work at

play that makes such outcomes possible. This thesis has attempted to uncover some of that hidden, unobvious work.

Besides *doing* invisible work, however, UX professionals may also contribute to *revealing* the invisible work carried out by users in their daily encounters with infrastructure. With the risk of getting a little too abstract, we might even argue that this is *part* of the invisible work. Our analysis showed that employees in DMC employed various strategies for dealing with the infrastructure for development and learning: some enrolled external actors to make the infrastructure work according to their individual needs; some had to spend time outside office hours in order to learn to use it because neither training nor time was provided for that purpose (which adds to the point!). Others again had to find ways to bypass the infrastructure altogether because it simply did not support activity for them, and therefore did not work according to their reality.

Consequently, by aligning various and competing objectives and needs and transforming the infrastructure into a boundary object (or at least attempting to), UX professionals might contribute to decreasing the amount of invisible work required to use, or work around, the infrastructure. The point is not that they should prevent the daily work of appropriating the infrastructure from happening, because such work is both natural and necessary to establish an infrastructure that works in its given context. No infrastructure is simply plug-and-play, not even - or rather, especially not - if it is made up of off-the-shelf systems providing ostensible convenience. Rather, the ideal would be removing unnecessary and extraneous invisible work stemming from infrastructure that does not support local needs.

A starting point for doing so might be to foreground and emphasize the mediating work that UX professionals do, for instance by integrating it more systematically and holistically in the organization. A strictly system-oriented approach that favors inquiry into individual systems on a priority-basis can initiate situated and concrete change, but the change might also be fragmented, as it only concerns a fraction of the infrastructure.

To accommodate this possible fragmentation and take a step away from the silo and system-oriented approach of only looking at isolated systems, maybe even as part of their strategic work, could be if the UX team had a mandate in the strategic planning of the overall infrastructure in DMC. This could further enhance the UX team’s opportunity to expand their work from focusing on the project-cultural journeys to working on a higher level with the organizational culture. One way of doing so could be if the UX team conducted a UX review

and assessed the entire infrastructure, thereby creating a consolidated analysis of the general needs and work practices embedded in DMC and what it would actually require for the entire infrastructure to work on a more generic level.

As we begin to understand UX professionals as (potentially) vital change agents in infrastructural change processes, it is also important to recognize that it comes with a set of obligations. Like we discussed above, the potential impact of the changes UX work contributes to does not end when the project does (which, granted, would seem counterintuitive). Changing an infrastructure will often also entail changing the social environment behind it: as Hepsø et al. (2009) argue in their analysis of the implementation of a SharePoint infrastructure in a large oil company, local practices may be resilient and durable, but they are not immune to change efforts embedded in the infrastructure. Importantly, however, such change does not happen overnight. Infrastructure may, for instance, introduce cultural disruptions by changing the way work is perceived by classifying and representing it according to a particular reality. This does not mean that users automatically accept, change and adapt their practices to this 'new normal' from one day to the next. Rather, it requires continuous and careful negotiation and articulation beyond project-level. This also involves *making room* for the infrastructuring work that is necessary for any affected group to partake in to make the *infrastructure work*. As such, we suggest that an ongoing effort to prioritize and pay attention to the infrastructuring work users do is not just necessary, but could also contribute to more inclusive and fruitful cultivation of the infrastructure. We imagine this to be a potential area of responsibility well-suited for UX professionals.

We end this discussion by briefly returning to the applicability of our findings. In this thesis, we have focused on the infrastructuring work carried out by a UX team in a large pharmaceutical company. As such, our findings are situated and specific - not universal or general. Still, we believe that the roles we have mapped out and discussed represent dynamics and issues that will be recognizable in other settings of infrastructural change. The roles may, of course, also apply to other domains and disciplines, and we do hope they can inspire others to reimagine the parts various actors play on the infrastructural battlefield. However, we also believe that UX holds a unique and important role, because they are the glue between those designated to build and change infrastructure, and those who are at the 'receiving end' of it (Edwards et al., 2009, p. 371).

6. Conclusion

Establishing a (working) infrastructure is indeed a complex sociotechnical endeavor that invariably involves multiple heterogeneous human and non-human actors. In this thesis we were interested in exploring the following research questions:

What is the practical-political process of establishing an information infrastructure in DMC, and what role(s) does UX play in that process?

To answer these questions, we took an infrastructural inversion approach to trace the battles and relations between the actors in the network. According to theory, breakdowns in infrastructure often present an empirical-analytic entry point for infrastructural inversion, because the sudden visibility of an otherwise invisible infrastructure encourages a shift from focusing on the activities the infrastructure (supposedly) supports, to the activities that enable the infrastructure to function. Accordingly, we set out to investigate a project that was prompted by such a breakdown. This breakdown was the center of the battle described in the first part of our analysis. The breakdown was simultaneously the cause and the result of misalignments between the employees' values and needs and the use patterns inscribed in the infrastructure. This, in turn, resulted in a clash between different programs and anti-programs represented by the employees and organizational objectives. In this, we emphasized the *sociotechnical* nature of breakdowns: because infrastructure happens in practice, both technical *and* social forms of resistance can and will lead to breakdown.

Secondly, we saw how off-the-shelf systems competed with the installed base, which presented as a central and powerful actor that other actors must relate to in different ways. Integrating off-the-shelf systems into the infrastructure might prove challenging due to their inflexibility and the use patterns inscribed in them by external vendors, as they might not correspond to the local and situated needs of the employees.

Lastly, a strategic battle initiated by the UX team was outplayed between DMC and the UX team because the UX team, as actors on a mission, aspired to gain a more consistent influence on the infrastructuring work that took place in DMC.

Based on our analysis of these practical-political battles of cultivating an infrastructure in DMC, we identified and discussed four roles illustrating the - sometimes invisible - infrastructuring work the UX team contributed with.

The role of being a *rescue team* was 'imposed' on the UX team by DMC with the purpose of repairing infrastructural breakdowns. However, as presented in the discussion, the UX team aspired to have the influence of doing much more by acting as *negotiators* and bridge-builders between the different human and non-human human and non-human human and non-human actors in the heterogeneous network, i.e. the experts, the users, the installed base, off-the-shelf systems and DMC, with the purpose of finding ways of translating between them.
Furthermore, the UX team engaged in 'tactical' work by *strategically* prioritizing projects to ensure impact where it would be most critical, or where they would be able to avert 'infrastructural infrastructural crisis'.
Lastly the UX team acted as *activists*, advocating for the importance of early end user involvement in the establishment of the infrastructure and with the aspiration of the UX team being established as an obligatory passage in the infrastructure to which all actors in the network must pass when cultivating the infrastructure.

To some, The Infrastructure Project might seem like a somewhat trivial example of an infrastructural battle. Much work has been done on infrastructure development and infrastructuring practices within domains like healthcare, communication and information sharing, and global connectivity. In these cases, it is often easy to recognize how the choices and norms embedded in the infrastructure can become marginalizing - at least when we begin to question how they came into existence, and who benefits from them.
By focusing on a seemingly 'harmless' infrastructure such as one that aims at supporting professional development and learning within an organization, we hope to have shown how the consequences of infrastructure extends beyond obviously 'critical' issues, to the more mundane or, in Star's (1999) expression, "boring" aspects of day to day (work) life. The modern workplace, in many ways, *is* infrastructure, and so they are co-constituent. Whether it supports critical activities or activities that we might perceive to be of less importance in order to keep the social fabric running, infrastructure frames (work) realities.
Moreover, our goal has not merely been to prove the normative and distributive qualities of infrastructure (although this has definitely also played an important role in our analysis). We wanted to focus on *who* contributes to the establishment and restructuring of these issues, and *how*.

With the different roles we have identified in this thesis, we hope to have painted a more nuanced picture of the particular - and sometimes less particular - ways in which UX

professionals and their work contribute to the cultivation, configuration and appropriation of (information) infrastructure. Obviously, the list is not exhaustive; future studies might add additional insights about the kinds of infrastructuring work that UX professionals do, which may also depend very much on the context in which they are immersed.

We acknowledge that our insights reflect only a small glimpse of what it entails to establish and maintain an infrastructure and that doing infrastructural inversion is much more complex than what the scope of this thesis has been able to present. By choosing to focus explicitly on the UX team in DMC, other actors with just as important agendas and crucial functions in the infrastructural battle have been overseen. This prioritization does not stem from an assumption that the UX team are the only actors in the network performing important work to the cultivating the infrastructure and thus, with the scope of this thesis we too have put the other actors - i.e., the experts or other departments - in the infrastructural battle at risk of becoming silenced and marginalized.

These reflections are not an expression of errors or shortcomings in our thesis, however they have served as food for thought and are further an expression that it probably belongs to a rarity or a utopian way of thinking that as a researcher one holds the ability to encapsulate the attitudes, values, agendas of all the actors in the heterogeneous network that is an infrastructure.

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