

PART I

Data-Driven Organisation

Digitalisation, organising and organisational choice

Exploring the challenges of digital transformation using five applied sociotechnical lenses

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Abstract

One of the main challenges in the process of digital transformation is that the impact of new technology cannot be straightforwardly deduced from the functional specifications of technology itself. Digital technology affords new possibilities which affect organisational form and function which means that to understand the transformational impact of digital technology, human practices and systemic features of organisations need to be viewed in mutual entanglement. We therefore consider the process of digital transformation to be an applied sociotechnical challenge. This chapter explores the sociotechnical challenges of digital transformation using a framework derived from the applied sociotechnical approach in organisation science. This framework consists of five lenses which focus on a particular aspect of this sociotechnical challenge. While this framework could be used to reflect on the challenges of digital transformation in general, we place this discussion in the context of the military organisation. The resulting exploration shows the relevance of this sociotechnical perspective for the military organisation and could be used as a guide for the further developments of an (action) research program.

Keywords: Sociotechnical, Digital transformation, Innovation, Organisational choice, Action research

1.1. Introduction

Across domains and disciplines, there is a broad consensus that digital technology will have profoundly transformative effects on society, organisations, and human beings¹. Digital technology plays an important role in wide ranging fields such as artificial intelligence, communication technology, machine learning, robotics, 3D

printing technology, and some argue that the combined effect of these developments will lead to a fourth industrial revolution². Such a revolution is considered to cause shifts across industries by the emergence of new strategies, business models, reshaping of production, consumption, transportation and delivery systems and organisation design. Digital technology is an example of what the *Netherlands Scientific Council for Government Policy* calls a “systems technology”³, whose applicability is pervasive rather than focused on a single domain, with significant potential for technological improvements and complementary innovations. There is, however, controversy about the specific transformative effects of digital technology. Some argue that digitalisation will replace half of the occupations and related jobs⁴, also higher skilled jobs and knowledge work⁵, while others argue that new technology has the potential to impoverish jobs⁶, and enable far-reaching forms of surveillance and control⁷. Against this background, some warn against (implicit) technological determinism⁸ while others warn against over-hyped claims about the potential of new technology⁹.

Such controversy indicates that transformative impacts of digital technology cannot be straightforwardly deduced from functional specifications of technology itself. Digitalisation affords new possibilities and potentially has a profound effect on work practices, structural design, and the social fabric of organisations, but these are not a given from the outset. New combinations of technology and organisational features afford new possibilities that affect organisational form and function¹⁰. While frequently technological innovation is viewed from a perspective which treats technological adaption, diffusion and use as separate phenomena¹¹, digital transformation requires the ability to view the social and technological systems of organisations in concert¹², with an open view towards integral effects on different aspects of an organisation’s functioning. We will refer to this as a sociotechnical challenge¹³.

The previous indicates that shaping of future organisations takes place against the background of the transformative potential of new technology. In this chapter, we start from the assertion that this challenge requires an applied perspective. The aim of this chapter is to sketch the challenges of digital transformation using insights from the applied sociotechnical approach in organisation science. This approach offers an integrated perspective to analyse organisations and to design interventions¹⁴. We believe that such a perspective has particular relevance when it comes to understanding the ways in which technological artefacts, systemic organisational features and social practices are entangled. As such, in this chapter the applied sociotechnical approach functions as a compass to explore the different related challenges that constitute digital transformation.

While we believe that the sociotechnical perspective is of general relevance to organisations, we place the discussion in the context of the military organisation.

Evidently, developments in the realms of digital technology are also of great significance to military organisations. Not only will digitalisation provide new possibilities for existing weapons systems across domains (land, sea, air), and create new possibilities for strategy and organisational design. It has also already afforded a cyber domain which not only cuts across the other domains but also has distinct security effects. Therefore, the military organisation is confronted with the sociotechnical challenge mentioned above as well. Below, we start by discussing the topic of digital transformation and organisational change in a general sense to develop an idea of the potential affordances of digital technology (section 1.2). Subsequently, we sketch the framework with the five lenses and apply those to the topic of digital transformation (sections 1.3 to 1.8).

1.2. Digital transformation and organisational change

Digital transformation is a heavily contested concept¹⁵. There is a strong and rich – but fragmented – body of knowledge with very interesting insights, frameworks and explanations on technology and organisational change¹⁶. The focus is on the opportunities – affordances – of technology to, among other things, enforce business transformation, implement IT strategies, create digital business ecosystems, optimise customer engagement, and digitise business processes¹⁷. Hanelt et al.¹⁸, agree that the literature on digital transformation spawns in multiple directions. However, it is possible to structure the extensive literature along three conceptual categories:

- 1) “contextual condition” as input for digital transformation (open and emerging technologies, data availability, organisational strategy),
- 2) “mechanisms” to link input conditions to perceived outcomes of digital transformation (innovation and integration of technology in existing processes), and
- 3) “outcome” of digital transformation (organisational setups and improved performance)¹⁹.

Combining the former conceptual categories Hanelt et al²⁰ as well as Kraus et al²¹ show two dominant patterns in current literature on digital transformation. First, the influence of technology on the organisational design and the aim to create a malleable organisational design. This type of organisational design is characterised by – what’s referred to as – an agile structure driven by opportunities of technology, to constantly adapt to competitive and social demands from their environment by using technology²². For example, Amazon is depending on technology and user data to adjust their supply-chain on the demand in certain regions and optimise logistic processes within their warehouse by using current information (collected from customers). However, changing organisational processes is a complex

undertaking²³. It demands a constant and explicit interaction between technology and structural design during the process of developing and deploying digital tools²⁴. In this process there is a strong emphasis on who within the organisations can innovate, change, and socially influence the quality of work and quality of working relations all within a subset of organisation formal rules and organisational values.

Second, and inherently connected to the idea of organisational design, is how technology opens the path of interorganisational cooperation. For example, emerging technologies (AI, Internet of Things) are open and easily applicable and can simply bring previously disconnected markets together (for example internet, phone, video). Therefore, organisations move to participate in business ecosystems – because of the competitive environment – to maintain their accessibility to these open emerging technologies. Although external access does not necessarily change the organisational structure. The move to fragmented networks of strategic parentships, however, blurs the boundaries of an organisation.

Important to take from the former argument is that digital transformation refers to an entangled interaction between technology, structural design, environmental characteristics, and the users of digital solutions²⁵. Technology will offer users an opportunity to redesign organisational processes and use it as a tool to react to a competitive environment. However, users will use the technology within the boundaries of the organisational structure and will make conscious choices of how to make use of technology. Digital transformation will set in motion a process within an organisation to discover affordance of technology in a specific setting²⁶. In this sense technology is not a deterministic force, but an artefact that will get social and technical significance when it is used within an organisational context (structure, processes, and values)²⁷. Organisational context is shaped by its structural design and social values; however, technology will also (re)shape the context. Moreover, social values and organisational structure will enable or constrain users to engage with the technology and use it to its full potential. That is, users will eventually use technology, discover, and maximise what a digital solution can offer them from a technical point of view. However, technology will be implemented within the boundaries of social rules and conventions, which can constrain digital possibilities²⁸.

Although the former conceptualisation of digital transformation has a strong business-oriented focus, it offers very interesting insights for the military organisation. Digital transformation goes way beyond the conversion of information from analogue to digital form and the use of information technologies. It is a complex transformation – with a vast number of digital tools as the main driver of change – of organisational processes to discover new technological affordances to, among other things, perform a task and increase tactical performance²⁹. Introducing technology within an organisation (a military organisation as well), potentially demands a fundamental change in the organisational structure and redefinition of social values³⁰. It

is a complex multi-dimensional – and therefore interdisciplinary – transformation of exciting organisational conditions – structural and process-design, managerial and legal frames – enforced by (external) disruptive technologies (agile organisational structuring, automation of processes, and smart solutions)³¹. For example, big data in combination with artificial intelligence offers “law enforcement,” an extensive digital tool to analyse expected behavioural patterns within large crowds during sports events or demonstrations. However, law enforcement should interact with this specific technological solution to make full use of it. Consequently, they must integrate the technology in current processes, create a structure that allows them to quickly analyse data, and act upon the result of the data-analyses. All within the frame of a legal structure and the social values of society.

The main challenge of the adaptation of technologies – digital transformation – by an organisation (military organisation alike) is influenced by how users of digital tools explore and discover “new” affordances of technology. Although technology can be introduced within an organisation to rethink processes and day-to-day tasks, users enact technology as it will fit their ability to use digital tools to their potential all within the setting of structural design, social values, and norms of an organisation³². It is this complex interdisciplinary challenge that requires a “compass” rather than a map, which we will turn to below.

1.3. An applied sociotechnical perspective on digital transformation

The previous indicates that the implications of digitalisation are difficult to capture (because of the many different available digital tools) and difficult to demarcate (because of the sprawling effects in all possible directions)³³. Traditionally, the applied sociotechnical approach has focused on developing flexible and participative organisations with a distinct emphasis on humane forms of organising. While the first sociotechnical concepts were developed in the era of mechanisation³⁴, the perspective is continuing to develop in the context of emerging technology³⁵. As an applied approach, the sociotechnical tradition is focused on intervention, using different insights on the dynamics that are to be influenced and a tradition of empirical research in which these insights are related to the reality of organisations.

The introduction of this chapter emphasised the use of a compass rather than a map to navigate the interrelated dynamics of a sociotechnical transformation process. While a compass is more generic than a map, it can offer a perspective on a terrain that is characterised by many uncertainties and unknowns, and it can offer a direction on how to navigate that terrain. In this fashion, this chapter will use five sociotechnical lenses to discuss related challenges of digital transformation in organisations. These lenses are built on core insights in the applied sociotechnical

approach and explicate ways of looking at different aspects of a transformation process.

Taking this into account, the five lenses are based on (1) the core assumptions of the sociotechnical approach concerning organisational environment, transformation, and development, and on (2) the conceptualisation of the nature of sociotechnical relations. Since applied approaches inevitably are related to questions about whether certain situations are desirable or not³⁶, (3) the third lens perceives the process of digital transformation from the normative aim of the sociotechnical approach, (4) followed by a lens that focuses on the architecture of systems. The final lens, (5) sketches the basis of an intervention strategy that can be used to take up the topic of digital transformation in organisations. These different lenses are summarised in table 1.1.

Table 1.1. Five applied sociotechnical lenses

	Topic	Sociotechnical lens	
1.	Core assumptions	The principle of organisational choice	§ 1.4
2.	Unit of analysis	The conceptualisation of sociotechnical relations	§ 1.5
3.	Normative aim	Using creative, problem-solving potential	§ 1.6
4.	Architecture	Multilevel dynamics	§ 1.7
5.	Intervention strategy	Sociotechnical action research	§ 1.8

In the subsequent sections, we sketch these lenses and use them to look at the challenges of digital transformation in organisations. The lenses are not specific for the military organisation, but in discussing them we aim to connect them to contemporary discussions in this domain.

1.4. The principle of organisational choice

The first lens explicates the core assumptions with which the applied sociotechnical approach perceives organisations. The principle of organisational choice is based on the contention that the inner workings of organisations are not fully determined by outside forces: they possess certain discretionary elbowroom – choice – in their response to environmental developments³⁷, whether these are economical, technological, or otherwise. This discretionary space can be used by organisations to develop into a direction that they consider desirable. The principle of organisational choice refers to a fundamental notion of systems theory. If systems did not have “choice” they would have to respond passively to environmental pressures³⁸,

in which case it wouldn't be relevant to study them in the first place. From a sociotechnical perspective, the discretionary space defined by organisational choice defines the domain the applied approach can focus on as it is this (metaphorical) space that organisations may use to influence their development.

The principle of organisational choice was introduced by researchers from the Tavistock Institute of Human Relations in the early 1950s, in the context of research into the effects of technological innovations in the mining industry³⁹. What initiated this research was the discovery that mechanisation in the mines (conveyer belt systems, power tools, etc) hardly improved productivity compared to traditional work systems.⁴⁰ According to the Tavistock researchers, the technological system as it was implemented in the mines caused different negative secondary effects, ranging from stress and alienation in miners to ineffective coordination between parts of the mining system. Furthermore, the case indicated that there were alternative organisational forms possible (with the semi-autonomous workgroup as a prototypical solution) that significantly reduced these effects. Such solutions achieved quite significant improvements in economic performance and quality of work in a way that used the potentials of new technology.

The Durham case is paradigmatic because it indicated that available technology does not one-directionally and inevitably force the design of organisations into a particular direction. As Leonardi⁴¹ points out, the Durham case suggests that there is an indeterminate relationship between task and technologies, "(...) such that a technology's fixed materiality could support multiple task structures depending on people's desires and goals". Therefore, sociotechnical theorists positioned themselves in opposition to what they saw as the technological determinism of Taylor's scientific management philosophy⁴², according to which – for example – the traditional conveyor belt structure would be seen as an inevitable result of prevailing technology. Challenging (implicit) technological determinism in strategies for implementing technology, making the connection between different aspects of an organisation's functioning (technological, economic, and social) in relation to environmental characteristics, adopting systems theory and developing new ways of designing organisations to facilitate human creativity and flexibility, arguably were the most important contributions of first-generation sociotechnical theory, which are still broadly supported in organisation science⁴³.

The emphasis on "organisational choice" remains relevant in the context of digital transformation. For example, Zuboff argues that the same information technology can often be used to both "automate and informate"⁴⁴: it can either create tighter control over work at the operational levels or create possibilities for self-organisation and human judgement in the same positions⁴⁵. Depending on "choice", very different organisations may result from "digital innovation". There is – as it were – a river that divides different philosophies of using the same technology. A

major complication in exploiting the potential of new technology is constituted by the potential conflicts with the demands of existing social, economic, and political interests. Increasing abilities to self-organise at lower hierarchical positions might make hierarchical layers and managerial positions superfluous, which might explain why managerial action often “flows along the path of least resistance”⁴⁶, without a serious attempt at exploring the possibilities to “informate”. This is an explanation for why innovation strategies often remain restricted to what is often colloquially referred to as “bolting new technology to an old organisation”.

One particular example from the military domain in which “choice” has been key to the design of military organisations is the development of the concept *Mission Command*. Van Crefeld has pointed out, military history shows that improvements in communications have often been implemented in ways to reduce initiative and possibilities for self-organisation and initiative at lower levels⁴⁷. He argues that such choices have significantly influenced the effectiveness of military organisations⁴⁸:

“The fact that, historically speaking, those armies have been most successful which did not turn their troops into automatons, did not attempt to control everything from the top, and allowed subordinate commanders considerable latitude has been abundantly demonstrated.”

In its various forms and guises, *Mission Command* essentially is about enabling flexible response to dynamically complex environments by creating local conditions for self-management⁴⁹. This idea about military command revolves around a choice to either “automate” or “informate” and is on par with the sociotechnical idea that environmental variety is best controlled closest to the locations in which it appears⁵⁰. Subsequently, this core idea can be used to think about how to design organisations that best facilitate such self-management and could also be fundamental to the way digital transformation is approached.

1.5. The conceptualisation of sociotechnical relations

If the principle of organisational choice defines the discretionary space that can be used by organisations to develop into a desirable direction, sociotechnical relations are the unit of analysis on which the sociotechnical approach focuses. This leads to the question of what “viewing the social and technological systems of organizations in concert”⁵¹ specifically entails. The early sociotechnical innovators indicated that in organisations the human system could not be understood without also understanding the technical system⁵². This also goes the other way around⁵³:

“The problem was not of simply “adjusting” people to technology nor technology to people but of organizing the interface so that the best match could be obtained between them. Only the sociotechnical whole could be optimized.”

Against the background of this idea, the early sociotechnical innovators emphasised “joint optimization”⁵⁴:

“Joint optimization means the best possible matching together of the people in any unit and the way their jobs are organized, with the physical equipment and the material resources in that unit”.

Within the applied sociotechnical approach, Ulbo de Sitter formulated a critique on the idea of joint optimisation of a separate “social” and a “technical” system. According to De Sitter⁵⁵, such a distinction essentially is an abstract dichotomy, while in organisations social and technical aspects are always and inevitably interwoven. This critique on the traditional concept of “joint optimization” was for De Sitter the basis for developing integral sociotechnical theory, which emphasises the ways in which architectural characteristics affect different aspects of an organisation’s functioning. Outside the realm of applied theory, Orlikowski emphasises the idea of “constitutive entanglement” according to which⁵⁶ “(....) the social and the material are constitutively entangled in everyday life”. This emphasis on entangled sociotechnical relations indicates that the rejection of technological determinism does not imply the rejection of any influence of technology. Instead, the idea of entangled sociotechnical relations offers a middle ground between technological determinism and social determinism.

When sociotechnical relations are entangled, an altogether more complicated view of the process of sociotechnical change emerges. If technology co-shapes the context in which humans act and helps to shape the kind of choices human beings make, a dynamic is suggested that is difficult to predict with precision. As a result, a process of disruptive sociotechnical transformation cannot be tightly controlled. This is the essence of Collingridge’s⁵⁷ dilemma of control, according to which we lack the evidence to govern technologies before “lock in” occurs because it is hard to understand the wider implications of innovations – and therefore hard to imagine relevant ways to “control” impacts – while after lock in the chance of establishing such control may be gone⁵⁸. Such a difficult process constitutes a main challenge in sociotechnical transformation: implementation of new tools may have lasting secondary effects before we were able to understand them.

Such notions about the way sociotechnical relations are interwoven is relevant to an applied perspective on digital transformation. Specific digital tools are more than mere material artifacts that are used for a particular functional purpose.

Their use may have significant – perhaps even existential – transformative effects on organisations and even more in general, human beings and society. Zuboff⁵⁹ emphasised that technological innovation can be seen “(...) as an alteration of the material horizon of our world with transformative implications for both the contours and the interior texture of our lives”. The consequence of this view is that “affordances” of digital technology are not a given but have to be discovered. The effects of digital innovations cannot just be deduced from functional specifications, but they appear when they are used. For an applied approach that means that not only an understanding of technology itself is important, but also the ability to envision how technological artefacts might connect to human practice and the ability to learn from experience.

As we have seen, digital tools may change the opportunities for communication and may pose new demands for interacting with technological artefacts, new ways for groups to cooperate; they may make long distance coordination possible, influence the way hierarchies operate, may change the design of a primary process and the strategic orientation of an organisation. Seen in this light, the characteristic flexibility of digital tools creates an abundance of opportunity, but such opportunities – affordances – can only be discovered in a process in which experimentation, imagination, envisioning and developing a deep understanding of how social practice and technological artefacts may become intertwined. As was argued in the previous section, a clear idea about “choice” can be essential to navigate such abundance of opportunity and the potential influence on choice and organisational “form and function”.

1.6. Using creative, problem-solving potential

If sociotechnical transformation requires organisational choice, the question is what the aim of such choice should be. If there is choice, what should we choose, or what direction should our choices be aimed at? These are normative questions. For the sociotechnical approach, a key normative idea is that enabling the creative, problem-solving potential of human beings can simultaneously create organisations that generate more desirable outcomes (better quality of working life, more desirable from a societal perspective) as well organisations that are preferable for more functional reasons (more effective, efficient, flexible and innovative).

From the outset, the Tavistock institute strongly focused on democratisation and participation also given their backgrounds in (psychological) health care. Within organisational sciences this has evolved in a concern for “the quality of working life”, which aims at improving the lives of people working within the organisation. The emphasis on self-organisation is important in this respect and may be

contrasted with the anthropological assumptions of more classical perspectives on organisations which view human beings⁶⁰: “(...) as a kind of trivial machines; programmable and re-programmable by operand conditioning, “motivated” by fear, performing operations contributing to contingent goals and possibly unknown to them, and examined as “cases” to increase their performance”. Attention in the sociotechnical approach to ethics is not limited to intra-organisational concerns for the quality of working life. For example, Achterbergh and Vriens⁶¹ bring forward the idea of “rich survival” of organisations which underlines the significance of the societal impacts of an organisation’s pursuit. So moral concerns in the sociotechnical approach are not only directed inside (quality of working life) but also outside (societal impacts).

Taking the key insight of this lens into account, a specific perspective on contemporary discussions about military technology – enabled by the possibilities of digitalisation – emerges. One of the most important contemporary discussions in this realm is about “autonomous weapons”, which is a development that is afforded by digital technology. A central concept in discussions about the ethical aspects of autonomous weapons is “meaningful human control”, which should according to the *Dutch Advisory Council on International Affairs*⁶² be understood in a comprehensive way in which the control of human operators on weapon systems is adequate and effective. Ekelhof⁶³ worked out a perspective on “meaningful human control” which takes the design of the sociotechnical system in which weapons are implemented into account. She brings forward that it is confusing to label a weapon system autonomous by narrowly focusing on characteristics of the technological system. Therefore, she focuses on the wider (organisational) targeting process to which an autonomous weapon system is connected⁶⁴: “(...) asking whether the operator exercises meaningful human control over the weapon may be the wrong question here. Instead, we should ask how the military organization as such can or cannot ensure meaningful human control over important targeting decisions.” Seen in this perspective, an autonomous weapon is a weapon system with potential autonomy in crucial functions in the targeting process. Conversely, the question of meaningful human control is related to the role of human operators in the targeting process, and this role is developed based on “choice”.

This indicates that Ekelhof connects the issue of meaningful human control to the question of how technology functions in the context of a sociotechnical system. The sociotechnical approach has shown that the potential for such control is in essential elements related to the design of the sociotechnical network. She takes this issue up by referring to a targeting cycle, which essentially is a control loop. Developing meaningful human control starts according to her in a design phase, in which parts of this targeting control loop are connected to human actors. Meaningful human control implies control over a part of the control loop. However, as Kramer (2020)

indicated, seen from a sociotechnical perspective meaningful human control is not about controlling one aspect of a control loop, but about controlling an integrated set of steps⁶⁵. Moreover, controlling such an integrated set of steps in a control loop for making control meaningful. Enabling human judgement requires more than the mere presence and programmed activity of human beings, but instead requires control of integrated regulatory steps.

Therefore, enabling self-organisation to “ensure meaningful human control over important targeting decisions” requires an organisation design strategy that is typically not used in traditional bureaucracy and seems not to be part of discussions about “meaningful human control”. A sociotechnical design perspective therefore relates to important dimensions of ethical decision making⁶⁶, which might be overlooked from a narrow technological perspective, but also from a narrow social perspective (as long as it is a human being that presses the button, it is OK).

1.7. Multilevel perspective

The prospects for a design philosophy that aims at creating the conditions for self-organisation would be gloomy if it could only be defended from the perspective of moral concern. A core idea of the sociotechnical perspective is that it is possible to find ways to simultaneously design more “humane” organisations and organisations that are more effective. This intention poses a design challenge in larger organisations. Early sociotechnical experiments indicated that semi-autonomous workgroups often remained an anomalous entity in what was in every other respect an organisation built up of Taylorist principles⁶⁷. This observation led to the development of integral design theory, which is focused on establishing the structural conditions for self-organisation and therefore approaches organisations as a multilevel phenomenon. Structural design of organisations plays an essential role in achieving sociotechnical ambitions at the level of the semi-autonomous workgroup. Sociotechnical design is based on the – to some counterintuitive – idea that design characteristics of the organisational context significantly influence the ability of groups and individuals to respond creatively and effectively to environmental demands.

What is new in the present era is that digital tools allow for opportunities for self-organisation that were not possible previously. This potentially has implications for how to approach organisation design. As Winby and Mohrman⁶⁸ emphasise: “Exponential technology advances pose great challenges to traditional forms of organizing that have not been designed to take advantage of this fourth-generation technology. The technical in the sociotechnical equation has changed fundamentally in scope and impact on social organization, driving new ways of organizing, working together, and meeting human needs, *or not*” (italics in original). The

former indicates the potential integral effects of new sociotechnical entanglements. Particularly the opportunities for communication, coordination and knowledge generation can have such pervasive effects that strategy, business models, designs and work systems can all be affected by the affordances of digital technology.

It can be propositioned that the sociotechnical challenge increases in complexity if the disruptive potential of new technology is greater. While hardly controversial, this proposition may have implications for organisation design. These can be illustrated by translating Henderson and Clark's⁶⁹ distinction of four different types of innovation into four types of sociotechnical innovation in an individual organisation (see table 1.2 below).

Table 1.2. Henderson and Clark's types of innovation vs sociotechnical innovation

Henderson and Clark's innovation type	Sociotechnical change	
	System level	Type of transformation
Incremental innovation	Individual level	Limited change
Modular innovation	Group level	Change in work process
Architectural innovation	Macro level	Change in organisation design
Radical innovation	Strategic level	Transformation in output

More specifically,

- *Incremental sociotechnical innovation* refers to different improvements that have no direct implications for the design of an organisation. For example, while the design of a new pen might be a great technological achievement, it is not likely to change much in the inner workings of an organisation. So, it might be radical from a technological perspective, but incremental from a sociotechnical perspective.
- *Modular sociotechnical innovation* refers to changes within the boundaries of a subsystem (e.g., a department), while the organisational design as such remains constant. In the military organisation, for example, this might involve a redesigned maintenance system with changes in tasks and responsibilities within a designated maintenance group. De Sitter⁷⁰ uses the term “local process innovation” to refer to this kind of sociotechnical innovation.
- *Architectural sociotechnical innovation* refers to the reconfiguration of an existing organisation. It may involve the design of a different transformation process that requires a different organisational design. For example, in the military organisation new digital ways of communicating might translate into the development of a new Operational Framework for the infantry. De Sitter⁷¹ uses the term “interlocal process innovation” to refer to this kind of sociotechnical

innovation. The more innovation affects the configuration of organisations, the more it has an integral effect on different aspects of the functioning of an organisation (logistics, HR, accounting, etc).

- *Radical sociotechnical innovation* is the most extensive form of innovation because it has strategic implications. This occurs when a technological change enables a different kind of transaction with the environment. This might be the result of a change in perspective on the environment (new kind of threats, new perspective on existing threats), but also when radically different possibilities arise because of technological developments. In the military domain the creation of cyber units in the last decade can be considered a radical sociotechnical innovation. De Sitter⁷² refers to “product development” in this context.

As the previous makes clear, technological innovation might affect different levels of a sociotechnical system. Trying to find out what innovations potentially involve for different layers in organisations, different aspects of an organisation’s functioning for the layering of systems itself, making a conscious choice about the use of those potential effects in a way that supports rather than undermines self-organisation is a key part of a sociotechnical design strategy.

What is significant is that if radical sociotechnical organisation transformation changes relationships with the environment, a design strategy may extend beyond the walls of an individual organization⁷³: “In the past, we designed single organizations; in the future, we will design the rough outlines of an ecosystem of partners and contributors who work together in an interconnected fashion using technological platforms to achieve a shared purpose.” Discussions about the design of ecosystems resemble the discussion about “netcentric” forms of organising as they have been studied in the military organisation for quite some time⁷⁴. Such net-centric ways of organising have a distinct technological side and are increasingly finding their way in military technology. However, the insights on how to organise such digitally enabled networks seem to struggle to keep up with technological affordances⁷⁵.

Clearly, the sociotechnical challenge increases from incremental to radical, not just in a narrow sense, but also because a more complicated cooperative network of stakeholders is involved. The previously mentioned approach of “bolting new technology to an old organisation” remains stuck at the incremental level, perhaps with limited implications at the modular level and flows along the path of least resistance. As the implications of technological innovations affect more levels, the network of stakeholders becomes more complicated, which also means that the sociotechnical design process increasingly requires the ability to manage the socio-political implications of transformations. Managing sociotechnical implications of technological developments across multiple levels is a significant challenge,

particularly when organisations are not just confronted with a single innovation, but with a wave of different technological developments at the same time with potential interactions. Particularly in such cases a sociotechnical compass to navigate multiple implications is needed.

1.8. Action research

The last sociotechnical lens that we bring forward here, focuses on the challenge of implementation and the approach to organisational change. It binds the previous theoretical perspectives together in a view on how to work on digital transformation and organisation design in concrete settings. At the core of this strategy is action research methodology. This methodology has been at the core of the sociotechnical approach from the outset⁷⁶. Van Beinum et.al. state that⁷⁷: “(...) action research represents a certain way of understanding and managing the relation between theory and practice, between the epistemic subject (the researcher), and the empirical object (the researched)”. Essentially, an action research strategy involves managing a process of co-generative learning⁷⁸. More specifically, Greenwood and Levin define action research as follows⁷⁹: “*Action research* is social research carried out by a team that encompasses a professional action researcher and the members of an organization, community, or network (“stakeholders”) who are seeking to improve the participants’ situation” (emphasis in original). They furthermore emphasise three elements in an action research perspective: a focus on improving a situation (“action”), with the use of formal knowledge of organisations (“research”), with an ambition to foster participation in problem analysis and solving (“participation”). The focus on action research indicates that the sociotechnical approach was never meant as a narrow expert-approach.

Relating this to the previously discussed cornerstones of sociotechnical innovation, action research is relevant as a basis for a sociotechnical innovation strategy because the available space for organisational choice is difficult to define and requires a sophisticated search process (action coupled with research), which requires experimentation and a process of co-generative learning. Action research seeks to improve the organisation’s ability to understand itself through participation, while at the same time generating scientific insights⁸⁰. This is an essential step in learning to self-manage (“learning by design”⁸¹). Because the potential wider systemic effects of innovations require understanding the ways different layers of systems are affected and require the involvement of a broad group of stakeholders.

A particular example can clarify how the topic of digital organisation design can be connected to action research. This is the so-called STARlab initiative (SocioTechnical Action Research lab) developed by a group of sociotechnical

practitioners and scientists in the US. Pasmore et al. bring the STARlab concept forward as a strategy for digital sociotechnical design⁸²: “(...) the STARLab is a rapid organization design approach that involves a multi-stakeholder group working iteratively to create design solutions to address the changing realities of the business context and to generate socio-technically optimized organization prototypes.” They argue that compared to more traditional sociotechnical design that focused on the work-system of a single organisation with fixed technology and with the focus of controlling variance, the affordances of digital technology create a shift in focus of sociotechnical design. Work systems have become complex, technologically enabled networked ecosystems that extend beyond an organisation and its employees and are geographically dispersed with a technology that continuously evolves. This requires a design strategy that incorporates external stakeholders (an “outside in” design approach), while at the same time a capacity for continuous evolution.

1.9. Discussion: between madness and foolishness

This chapter aimed to sketch an applied sociotechnical perspective on digital transformation, with the intention to be useful for discovering the affordances of digital technology in relation to structural, managerial, legal, and economic implications for organisations. The sociotechnical approach offers a particular kind of perspective that can serve as a compass to navigate these different interconnecting issues. While the compass that was worked out in this chapter remained at a more abstract level, it can be valuable as a basis to formulate an (action) research program that is oriented towards the specific challenges of the military organisation.

The sociotechnical approach as formulated in this chapter clearly relates to other well-known innovation strategies. Creating experimental settings, prototyping, establishing “agile” ways of working, concern for problems of scaling and – indeed – concern – for ethical implications certainly are not new or unique to a sociotechnical approach. What is typical for a sociotechnical approach is that these are part of an interconnected applied perspective that can serve as a compass to deal with a complex entangled issue like digital transformation. So, creating isolated design labs without structural connection to external stakeholders and without connection to the parts of the organisations in which the outcomes are to be implemented is likely to lead to dysfunctional outcomes. Avoiding taking strategic effects of technological innovations into account makes “bolting new technology to an existing organisation” a more likely outcome; attention for “social innovation” as a concern separate from other aspects of an organisation’s everyday functioning (technical, economical) is likely to lead to development of cosmetic ornaments that

initially might make people feel better but leave less visible structural determinants that affect people's well-being untouched.

At the same time, a sociotechnical innovation strategy is demanding not just cognitively – because of the range of interconnecting issues on multiple levels that have to be managed – but also politically – because of vested interests that might be affected by organisational transformation. What makes this particularly difficult is that because of the inherent uncertain affordances of “truly” radical technology, the outcomes of sociotechnical transformation are uncertain as well. The potential disruptive effects of digital technology may lead to “madness” as it *can* cause an endless regression of questions about the validity of every aspect of the existing worldview and existing societal order – without a guaranteed result. At the same time, the anxiety that is potentially generated by such madness may lead to the “foolishness” of avoiding difficult questions about the viability of the existing organisation and to choosing the path of least resistance and hoping for the best⁸³. A sociotechnical innovation strategy therefore aims to offer a pragmatic way of balancing such madness and foolishness.

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