The impact of digital transformation on sociotechnical thinking
The importance of the perpetual reinvention of sociotechnical thinking

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Paper presented at the conference of the Sociotechnical Roundtable
September 10th-13th 2019 in Los Angeles
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Abstract

It is undisputed that present day technological developments have profound impacts on organizations. Presently, we have witnessed many of such impacts and it can be expected that as yet unknown effects will materialize in the future, or in other words that "the technological" will continue to affect "the social". Some even hold that changes that are provoked by digital revolutions add up to a fourth industrial revolution. The relationship between "the social" and "the technological" has been studied in the sociotechnical paradigm from its onset. However, the degree of impact of present day technological developments is such that the question can be raised what they imply for theorizing about organizations. This paper focuses on sociotechnical thinking. Perhaps technological developments require a reorientation of sociotechnical perspectives on organizations? This paper approaches this theme by discussing a theoretical and a pragmatic topic. First, the cornerstones of the sociotechnical perspective are analyzed using insights from Science & Technology Studies. Second, two stories about digitalization are discussed and analyzed for their impact on sociotechnical thinking. These two stories focus on present day developments in the realm of digitization with potentially disruptive effects for the sociotechnical perspective. Given that this is both an extensive and complex issue, the ambition in this paper is not to answer the question, but to develop a way of thinking about the relationship between digitalization and sociotechnical theory.

Disclaimer

This paper is a conference paper and as such displays many of the shortcomings that wouldn't be acceptable in more mature texts. It remains rather experimental since this is the first time the author has dealt with its central topics in this particular way. It is too long, there are too many quotes, some discussions dwell on points that are not directly relevant to the topic at hand, other discussions are not worked out well enough and the overall coherence of the argument in the paper can be improved as well. Also, since English is not the author's native language, the text demands considerable development. The author hopes that readers will take this into account and view the paper as a first and honest attempt to come to grips with a complicated array of interrelated topics.

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1. Introduction

At the world economic forum in Davos in 2016 it was argued that the combined effects of developments in wide raging fields such as artificial intelligence, robotics, 3D printing technology, nanotechnology, internet of things and material science, add up to a fourth industrial revolution (Schwab, 2016). More specifically, the forum observed shifts across industries by the emergence of new business models and the simultaneous disruption of existing ones, reshaping of production, consumption, transportation and delivery systems. More generally, the forum observed changes in the way people communicate, express, inform and entertain themselves (Schwab, 2016, p.7). These different developments leverage on digitalization and information technology (Schwab, 2016, p.19) and therefore they play a key role in this asserted fourth industrial revolution (Brynjolfsson & McAfee, 2014; Susskind & Susskind, 2015). This indicates that the issues that are raised by technological innovations exceed the realm of the strictly technological. Instead, they have effects on society, organizations and on human being and raise different kinds of ethical questions (Verbeek, 2011). Focusing on organizations, they contribute to the change of strategies, business models and organization design (Teece & Linden, 2017, Barley, Bechky & Miliken, 2017;).

Against this background, this paper focuses on a specific theme: if present day organizations are confronted with disruptive changes as a result of digital transformations, what impact has that on thinking about organizations? Should thinking about organizations and organizing change as a result of these developments? This paper approaches this theme from a sociotechnical perspective. The sociotechnical perspective offers an applied framework to analyze organizations and to design interventions (Van Eijnatten, 1993, Pasmore, 1988, Cherns, 1987). The sociotechnical perspective was developed as a response to the profound effects mechanization had on organizations (Trist & Bamforth, 1951). From its onset the relation between the "technological" and the "social" have been at center stage in the sociotechnical perspective. Therefore, developments in the realm of digitalization have been on the radar of the sociotechnical approach for quite a long time (e.g. Pava, 1983, Mumford, 2000; Morgan, 1993, Miller, 1993, Coakes, Willis, Lloyd-Jones, 2000, Govers, 2003). However, if the effects of present-day digitalization are so profound that they lead to

an alleged fourth industrial revolution, perhaps they'll also have a disruptive influence on thinking about organizations? This theme is not merely relevant for academics; it is also relevant for practitioners. As an applied approach, the sociotechnical perspective needs to prove its value in the real world and is urgently confronted with trends in the world of everyday organizations and confronted with questions about what these developments imply for its conceptual frameworks.

Against the background of this broader theme, the goal of this paper is to explore two more specific questions. First, attention is focused on the level of fundamental theory. As an approach that was developed against the background of emerging technological developments, the sociotechnical approach is in its core based on concepts concerning the relation between "artifacts" and "organizing". The question is whether it's positioning in this regard is still relevant in view of developments in the realm of digitalization. Second, attention is focused on the pragmatic side of the sociotechnical perspective is discussed. The sociotechnical perspective does not develop a fundamental outlook on the relationship between technology and organizations for its own sake. Rather such theoretical positions are used to support an everyday understanding of organizational challenges and to develop interventions. The question is if the current conceptual tools of the sociotechnical perspective are capable of dealing with the most recent challenges in the realm of digitalization.

This two-step exploration proceeds by characterizing the sociotechnical perspective on the basis of three cornerstones. Subsequently these three cornerstones are compared to recent insights in Science and Technology Studies. The latter is a multidisciplinary field of study that occupies itself with how social, political, and cultural values affect scientific research and technological innovation, and how these, in turn, affect society, politics and culture. Subsequently, to explore the pragmatic side of the sociotechnical perspective, two "stories" about digitalization in organizations are sketched. These stories describe relevant present day developments in organizations and the question is what they mean for sociotechnical thinking from a pragmatic point of view. Subsequently, it is discussed what the implication of the stories are in relation to the cornerstones of sociotechnical thinking. All in all, this paper is very much an exploration of issues that will become increasingly significant for the sociotechnical tradition. A conclusion will be that the sociotechnical perspective on the one hand needs to (perpetually) develop to keep up with developments in the world of organizations. On the other hand, these developments make clear that a sociotechnical perspective continues to be relevant as an approach that searches for ways of humane organizing in a world of changing technology. Therefore, the sociotechnical perspective can

find a contemporary significance in light of the present day complex developments in the realm of digitalization.

2. Three cornerstones of sociotechnical thinking

Before the impact of digitalization on sociotechnical theorizing can be discussed, it is first necessary to develop a sketch about the theorizing that might be impacted. This is not straightforward, as there are different ways to describe the sociotechnical perspective. Well-known is Van Eijnatten's distinction in four distinctive "regional" conceptual developments (Van Eijnatten, 1993, Van Eijnatten, Shani & Leary, 2008). More specifically, he distinguishes between North American STS, Australian STS, Scandinavian STS and Dutch STS. Another distinction is made by Pasmore (1988) in STS Theory, STS Design and STS Process & Development. Both – partly overlapping – ways of dividing the sociotechnical paradigm up are valid and valuable because they fit a certain purpose. Van Eijnatten's distinction makes clear that in different regional contexts different socio-technical traditions with their own emphasis have developed, probably fitting their own particular context. Pasmore's distinction makes clear that an applied field that aims to be practically relevant needs to address different kinds of issues (fundamental theory, problem orientated theory and concepts about materializing change). Here the sociotechnical paradigm is described on the basis of three cornerstones. In no particular order, the three cornerstones are:

- The principle of organizational choice
- The postulate of integral theory
- The normative orientation on humane organizing

Since each of the cornerstones relates to conceptualizations concerning the relation between "the social" and the "technological", it is possible to develop a characterization of the sociotechnical perspective by using insights from Science & Technology Studies. This means that each of the three characteristics creates the opportunity for specifying the central question of this paper. Below each cornerstone is first sketched and subsequently characterized using insights from science and technology studies.

Organizational choice

A first characteristic of the sociotechnical perspective is summarized in the principle of organizational choice. "Organizational Choice" was the title of the book in which the first sociotechnical innovators summarized their path-breaking research findings and put forward

their specific ideas about organization design (Trist et al, 1963). According to this principle, technological or economic developments that confront organizations do not bring with them the necessity for *specific* changes, in other words, they are in their architecture and internal policies not fully determined by these outside forces. Organizations possess certain discretionary elbowroom – choice – when confronted with "demands" from the environment. The concept of organizational choice is derived from the systems theoretical principle of equifinality and defines the space in which understanding of organizational dynamics is relevant (Morgan, 1993). Without "organizational choice" it is not relevant to think about organizational dynamics. Trist et.al (1963, p.6) relate the principle of organizational choice to the systems theoretical concept of equifinality: "Unlike mechanical and other inanimate systems they possess the property of "equi-finality"; they may achieve a steady state from differing initial conditions and in differing ways" (emphasis in original).

The early innovators positioned the sociotechnical perspective in opposition to the technological determinism of Frederick Taylor's scientific management philosophy (Trist, 1993). Technological determinism stands for the view that technological developments have inevitable economical and societal effects. More specifically, Bijker (2008) points out that technological determinism consists of two core ideas. First, the idea is that technology develops autonomously, according to an internal logic, independent of external influences. Second, technological determinism stand for the view that technology shapes society by having economic and social impacts. Brought within the context of organizations, technological determinism refers to the idea that it is the available technology that one-dimensionally forces the design of organizations in a particular direction. In the era of mechanization this would for example mean that available conveyor belt technology was thought to inevitably determine the division of labor and therefore for example task-design in organizations. Gareth Morgan formulates this as follows (1993, p.354):

> "In common with so much technological and organizational change occurring at the time, the quest for organizational efficiency in the mines was associated a raw determinism that simultaneously mechanized production methods *and* the web of human relations through which they were organized" (emphasis in original).

Although Mayo's Human Relations approach can be understood as a critique of scientific management, it has from a very early day been criticized for accepting "the technological imperative" (Trist, 1993, p.584). One of the main achievements of the sociotechnical perspective was that it found ways of influencing the design of the organization (the technical

system) in order to establish a better fit with characteristics of "the social system" in ways that also positively influenced economic performance.

There is another side to this question. The principle of organizational choice can be seen as an argument against the opposite of technological determinism as well. This opposite is often referred to as "social voluntarism". This is the view that technological artifacts – things - are of limited relevance for social scientific theory (Winner, 1980). In such a view, technological development takes place in a separate realm, only relevant as an influence on the sideline. In this view things do not matter at all (Winner, 1980, p.122):

> "This conclusion offers comfort to social scientists. It validates what they had always suspected, namely, that there is nothing distinctive about the study of technology in the first place. Hence, they can return to their standard models of social power — those of interest-group politics, bureaucratic politics, Marxist models of class, and the like – and they have everything they need."

Social voluntarism would imply that principles of organization design could be formulated independent of technological developments, or socio-economical developments. In such a perspective, the technological context as well as the socio-economic context is considered to have no direct bearing on design principles, which are considered "universal and eternal". Whereas the position against technological determinism is widely shared in the sociotechnical perspective, the argument against social voluntarism perhaps is not. While the initial sociotechnical innovators certainly did locate their theorizing in a specific socio-historical context in which certain technological developments took place (i.e. the era of mass production, mass distribution and mechanization), other sociotechnical theorists lean towards the idea of formulating "eternal and universal" design rules (Achterberg and Vriens, 2010). In a social voluntaristic perspective concerns about technological developments can be largely sidelined in organization design. They are of a later concern – filling in details – after main steps in the design of organizations have been worked out. The argument here is that the principle of organizational choice steers between both technological determinism and social voluntarism: technology does not determine "organization", nor is it irrelevant or a secondary concern.

The postulate of integral theory
A defining characteristic of the sociotechnical perspective is that it proposes an integral view on organizations. In an integral perspective, different aspects of an organization are not studied separately, but in mutual relation. Typical of the sociotechnical paradigm is that this

integrated whole is understood in relation to an environment. As such, the integral view of organizations is related to a systems theoretical orientation. In a certain sense also scientific management developed by Frederick Taylor offers an integral theory: it is a theory that aims to fit job design and organizational design in general to certain assumptions about worker motivation (i.e. the image of the *homo economicus*) (Kuipers, et.al. 2018). As scientific management is the sociotechnical approach' nemesis, it focuses on a particular kind of integral theory, which is essentially based on a particular concept of sociotechnical relations.

The sociotechnical perspective was developed in the context of research into the effects of technological innovations in the Durham mines (Trist, et.al 1993). The issue that initiated this research was that the introduction of mechanization (introduction of conveyer belt systems, power tools, etc) did not yield the expected results (Trist, et. al., 1963). In fact, the mechanized mine was hardly more productive than the traditional work system. This finding led to the idea that changes in the technological system of the organization need to be accompanied by changes in the social system. The intention was to develop organizations that offered a more humane working environment (Trist et al devoted significant part of their study to understanding the profoundly alienating effects of mechanization) while at the same time being economically more viable. All in all, this combined focus on the social and technical system in organizations led to the label "sociotechnical" and led to the idea of "joint optimization". First generation integral theory stressed the importance of *joint optimization* (Hill & Emery, 1993, p.266):

> "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".

It is the idea "joint optimization" that shows the integral way of viewing organizations in the sociotechnical paradigm: as a way of optimizing two distinctive systems, i.e. the social and technical. Trist emphasizes that this implies a new unit of analysis for studying organizations (1993, p.587):

> "From the beginning, the Tavistock workers felt that a new unit of analysis was required. This led the writer to introduce the concept of *the socio-technical system* (Trist, 1950; 1981/ Vol. II). 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" (italics in original).

The first path-breaking sociotechnical studies found that behavior of organizational members was tightly coupled to the way work was designed. Pasmore (1988, p.2) emphasized that the crucial step the sociotechnical innovators made was to indicate that the human system could not be understood without also understanding the technical system. This integral view on the mutual relations between social and technical systems is what gave the sociotechnical perspective its name.

The theoretical developments initiated by De Sitter (1994, 2000) – and more in general by the collective of Dutch and Belgian academics and practitioners working in the sociotechnical field (Groep sociotechniek, 1986; Kuipers, 1989; Kuipers & Van Amelsvoort, 1990) – were triggered by both pragmatic and theoretical dissatisfactions with the original formulations of sociotechnical theory. One pragmatic reason to develop the original body of sociotechnical theorizing was the observation that semi-autonomous workgroups often did not achieve their intended effects. As Kuipers et. al. (2018) describe, the idea developed that – in order for them to function properly – the organizational context should be in harmony with its intentions. In the early experiments, semi autonomous workgroups often remained an anomalous entity in what was in every other respect an organization built up of Taylorist' principles. This led to the idea that the (macro) structural design of organizations played an essential role in achieving sociotechnical ambitions at the level of the semi-autonomous workgroup, which eventually led to a design theory including rules for sequencing design steps. This explains the emphasis on structural design in the approach that initiated in The Netherlands and later in Belgium.

The change toward a perspective on macro-design of organizations in itself does not add up to a second-generation integral theory. Apart from developments in design theory, De Sitter also formulated a critique on the concept of "joint optimization" of a "social" and a "technical" system. According to this critique, the difference between a technical system and a social system is an *analytical* construction. This means, on the one hand, it is always possible to make a distinction between a system of interrelating technological artifacts and a system of interrelated (groups of) human beings. On the other hand, making such distinction is according to De Sitter (1994, 2000) artificial because social aspects and technical aspects are always and inevitably interwoven in organizations. Because of this interwoven character of "the social" and "the technical" the principle of joint optimization does not offer a clear foundation for design theory.

The normative orientation on humane organizing

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In his book *The Reflective Practitioner* (1983) Donald Schön makes clear that practitioners are inevitably concerned with issues that are intertwined with norms. In the view of Van Strien (1997), making a judgment inevitably implies establishing a connection with a norm, that for example can be used to determine whether a particular situation is desirable or not. Being decidedly pragmatic, the sociotechnical perspective is no exception: its conceptualizations are meant to support practitioners in making judgments. True, for long there have been discussions within the sociotechnical perspective about the degree to which external theoretical frameworks can be used to make judgments and to base interventions on. Van Eijnatten (1993) makes clear that there is a tension within the sociotechnical perspective between those that emphasize "participative design" (rejecting the idea of expert knowledge) and those that emphasize the importance of expert knowledge (challenging the possibility of design on the sole basis of local knowledge) in the process of organizational design. However, these are discussions about the possibilities and limitations of strategies to aim for certain norms, not between those that reject a normative orientation and those that don't. After all, the idea that implementing external frameworks in a deductive fashion is undesirable is also a judgment based supported by a theoretically logic, as well as the choice to relinquish the use of frameworks altogether.

From its onset, the sociotechnical approach has been focused on improving the quality of working life. (Trist, 1981). Not incidentally, the three volumes on the sociotechnical perspective edited by Trist & Murray – published in the 1990s – were titled "the social *engagement* of social science". The opposition against scientific management was also informed by a normative orientation towards quality of working life. The normative orientation of the sociotechnical approach is visible in different of its central theoretical notions. The concept of self-organization indicates the importance that is attached to the ability of workers to control key variables in their working environment. The idea of action-research, which has from the onset been at the center of the Tavistock approach (Trahair, 2015), indicates that sociotechnical design was never meant as a narrow expert-approach. What perhaps might seem a detail, but is in fact very telling of the normative orientation of the sociotechnical approach is that the first sociotechnical design innovations were not designed behind an expert's desk but were discovered. Organizational choice therefore also means orientation toward a certain normative orientation.

While the second generation integral theory differs from first generation integral theory in the way it conceptualizes sociotechnical relations, both are firmly sociotechnical because of their emphasis on the importance of enabling the creative potential of human

beings, both for pragmatic (this creative potential is essential for flexibility, but also for innovation) as for humanistic reasons (enabling creative potential and fostering human development is desirable for its own sake). Both first and second-generation integral theory contain the idea that it is possible to find a way to simultaneously design more "humane" organizations with a better quality of working life and economically more viable organizations.

If this paper focuses on how digital revolutions demands a transformation of thinking about organizations, the question is what this means for the normative orientation of the sociotechnical approach. One position would be that the normative orientation allows for a perspective on recent trends in the world of organizations. Some trends may be embraced while others are rejected because they either stimulate or prohibit the development of humane organizations. So even when a fourth industrial revolution fueled by digital developments requires a significant redefinition of sociotechnical relations, still there might be a normative core that allows for a sociotechnical perspective on digital revolutions. However, this approach would not involve considering if digital transformations would affect the normative core itself. Perhaps technological developments fundamentally transform the way human beings understand themselves? Question such as these are central question science and technology studies.

3. The cornerstones from the perspective of Science & Technology Studies

The previous describes three cornerstones of sociotechnical thinking that relate to the ways the relations between "organization" and "technology" are perceived. Below, each of these cornerstones is discussed from the perspective of Science and Technology Studies.

Organizational choice

Contemporary theorists in the field of science & technology studies straightforwardly rejected technological determinism as a viable idea about the relation between technological and social development. Bijker even considers technological determinism a "debilitating" view (2008) and points out that empirical studies in the fields of "the sociology of scientific knowledge" (SSK) and "the social construction of technology (SCOT) have extensively shown this position to be indefensible (see for example MacKenzie & Wajcman, 1999). In organization studies, it is not just the sociotechnical tradition that argues against technological determinism; essentially Orlikowsky (2007) and generally those that study organization from

the perspective of "social materiality" argue the same point. At the same time, also social voluntarism is rejected. Contemporary discussions in science and technology studies emphasize that technology "matters" (Winner, 1980). Orlikowsky (2007, p.1436) has made a comparable point in relation to organization studies: organizational scientists have a tendency to study technology from a limited perspective:

> "One difficulty concerns the explicit focus on technology adoption, diffusion, and use as separate and distinct phenomena occurring within organizations. The implication of such a focus is that materiality is an issue to be considered occasionally, as specific technological events arise — for example, when an organization invests in or acquires new manufacturing technology or when a new communication medium emerges and is appropriated by members of various groups or communities."

If the principle of organizational choice is understood as steering between the ideas of technological determinism and social voluntarism, it appears as particularly modern from the perspective of contemporary science and technology studies.

The postulate of integral theory

The two generations of integral theory are essentially based on a different way of conceptualizing sociotechnical relations. If these two conceptualizations are analyzed from the perspective of science and technology studies, it is clear that second-generation integral theory is distinctly more modern. In fact, De Sitter's concerns about the way "the social" and "the technical" are interwoven could perhaps even be seen as an early formulation of a core contemporary insight in Science & Technology Studies. Typically, theorists within Science and Technology Studies will emphasize that human beings are entangled with the technologies they use (see for example Verbeek, 2011). Typically, it is argued that this view was originally formulated by the philosopher Martin Heidegger (1977), although De Mul (2014) indicates that in philosophical anthropology Helmuth Plessner first hypothesized the "artificiality by nature" of human beings. Bringing this discussion to organization science, Orlikowsky remarks that (2007, p.1437):

> "Such an alternative view asserts that materiality is integral to organizing, positing that the social and the material are constitutively entangled in everyday life. A position of constitutive entanglement does not privilege either humans or technology (in one-way interactions), nor does it link them through a form of mutual reciprocation (in two-way interactions). Instead, the social and the material are considered to be inextricably related — there is no social that is not also material, and no material that is not also

social."

She subsequently argues that it is a challenge for organization studies to take the recursive intertwining of humans and technology seriously and emphasizes the importance of studying constitutive entanglement humans and technology (Orlikowsky, 2007, p.1438) which in a later publication has been connected to a "practice theory" lens (Feldman & Orlikowsky, 2011; D'Adderio, 2011; Nicolini, 2013). This perspective revolves around the notion that "social life is an ongoing production and thus emerges through people's recurrent action" (Feldman & Orlikowsky, 2011, p.1240). The focus in second-generation integral theory is on activities and the social interaction network is organized around that, in relation to a turbulent environmental context (De Sitter, 1994, 2000). This shows that on the level of fundamental theory, De Sitter's proposals are close to current insights in Science & Technology Studies and Organization Theory.

The normative orientation on humane organizing

There is an interesting parallel between the sociotechnical perspective and Science and Technology Studies. A paradigmatic position in Science and Technology is that humans shouldn't understand themselves as seperate from artifacts. Instead, they emphasize that artifacts have moral significance. Paraphrasing the philosopher Bruno Latour, Verbeek (2011, p.46):

> "Technologies should not be understood merely in terms of functionality, for this would limit us to seeing only how human intentions can be realized with the help of nonhuman functionalities serving only as means of extension. Technologies are not simply *used* by humans, they help to *constitute* humans" (italics in original).

What this means that the previously emphasized point of humans and technology being constitutively entangled has also an ethical significance. Rather provocatively, some philosophers would portray technology as a moral agent, indeed because it helps to constitute humans (Floridi & Sanders, 2004). Verbeek (2011) is not willing to go that far: is his view there is a tendency toward animism in the portrayal of technology as a moral agent (2011, p.64). Instead, he emphasizes the role of technology as a mediator and phrases his position as follows (2011, p.64-65):

> "The example does not suggest that artifacts can "have" intentionality and freedom, just as humans are supposed to have. Rather it shows that (1) intentionality is hardly ever a purely human affair – most often it is a matter of human-technology associations; and (2) freedom should not be understood as the absence of "external"

influences on *agents* but as a practice of dealing with such influences or mediations." (emphasis in original)

The finer distinctions in the discussions between philosophers about the relation between ethical questions and technology are not of direct relevance within the limits of this paper. What is important, however, is that the description of the sociotechnical perspective reads as a case history of normative questions that emerge in the context of the implementation of technology in organizations. The paradigmatic studies in the Durham mines can be interpreted as an analysis of the normative consequences of mechanization. "Organizational choice" as a key idea in the sociotechnical perspective is about tailoring the way technology has effect on humans. Organizational choice can therefore be understood in relation to ethical questions that emerge in the context of entanglements between humans and technology. As such, the sociotechnical perspective can be seen as an early form of what in contemporary lingo would be called "responsible innovation".

There are two further points that can be made in the context of this discussion. In the first place, sometimes Science and Technology Studies displays a tendency toward an individual focus ("human" and technology). However, the sociotechnical perspective from its onset focused on "organization", that is, a collective of humans. For this reason, the sociotechnical perspective emphasized from its onset the importance of "design". In the paradigmatic Durham-mines case, it was "design" that offered "organizational choice" – elbow room as Morgan called it – to find the opportunity to find ways of humane organizing. As such, Science and Technology Studies could potentially gain important insights from bothering itself with the pragmatic solutions that were found in the sociotechnical tradition. In the second place, Science and Technology Studies keeps emphasizing that values and norms are not eternally fixed (Verbeek, 2011). Rather, in the context of changing technology and changing possibilities that this changing technology allows, ethical perspective change as well. This focus suggests that what is considered "meaningful work" will evolve in a changing society. When a normative orientation is a cornerstone of the sociotechnical perspective, it will need to perpetually evolve its understanding of its normative perspective in light of a changing societal and technological landscape.

4. Two stories about digitalization

When perceived from a perspective derived from Science and Technology Studies, the sociotechnical perspective can be considered relevant, also in an age of digitalization. The

sociotechnical perspective rejects technological determinism, while at the same time technology is taken seriously. Furthermore, the sociotechnical perspective has developed a contemporary conceptualization of socio-technical relations. Second-generation of integral theory is generally on par with ideas within Science and Technology Studies. Also, the normative orientation that is typical of the sociotechnical perspective indicates that organizational development is also seen in relation to ethical considerations.

However, the question still remains if as a pragmatic approach to organizational challenges, the sociotechnical perspective has the tools to deal with the most recent issues in the realm of digitalization. After all, it is quite possible to think productively about socio-technical relations on the level of fundamental theory, while being rather out of touch with real world developments – that is, contemporary issues concerning sociotechnical relations in the real world. This leads to the second goal of this paper. The sociotechnical perspective does not develop ideas about organizations for its own sake. Instead, it has pragmatic intentions. The question is to what degree current thinking in the sociotechnical perspective is relevant given developments in the realm of digitalization in organization.

For this reason, two "stories" about digitalization cases will be discussed. These "stories" are on the one hand are similar because they both describe developments in the realm of digitalization that confront sociotechnical theorizing with important questions. Inherent in both stories is a possible potential to transform sociotechnical thinking. On the other hand, the stories are different as one represents a case that from a sociotechnical perspective might appear as a "good" development, while the other is definitely more questionable. As such, the cases confront the sociotechnical perspective with questions at different levels. The first "good" case leads to questions about how pragmatically fitting current sociotechnical conceptual tools are in the light of these developments. The second "bad" case leads to questions about how a sociotechnical perspective should relate to certain digital developments in the wider societal context.

Sociotechnical solutions in digitalized contexts
A promising way to apply the sociotechnical perspective to contemporary possibilities generated by digitalization is described by Winby and Mohrman (2018). Like this paper, they start out by maintaining that present day technological developments create possibilities that were unknown at the time in which the sociotechnical approach was developed. They claim that these possibilities challenge existing sociotechnical design theory. In contrast to existing design theory, the "object of design" should shift from the individual organization to the

"ecosystem" – the network of participants inside and outside the strict borders of a single organization – that is concerned with a certain transformation process. The Winby and Mohrman case indicates how digitalization enables the development of organizational networks. They emphasize the emergence of: "(…) horizontal organization and industry models characterized by virtual relationships to and among customers; partnerships along the value stream; outsourcing; the increasing use of contract and transaction-based relationships that are increasingly replacing loyalty and commitment-based relationships; and the building of work systems that include robotics, artificial intelligence (AI), and machine learning that often shift work to robots and to customers." As a result of these developments, they emphasize (2018, p.3) that digital platforms "have become major enablers of the communication, coordination, and knowledge generation underpinning economic transactions and work systems."

Winby and Mohrman subsequently emphasize that the developments in the realm of digitalization provides an opportunity for sociotechnical thinking (2018, p.3): "Work is often carried out by "smart" teams with members cutting across organizations, sectors, and geographic boundaries. Technology provides these teams with unprecedented access to data, information, analyses, and learning that provide the foundation for coordinated and complementary activity. In effect, the capabilities inherent in the digital platforms are integral to significantly increased collective intelligence". What makes this perspective typically sociotechnical is the simultaneous emphasis on the importance of the use of present day technology and the mobilization of the creative intelligence of humans that work with this technology (Winby and Mohrman, 2018, p.4): "In the era of rapidly evolving advanced digital technology, simultaneously addressing human purposes and technological capabilities is a business necessity for achieving sustainable business effectiveness." This makes clear that they consider the mobilization of human capabilities a business necessity, rather than that they consider it desirable for its own sake. More carefully phrased perhaps, they consider it as *more* than desirable for its own sake: it is a genuine opportunity to develop organizations that perform better, also from an economical perspective. We can infer from the text that they see present day technological developments as an opportunity for developing the creative human potential. Yet, unlocking this potential requires "design" of an ecosystem from a particular perspective. Essentially, this perspective aligns with conventional sociotechnical intentions. Their goal can be understood against this background: they want to update STS with the opportunities that modern technology offers in mind.

If digitalization enables different patters of communication, the question is what that

means for design of subsequent networks. To start with, Winby and Mohrman emphasize that the revolutionary ways of communication made possible by digitalization, enable organizations to better handle complexity. Winby and Mohrman (2018, p.7): "Digital solutions have been the major enabler of the capability to deal with increased complexity as organizations have grown in size, scope, and geographic dispersion. (…). Organization structures can now be independent of geographic location and work is often carried out across boundaries by cross-cutting networks that include both human and digital actors rather than in self-contained hierarchical units." Handling the complexity of such networks of interrelating companies becomes a design challenge. Winby and Mohrman (2018, p.7) emphasize that there are concerns with these "network" developments which require a design perspective:

"Concern about the impacts of this increasingly technology-driven economy has given rise to a sense that the "socio" part of organizational systems are not being fully addressed. "24/7" capabilities of digital systems have sped up work and capacity for quick response to customers but have greatly affected employee lives by creating "always on, never off" pressures amid the relentless race to address customer expectations. The tight technical interdependence across complex organizations means that errors in one location may cause service disruptions, delays, and even shut-downs in others."

They subsequently emphasize the need for a solid basis for collaboration between networks of organization. Winby and Mohrman (2018, p.8) emphasize the importance of transcending the conventional focus on single organizations when focused with design challenges: "Our organization design frameworks need to be updated to include the full range of stakeholder interdependencies and impacts." All in all, this sets the stage for what they call Digital Sociotechnical Design, the purpose of which they formulate as follows: Achieving relevance in the ecosystem requires design processes that take into account the legitimate purposes and interests of others in the ecosystem with whom a particular organization is interdependent. Taking an ecosystem perspective also highlights the need to consider the legitimate rights of many stakeholders in designing how industries, societies, and economies operate".

The case that Winby and Mohrman discuss is about the health care industry. Digitalization provides the tools for self-care at home and the opportunities to monitor this process from a distance by health care providers. This reduces the necessity for actual visits to hospital. In the words of Winby and Mohrman (2018, p.10) this transition – triggered by the possibilities that digital technology allows – evoke a next-generation sociotechnical design: "one that expands the venues and worksystem elements that are being designed, crosses

organizational boundaries, involves many different stakeholders, and designs technology and organizing approaches interactively." Their case focuses on Satellite Healthcare – a not-for-profit organization that offers kidney dialysis. Previously, kidney dialysis was exclusively performed in medical centers, but technological development has enabled the possibility of home dialysis, which potentially provides many advantages, not in the least for patients' comfort. Winby and Mohrman exphasize that technology is an enabler, but has to be connected to an ecosystem constituted of different actors and constituencies. All in all, this is an ecosystem or organization design question (Winby and Mohrman, p.11):

> "Patients who are self-administering dialysis at home continue to be connected to a Satellite Healthcare dialysis center that monitors their progress and helps them through the spectrum of care. Home patients may periodically come to a center for in-person assessment and treatment, and some may move in and out of the home dialysis modality through time. Thus, the design must include both technical and social linkages to the centers. The design of the centers' roles, structures, and workflow will have change to accommodate the redesigned home dialysis system and to address the dynamic life cycle that may move between home and in-center care."

The design challenge in this case, is according to Winby and Mohrman (2018, p.12) require a different kind of sociotechnical perspective:

> "A traditional approach to sociotechnical design would focus on optimization of Satellite Healthcare's internal work systems—its processes, technology, and employees — to accomplish the technical tasks of delivering high-quality care and to set up a social system that allows for meaning, motivation, and development of the workforce. It was clear to the leaders that designing a system to foster and enable self-care would require designing the full ecosystem, not just Satellite Healthcare, around the needs of the patient. This would entail broad participation in the design process."

One of the challenges that connects that makes such a development possible was the development of a digital application that supports the patient with the home dialysis process by enabling connections to the different actors in the surrounding ecosystem.

The design process that was focused on enabling home dialysis and therefore placed the patient at the center of an interaction network. Essentially, this interaction network forms the basis of the ecosystem that is to be designed. In the words of Winby and Mohrman (2018, p.13) ecosystem is represented in "a network diagram of the actors and stakeholders who will be affected by and need to be involved in the changes to the home dialysis process." Subsequently, a "life-cycle journey map" is sketched which basically explicates the different

activities that belong to the transformation process that is handled by the ecosystem. After that, "variance analysis" is performed, which essentially is a traditional technique for sociotechnical analysis, now applied to a patient as a central node in the ecosystem. On the basis of this variance analysis, specific connections within the ecosystem were redesigned in order to control variances that negatively impacted patient experience and the quality of the medical process. The digital application mentioned above was designed in order enable those variances (Winby and Mohrman, 2018, p.17):

> "The digital application was designed to enable greater consistency, increased cross-functional coordination, and shared knowledge among the various ecosystem members that they encountered. The digital designers were shaping the technology to support the information processing requirements of the emerging roles and teams."

However, not just the digital technology was designed to enable processes within the ecosystem, also the social system was developed (Winby and Mohrman, 2018, p.17): "As the social system was changed to work integrally with the technology solution to control the variances, changes were made in each." One change was for example adding a specific role for someone that enables integration in the network. The basis that was developed with this process description for home analysis against the background of a supporting ecosystem was subsequently used to redesign the existing centers (Winby and Mohrman, 2018, p.19):

> "Structurally, the centers are shifting to digitally supported smart cross-functional teams with accountability for the life cycle care of a set of patients. Structurally, the centers are shifting to digitally supported smart cross-functional teams with accountability for the life cycle care of a set of patients."

Essentially Winby & Mohrman case conveys the message that sociotechnical ideas and network-organizations are quite a good match. In a sense they use typical sociotechnical ambitions (enabling self-organization) to a different level of analysis (an ecosystem). They show that traditional sociotechnical tools (variance analysis) can be used at a different level of analysis. Also, they use a design sequence that is not unlike a traditional design sequence (define a scope of a system – create a vision – establish the demands on the new organization – design a transformation process (and design a digital application that can support such a process) – redesign the existing organization on this basis. The design solution they have developed also resembles traditional sociotechnical solutions (cross-functional teams with accountability for the life cycle of care). As such they argue that the fundamental sociotechnical theory does not need to change as a result of digital transformation. Instead, the existing problem sociotechnical theory (i.e. design theory) needs to be changed – essentially

broadened in scope – in order to make use of the possibilities of new digital technology.

A new digitalized scientific management?

The second story on digitalization in organizations is the "questionable" one and is about developments in digital surveillance techniques that increasingly become relevant also in organizations. Recently, Soshana Zuboff published a book in which she sketches the emergence of "surveillance capitalism" and unravels its broader consequences (2019). Zuboff identifies Google as the company that developed surveillance capitalism when it tried to develop a new business-model after the dot.com bust in the early 2000's. Starting point for developing this new business-model was the monetizing of so-called "behavioral surplus" that was gathered when the Google search-engine was used by users. Behavioral surplus refers to the small digital traces that people leave behind when they – for example – use the Google search engine. It appeared that such traces are particular value to advertising companies as it allows for more targeted advertising. As more detailed information on users allows for even more targeted advertising, the selling of behavioral surplus initiated the development of a sophisticated system of surveillance of users. Since Google has acquired different platforms, it can gather information from different sources, which it can combine. It is the pervasiveness of a digital infrastructure that makes surveillance capitalism possible. While Google was trendsetting in developing surveillance capitalism, also companies like Facebook, Amazon but also Microsoft developed into this direction. Since this "surveillance capitalism" has proven to be outrageously profitable, Zuboff (2019) considers these developments as an early trend that will develop into an ever more pervasive effect of surveillance through digital means. Zuboff also observes that surveillance capitalism can be successful, particularly because it to a degree operated beyond the scope of existing legislation.

A compelling example she mentions is that of a recent model of a robotic vacuum cleaner that connects to a user's WiFi and uses its sensors to develop a detailed map of a user's living room. This map is subsequently monetized. Zuboff portrays Google as a company that essentially has two faces. On the one hand there is a face that everyday users meet when they use often free-of-charge products with practical value (google search, youtube, google docs, google maps). This face goes trough great lengths to be helpful to its users. On the other hand, however, there is a face that is largely kept hidden to the public. This is the face that develops user profiles (UPIs; User Profile Information) with extremely detailed information on users. The information in these profiles is sold. The development of surveillance capitalism is relevant for the sociotechnical way of thinking about organizing in

two different ways. On the one hand, it forms the socio-economic background against which contemporary organizations work. On the other hand, the techniques that are used by surveillance capitalists are also disseminate into the workplace. As will be discussed below, digitalization enables detailed surveillance at the workplace and there is an influential line of research that aims to use such techniques to the espoused benefit of organizations. These developments go under the name of "people analytics", which goes beyond the more widely known "HR analytics".

In this respect, Zuboff specifically focuses on the work of MIT scientist Alex Pentland. Essentially, Pentland foresaw early that "digital breadcrumbs" that users of modern digital appliances leave behind, potentially tell a very accurate story of their life (Zuboff, 2019, p.422):

> "From the start, Pentland understood reality mining as the gateway to a new universe of commercial opportunities. In 2004 he asserted that cell phones and other wearable devices with "computational horsepower" would provide the "foundation" for reality mining as an "exiting new suite of business applications". The idea was that businesses could use their privileged grasp of "reality" to shape behavior toward maximizing business objectives (emphasis in original)"

From its onset in the 2000's, "reality mining" applied to the study of human behavior was considered a revolutionary way to study the behavior of groups and individuals. Zuboff argues that what happens to human beings is in essence comparable to what biologists since the 1970's with animals. Equipping animals with different kinds of sensors and trackers enabled them to study complicated behavioral patterns that were previously out of scope. Information about human behavior gathered in this way – through "sociometers" & sociometric badges" – is considered helpful for managers as they could see who was working with whom and infer the kind of relationship between people (Zuboff, 2019, p.423). Zuboff indicates that the idea of the research group surrounding Pentland is to equip employees with *hundreds of thousands* environmental and behavorial sensors to allow for group performance metrics and employees with self-performance evaluations (ibid, p.423). This is what Pentland calls "social physics" (2014) and Zuboff emphasizes that its proponents generally underwrite the idea that (Zuboff, 2019, p.424): "… the continuous pervasive collection of human behavioral data could succeed only when conducted outside the boundaries of human awareness, thus eliminating possible resistance…". Ben Waber, one of Pentland's students, calls the use of extensive data rendition of the behavior of employees and minute analysis "people analytics" (Zuboff, 2019, p.424-424):

"Waber portrays the work as "moneyball" for business, enabling any organization to manage its workers like a sports team based on measures that reveal how people move through the day, with whom they interact, their tone of voice, if they "lean in" to listen, their position in the social network across a variety of office situations, and much more, all of it to produce forty separate measures that are then integrated with a "business metric dashboard" (emphasis in original).

Zuboff emphasizes that "people analytics" is spreading rapidly in the business world. These developments can be portrayed as a development into the direction of 21st century time-and-motion studies, or more generally a 21st Century digitalized scientific management.

In order to analyze people analytics from a sociotechnical perspective, it is important to note that Zuboff relates this development to an underlying view of society she calls "instrumentarianism" (2019, p.352):

"… I name it *instrumentarianism*, defined *as the instrumentation and instrumentalization of behavior for the purposes of modification, prediction, monetization and control*. In this formulation, "instrumentation" refers to the puppet: the ubiquitous connected material architecture of sensate computation that renders, interprets, and actuates human experience. "Instrumentalization" denotes the social relations that orient the puppet masters to human experience as surveillance capital wields the machines to transform us into means to others' market ends." (emphasis in original)

Although it might seem obvious to connect surveillance capitalism to Foucault's concept of panoptic surveillance and totalitarianism, this is not the direction in which Zuboff goes (2019, p.360): "Instrumentarian power moves differently and toward an opposite horizon. Totalitarianism operated to the means of violence, but instrumentarian power operates through the means of behavioral modification, and this is where our focus must shift. Instrumentarian power has no interest in our souls or any principle to instruct." She emphasizes furthermore that instrumentarian power is "profoundly indifferent to our meanings and motives" and "it only cares for whatever we do is *accessible* to its ever-evolving operations of rendition, calculation, modification, and control" (italics in original).

According to Zuboff, the world-view – so to speak – behind instrumentarianism can connected to that of radical behaviorism developed by B.F. Skinner (ibid, p.361). One core idea of radical behaviorism is that freedom is basically an illusion and "that knowledge does not make us free, but rather releases us from the illusion of freedom" (ibid, p.363). A commitment to freedom and dignity is considered an escape route by which we deny the

relations between behavior and environment (ibid, p.368). This focus on behavior is in Skinner's behaviorism related to the idea of conditioning of behavior. According to Zuboff, Skinner's sketch of an utopia in in the book *Walden Two* is meant as a suggestion to rebuild Western society after the horrors of totalitarianism in WWII (ibid, 373). This utopia is anti-democratic (as this founded on ideas of freedom and dignity), against free-market idealism (leads to destructive competition between people) and against existentialism (which leads to passivity). Instead (Zuboff, 2019, p.373):

> "Skinner's cure was different and unique: a utopia of technique that promised a future of social equality and dispassionate harmony founded upon the viewpoint of the Other-One, the "organism amongst organisms", as the object of "behavioral engineering" (emphasis in original).

Skinner's utopia certainly isn't everyone's utopia and might even be most people's dystopia. Although Skinner predicted the development of instruments that would make this kind of engineering possible, this was not possible in his era. However, the way "people analytics" is marketed echoes this utopian spirit as its techniques are said to contribute to better functioning, more harmonious groups, organizations and the like. Zuboff concludes that surveillance capitalism's ever increasing inventory of techniques for behavioral rendition and modification have made an enormous step in the direction of Skinner's ideals, although not in the interest of an utopian society, but in the commercial interest of those who control the techniques (ibid, p.374):

> "Skinner's vision is brought to life in the relentless pursuit of surveillance capitalism's economic imperatives and the ubiquitous digital apparatus that surveillance capitalism creates and harnesses to its novel aims. Instrumentarian power bends the new digital apparatus – continuous, autonomous, omnipresent, sensate, computational, actuating, networked, internet-enabled – to the interests of the surveillance capitalist project, finally fulfilling Skinner's call for the "instruments and methods" of a "behavioral technology comparable in power and precision to physical and biological technology" The result is a panvasive means of behavioral modification whose economies of action are designed to maximize surveillance revenues." (emphasis in original)

Given the relation that Zuboff sketches between the philosophy and intentions that underlie behaviorism and developments in the realm of "people analytics", it is perhaps possible to claim that people analytics aspire for the "operant conditioning" of the workforce.

5. The two stories in relation to the three cornerstones

The stories that were discussed were similar in the sense that inherent in both is a potential to challenge sociotechical thinking. They are different in the sense that these challenges point into a different direction. This section connects the two stories about digitalization to the three cornerstones: what do these stories show about the principle of organizational choice, the postulate of integral theory and the normative orientation of the sociotechnical perspective?

Organizational choice

The first story shows that a technological development was a starting point for an extensive organizational change project. What the first story shows is that technological development did not determine the way activities should be interconnected and the way the structure of social relations should be shaped. Instead, technological development triggered an issue of organizational design, and a process of exploration. All in all, the focus was on developing the potential of the available technology in the interest of flexibility and self-organization. As such the first story exemplifies the principle of organizational choice. If it does challenge sociotechnical thinking it is about the way "choice" is fashioned within the organization, so in the pragmatic application of sociotechnical thinking rather than in the principle of organizational choice itself.

The second story is more complicated. Using the instruments of "people analytics" for purposes surveillance and intervention certainly reveals an ambition at influencing social relations in a particular way. It is comparable with designing organizations according to a felt "technological imperative" as Trist called it or the "raw determinism" that Morgan referred to. In this case this raw determinism digitizes production methods and the web of social relations within organizations. In this specific way, it is an example of "anti-organizational choice" as it is understood in sociotechnical theory. This paper lacks the available room for working this out, but this very observation indicates that there is a potential for contemporary relevance of the sociotechnical tradition. The sociotechnical perspective can develop an outlook on digitalization in which it is clear that there is a potential way out of the raw technological determinism that hides below the surface of the developments in the second story.

Digitalization and integral theory

Regarding the postulate of integral theory, the two contrasting stories about digitalization challenge the sociotechnical perspective in two distinct ways. The case of people analytics confronts the sociotechnical perspective with a particular kind of challenge. Instead of

demanding a renewal of existing design-tools it points to relevant developments in the world of organizations. While the instruments of people analytics might at first glance be evaluated as "just a useful tool", Zuboff's discussion makes clear that this philosophy comes with an underlying world view that is comparable to the sociotechnical perspective's traditional nemesis: scientific management. As was remarked above, it seems that people analytics – as it is sketched by Zuboff – aims at the operant conditioning of (in contemporary lingo called "nudging") the workforce. The case underlines the importance of an integral perspective on organizations, but at the same time, it makes clear that it is essential for the sociotechnical perspective to keep up with the times regarding developments. A more thorough analysis of the integral effects of people analytics – more thorough than fits with the limits of this paper. The case of Winby and Mohrman makes clear that digitalization makes new forms of organizing possible, more specifically, it enables the possibility of developing organizational networks. This leads to the question to what degree existing sociotechnical tools are suitable for applying on this level of analysis. Winby and Mohrman apply sociotechnical conceptual – predominantly first generation integral – design-tools to the design and development of what they call "eco-systems". However, as they indicate, sociotechnical thinking about such design issues is underdeveloped.

The observation of a development into a network economy is certainly not new. Already in the 1990's D'Aveni (1994) pointed to the necessity for dramatic flexibilization of organizations against the background of hypercompetitive environments. Miles and Snow (1986) noticed at the same time that increasing competition confronted organizations with increasing uncertainty. They observed that already in the 1980's network forms were observable and indicate that such developments put classical hierarchical structures (functional, divisional and matrix forms) under pressure. In fact, already in 1977 Karl Weick indicated the emergence of "chronically unfrozen organizations". Since this publication the attention in organization science for networks has soared. Also outside the organization sciences there is attention for "the network society" (Castells 1996), which refers to a broader societal trend. The development of theory that supports the design of networks is not unproblematic as is clear from a discussion by Schreyögg and Sydow (2010). One issue Schreyögg and Sydow underline is that by overly focusing on the fluidity of new forms, scholars tend to overlook that essentially an organization is only an organization because it reduces complexity.

Kuipers et.al. (2018) indicate that the "network-regime" is a strong contemporary design trend in organizations that can be distinguished from the "bureaucratic regime" and the

"flexible regime". A core issue they mention is that the very idea of "designing" a network seems to contradict the idea of a fluid system of relations that can adapt without inhibition to contingencies (Kuipers, et.al., 2018). In other words, a challenge for the sociotechnical approach is to see how "design-theory" and "networks" can be brought together, which would be a first step to consider how the sociotechnical approach can evolve to make use of the possibilities that digitalization affords. Kuipers et.al. (2018) propose an approach to this topic which essentially boils down to considering second-generation design theory as a *compass* that helps to keep track in what way different aspects interrelate instead of a theory about sequences in design-step. Whereas a sequence of design steps suggests that a design process should take steps in a particular order, a compass can be used to explore a "landscape" in all kinds of directions. Particularly if a landscape is explored in different – perhaps even surprising – directions, the compass can be used to keep track. This function is important not to enforce a pre-determined solution on an organizational problem (an often heard criticism on sociotechnical design efforts (Van Strien, 1986)), but because certain principles can help a practitioner to avoid being swamped by the uncertainties and uniqueness of a new situation (Kuipers, et.al. 2018, Kuipers, 1998). Essentially, viewing design theory as a compass, rather than as a strict sequence comes down to a flexible way of applying a systems theoretical perspective. Kuipers et.al. (2018) portray their view on network design as first steps of developing a more mature view sociotechnical network design. Winby and Mohrman's (2018) case can be seen as an important example of a way in which sociotechnical concepts can be applied more flexibly.

Digitalization and normative orientation
The first story offers a new challenge for the sociotechnical perspective in the sense that it is applied to an "eco-system" level of analysis. However, at the level of the normative it remains firmly sociotechnical. Design is oriented on finding opportunities for self-organization. Digitalization in this respect allows opportunities for self-organization that were previously not possible. Indeed, in this particular way, digitalization supports the development of humane design. Interestingly, after the opportunities of digitalization were acknowledged, the network design offered the specifications to work out the design of a digital infrastructure. That is, there was not a one-way direction from "technological design" to "organizational design". To the contrary, Winby and Mohrman describe a case in which technological design and organizational design mutually influenced one another. For the sociotechnical perspective as a way of thinking about organizations, this means that its normative orientation can remain

relevant against the background of present day developments in the realm of digitalization. Furthermore, it shows that digitalization does not have a normative effect for its own sake: there is room for organizational choice.

The second story is different. Zuboff describes a development in which digital technology is used to support the detailed surveillance of the workforces and she compares it to the ideals of B.F. Skinner. Above this was characterized as the "operant conditioning" of the workforce. Since the explicit goal of this process was remain outside the awareness of those being followed, it is the opposite of the use of a technology that supports independent judgment and self-organization. As such, this goes against the normative orientation of the sociotechnical perspective. The use of modern digital sensor technology in the way that is described and evaluated by Zuboff is considered a second-generation scientific management. What does this mean for the sociotechnical perspective as a way of thinking about organizations? The sociotechnical perspective was originally developed as a criticism on the effects of scientific management on organizations, regarding its underlying worldview, its value system as well as its pragmatic effects. Current developments in the area of digitalization reveal a potential that far exceeds the possibilities of traditional scientific management while its ambitions seem comparable. That means that potentially the sociotechnical perspective can find significance in critically following such contemporary developments and finding out alternative ways of using modern technology.

6. Final discussion

This paper is an exploration of what current developments in the realm of digitalization signify for the thinking about organizations in the sociotechnical perspective. Being an exploration, this paper has a number of limitations that should be underlined. Both the exploration of the relationship between the sociotechnical perspective and Science and Technology Studies remain a first rough sketch. In fact, both deserve perhaps a more thorough discussion in separate papers. The discussions within the field of Science and Technology could be discussed in much richer detail and the distinction in three cornerstones could be worked out further. The arguments for making this distinction in three cornerstones could be worked further as well. The analysis of the three cornerstones and contemporary insights from Science and Technology Studies remain a first rough exploration and can be worked out further. As for the discussion of two contrasting stories of digitalization, this is of course a very basic way of discussing contemporary developments that leaves out a lot. Also,

the developments in the realm of "people analytics" are discussed mainly from the perspective of Zuboff. They require, however, more elaboration. In short, in exploring a broad array of issues that are entangled in a complex way, this paper attempts to accomplish a lot, but comes up short in many respects.

However, the exploration has yielded a couple of results that may contribute to discussions about what digitalization means for thinking about organizations. In the first place, it seems that on a fundamental level, the sociotechnical approach appears roughly on par with insights in Science and Technology Studies. What we have seen is that the principle of organizational choice is quite relevant for Furthermore, the sociotechnical perspective takes an important step into the direction of conceptualizing the constitutive entanglement of humans and technology. Second generation integral theory considers a relationship between "the social" and "the technological" that is quite close to what Orlikowsky calls "constitutive entanglement".

As for the stories, the first story shows that the sociotechnical perspective can be relevant, also in the realm of digitalization, if it is prepared to develop its theoretical tools in a way that fits present day developments. Design theories are inevitably pragmatic and therefore focused on issues relevant in a given socio-historical context. This is what De Sitter emphasizes on the first pages of his last book: the design perspective he proposes is focused on redesigning organizational forms that were dominant at the time (functional concentration). As such, this design theory is explicitly located in a specific socio-historical context. Since present day technological developments apparently have triggered what some consider as a fourth industrial revolution – unheard of possibilities in the realm of organizing – perhaps a qualitative step has been made in this socio-historical context. Winby and Mohrman's case indicates that there is a way to apply a sociotechnical perspective to contemporary design challenges in the context of digitalization. As for the second story, this shows that a critical perspective on contemporary developments in digitalization is important. Given its history and normative orientation on organizations, the sociotechnical perspective can contribute to such discussions and find a contemporary significance.

The stories indicate that the sociotechnical perspective can have a positive – as a "compass" for organization design – as well as an important critical function in an era of digitalization. Both stories indicate, however, that the sociotechnical perspective needs to be prepared to keep up with the times, if it aims to fulfill this function. In a changing societal context with technological developments that have (combined) effects that are difficult to predict, the sociotechnical perspective needs to be prepared to continuously reinvent itself.

7. References

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