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Strategizing organizational capabilities for industrial digitalization – exploring managers' technological frames

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Abstract

Purpose – This study draws on technological frames to provide an understanding of organizational processes of strategizing by exploring how strategizing organizational capabilities for industrial digitalization could be understood through managers' perceptions of digital technology applications. This study complements earlier research focused on industry outcomes by addressing technological frames to understand how strategizing organizational capabilities within industrial digitalization may provide insight into socio-cognitive aspects which may affect technology-induced organizational change.

Design/methodology/approach – The single case study uses 14 in-depth interviews collected over two years (October 2020 to February 2022). The study follows an interpretative research design exploring managers' perceptions of industrial digitalization through a digitalization project.

Findings – The case study contributes to research by emphasizing socio-cognitive aspects through technological frames exploring how and why managers' perceptions of industrial digitalization affect strategizing organizational capabilities. The study contributes to practice by bringing attention to the disparate views of industrial digitalization. By illustrating how socio-cognitive aspects shape organizational capabilities, this study offers managers valuable insight into the relationship between an organization's capabilities, the individual and the shared structures affecting a digitalization project.

Research limitations/implications – The case study is limited to Swedish manufacturing industries and is not aiming to be transferred or generalized to other industrial contexts or countries.

Originality/value – This study recognizes that strategizing organizational capabilities depends on managers' ability to illuminate the socio-cognitive aspects. Hence, the study contributes to practice by bringing attention to the disparate views among managers on the enhancement efforts made using digital technologies.

Keywords Industrial digitalization, Strategizing, Organizational capabilities, Socio-cognitive aspects

Paper type Article

1. Introduction

Digital technologies used in the manufacturing industry, such as artificial intelligence, cloud computing and the Internet of Things, are part of the larger dynamic environment referred to as industrial digitalization (Colli *et al.*, 2022; Savastano *et al.*, 2022). Industrial digitalization as context reflects the enhancement efforts made using digital technologies within manufacturing organizations towards production (Carlsson *et al.*, 2022). Digital technologies often affect all functions of an organization and even cross firm boundaries impacting, i.e. products and business processes (Matt *et al.*, 2015) -challenging existing ways of doing business. In this context, it has been argued that it is not a specific set of dynamic capabilities required, but the organizations capabilities to enhance digital technologies (Henderson and Venkatraman, 1999). Or the capability of an manufacturing organization to

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continuously explore the basis of digital technologies. Given this, organizations may act depending on their ability to strategize organizational capabilities within industrial digitalization (Spieth *et al.*, 2021; Volberda *et al.*, 2021).

Strategizing is a dynamic organizational process of acknowledging potential tension between exploiting existing plans, ideas, resources, while exploring new and emerging means to achieve organizational objectives through activities (Marabelli and Galliers, 2017), such as enhancement efforts made using digital technologies. Given this, strategizing is a social process in which challenges associated with digital technologies are discussed and worked through by individuals and the collective (Volberda *et al.*, 2021).

A challenging part of strategizing is argued to be balancing exploiting existing organizational capabilities while building new ones (Warner and Wäger, 2019) since managers rely on socio-cognitive structures to untangle the complexity, referred to as "technological frames". Technological frames (TF) describe the assumptions, expectations and knowledge individuals use to understand a technology's application and consequences in a specific context (Orlikowski and Gash, 1994), for instance, the use of digital technologies within manufacturing production. In addition, a manufacturing organization comprises multiple individuals with diverse specialties, competencies and incentives, all of which are argued to require coordination for significant digital technology advancement (Carlsson *et al.*, 2022; Eriksson *et al.*, 2022; Orlikowski and Gash, 1994). This implies that to untangle the complexity of technology-induced organizational change, managers must interpret, assess and select appropriate digital technologies (Spieth *et al.*, 2021). As such, organizational capabilities complement managers' TF related to technological advancement (Mishra and Agarwal, 2010), emphasizing the importance of understanding how socio-cognitive aspects may shape strategizing organizational capabilities.

The overarching concept of organizational capabilities embraces a collection of capabilities that depend on the organization's dynamics (Teece, 2012; Teece *et al.*, 1997). Organizational capabilities are defined by an organization's abilities, skills and accumulated knowledge that enable an organization to continuously create value (Li *et al.*, 2017; Mishra and Agarwal, 2010). Furthermore, they are characterized by an organization's ability and reliability to be at least minimally satisfactory in an identified process given the environment (Demeter *et al.*, 2021; Li *et al.*, 2017).

Industrial digitalization does not simply start and end on the shop floor or in management at managerial levels. Instead, it can be contextualized to every part and aspect of the manufacturing organization, its formal and informal organizational structures, and its various individuals and functions (Björkdahl, 2020). This complexity of industrial digitalization makes interpreting and assessing digital technologies challenging (Azad and Zablith, 2021; Becker and Schmid, 2020). Previous research reports how managers might struggle to sense and seize digital technologies (Demeter *et al.*, 2021). For instance, against what criteria digital technologies should be validated and how they might affect the organization (Vial, 2019). Research on managerial perception has shown that managers' interpretation of the environment affects an organization's response to environmental-driven change (Grewatsch and Kleindienst, 2018). How a manager's assumptions, knowledge and expectations affect organizational abilities, skills and accumulated knowledge is an understanding or interpretation of what meaning or use managers have entitled them to (Eggers and Kaplan, 2013; Mishra and Agarwal, 2010). It is also suggested that organizational capabilities influence a manager's perceptual ability to recognize ways to improve competencies and identify opportunities to apply them (Teece *et al.*, 1997). In this sense, organizational capabilities exist as managers interpret them, and in turn, the interpretation of organizational capabilities' purpose depends on being seen as useful or meaningful (Grewatsch and Kleindienst, 2018). Thus, understanding organizational capabilities should be guided by socio-cognitive aspects, given that a particular context

shapes managers' frames and thus affects how managers assemble and develop organizational capabilities (Demeter *et al.*, 2021; Grewatsch and Kleindienst, 2018).

This study aims to explore how strategizing organizational capabilities for industrial digitalization could be understood through managers' perceptions towards digital technology applications-drawing on the TF framework to provide understanding into organizational processes of strategizing. As such, the following research question is posed:

> How may strategizing organizational capabilities for industrial digitalization be understood through managers' perceptions of digital technology applications?

2. Theoretical background

2.1 Technological frames

A large amount of research on IT in organizations has found that individuals form perceptions of technologies during the practice of work (Orlikowski and Gash, 1994). TF was first introduced by Orlikowski and Gash (1994), referring to frames as social constructs that include "assumptions, knowledge and expectations expressed symbolically through language, visual images, metaphors and stories" (p. 175). For example, how industrial digitalization is spoken about or how consensus on means in digital technologies is reached. By examining sensemaking related to information technology in organizations, Orlikowski and Gash were able to identify frame content in a new context for socio-cognitive perspectives covering three domains: (1) *the nature of technology,* which refers to the individuals' interpretation of technology and their understanding of its usefulness and meaningfulness; (2) t*echnology strategy*, which refers to the user's view of why the organization needs to implement the technology; and (3) *technology in use*, which refers to individuals understanding of how the technology can be used in the everyday practice and the possible consequences related to this (Orlikowski and Gash, 1994). These domains indicate context dependency and facilitate interpretative analysis of an individual's understanding, perceptions and use of technology at various organizational levels and throughout an organization, e.g. managers, engineers, designers and so forth. Thus, TF is applied to address individuals' experience and interpretation of digital technology to illuminate how frames may shape strategizing organizational capabilities.

In an organizational context, it has been argued that the dynamics and potential challenges of configuration and re-configurations of frames are essential for technology-induced change (Klos and Spieth, 2021). A manager who interacts with new digital technology evaluates its usefulness concerning the presumed work task (Mishra and Agarwal, 2010). When confronted with new technology, TF is often seen as a socio-cognitive sensemaking structure applied by individuals and groups (Klos and Spieth, 2021). As such, managers draw on assumptions, expectations and interpretations to make sense of and process new information individually and collectively, forming socio-cognitive aspects that may guide a manager to understand consistent problems and constrain reactions to new information (Davidson, 2006; Raffaelli *et al.*, 2019), i.e. the application of digital technology. Thus, the sensemaking activity is carried out through managers' socio-cognitive structures of knowledge that relate to a potential technology-induced change.

TF exhibit a diagnostic dimension, i.e. sensing the problem and a prognostic dimension, which includes seizing a solution for the identified problem (Mishra and Agarwal, 2010). In addition, it is suggested that TF are flexible in structure and content and may shift over time (Högberg and Olsson, 2019). This understanding implies that the formed understanding of digital technology is fluent. Arguing that TF act as a socio-cognitive filter, directing managers' attention but also filters contextual information inconsistent with existing frames (Davidson, 2002). As such, individual frames may be incongruent with others'

understanding of the usefulness and meaningfulness of digital technology (Orlikowski and Gash, 1994).

Herein, TF is understood as a collectively constructed set of assumptions, expectations and knowledge concerning technology and its uses and applications in an organization, based on the socio-cognitive processes by individuals and the collective, see Figure 1.

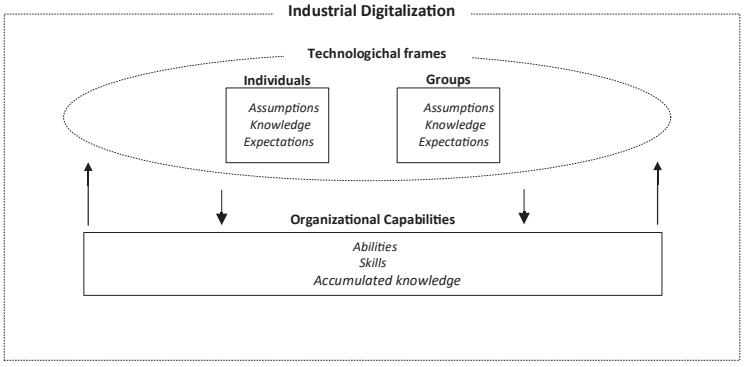
The concept of TF is adopted to explore the mutual shaping of frames by managers and the collective during strategizing organizational capabilities, given that frames act as interpretive filters favoring cues consistent with an existing frame (Davidson, 2002). Both managers' frames and their effects on the collective and organizational belief system are thus given attention.

2.2 Socio-cognitive aspects of organizational capabilities

Organizational capabilities are a complex bundle of abilities, skills and accumulated knowledge that allows an organization to perform activities generating value (Mishra and Agarwal, 2010). Organizational capabilities are not fixed but may evolve and change over time (Li *et al.*, 2017) and are influenced and responsive to the dynamic environment (Teece, 2012), such as industrial digitalization. Organizational capabilities responding to the dynamic environment consist of activities clustered into three core dynamic capabilities: sensing, seizing and transforming (Teece, 2007). These core capabilities are structured by abilities, skills and accumulated knowledge that enable an organization to create value continuously (Li *et al.*, 2017; Mishra and Agarwal, 2010). In addition, it has been argued that carefully developed knowledge-related assets, as mentioned, give greater flexibility in a dynamic environment (Kyläheiko and Sandström, 2007).

Technology-induced change in an organization is argued to involve the ability to sense and seize potential challenges and opportunities of digital technologies. The transformation of an organization is often related to change and, therefore, also closely related to an interpretative process of making sense (Colli *et al.*, 2022; Demeter *et al.*, 2021).

As manufacturing organizations may "*evaluate their ability to sense opportunities in digital technology, strengthen their organization ability to seize large market opportunities, and propose the competitive capability of transforming their business*" (Lin *et al.*, 2020, p. 409). Depending on the context and the associated individuals, sensing and seizing may result in inconsistent information triggering socio-cognitive inertia in managers, which risks spreading in an organization through interaction (Young *et al.*, 2016). For example, a manager working within a job shop may evaluate the usefulness and meaningfulness of a



Source(s): Authors work

Figure 1.
Overview shaping of frames for strategizing organizational capabilities within industrial digitalization

particular digital technology differently than a colleague in another job shop – despite being bound by the same organization. In this sequence of events, organizational actions depend on how management allocates attention to information and how such information is interpreted (Ocasio, 1997; Raffaelli *et al.*, 2019).

When a manager tries to handle the endless stream of competing and conflicting information and actions, understanding organizational capabilities can support managers in building a competitive advantage (Carlsson *et al.*, 2021). Volberda *et al.* (2021), for instance, argue that digital technologies not only affect how an individual makes use of and responds to information but also that the role of different individuals impact strategizing. An individual acts upon her interpretation of industrial digitalization, and her understanding must change if their actions are to change. In strategizing organizational capabilities, it becomes essential to understand how managers make sense of digital technology in relation to industrial digitalization. As such, the socio-cognitive aspects represent a dominant collective understanding of the prevailing organization's actions and objectives and the opportunities the organization may pursue to reach a more prosperous production.

3. Research study

The study explored how a local digitalization project was understood and acted on by managerial functions responsible for untangling the identified core areas and managers steering the project. Given that the aim never was to draw generalized assumptions but through exploration understand what potential socio-cognitive aspects of managers' perceptions that affect the technology-induced change while configuring and re-configuring for technological adjustment.

3.1 Case description

With two sites in Sweden, Alfa (a pseudonym) employs around 2,500 employees. Like many other Swedish manufacturing organizations, Alfa has a hierarchical structure operating through local production units at the centralized office level. The central level coordinates through policies set by headquarters, operating both from Sweden and global offices. One of the most influential policies is the strict "business case" structure that controls digital initiatives' identification and project building, such as a digitalization project. Alfa has a separate digitalization office that sets corporate standards and supports manufacturing functions.

One production unit specializes in additive manufacturing (AM) with powder solution producing new equipment, spare parts on-demand and repair work. In 2015, the AM production unit began a digitalization journey referred to as the "Digitalization project" (pseudonym), aiming toward the envisioned use of 3D printing. Alfa identified the need for a documented process and an increased machine learning capacity to leverage the production process. To do so, Alfa worked until 2018 to identify core areas lacking competence, skill, or technological advancement to achieve a more prosperous production. Between 2020 and 2022 Alfa focused on analyzing identified core areas for the next phase of the Digitalization project. The next and final phase of the Digitalization project is the aim of the AM job shop to be a closed-loop and self-healing process where spare parts and other necessities are ordered by themselves. This envisioned autonomous workshop is projected to be reached by 2025.

3.2 Data collection

The interpretative single case study follows Alfa in its Digitalization project over two years (2020–2022), surrounding the AM workshop as they set off to identify critical characteristics for taking the next step in their established industrial Digitalization project, e.g. reaching for a

more prosperous production. It must again be emphasized that despite the potential difficulty or undesirability in summarizing a case study, the case-study method contributes to the cumulative knowledge (Flyvbjerg, 2006), as per the focus in this study.

Following Yin (2018), the data collection was iterative and included information and data for formulating pre-understanding as well as for data analysis. The interpretative approach facilitated exploring the dynamic environment (industrial digitalization) and the TF affecting the project. This approach allowed for actively reflecting and iterating between data and theory (Walsham, 2006) to illuminate managers' assumptions, expectations, choices and actions throughout the research process.

Notes from six Digitalization project meetings during 2022 formulated a pre-understanding of the Digitalization project and the prospected technology-induced change within Alfa. Access to nine documents formulated the preunderstanding of the case-study context: visionary documents; policy documents of Alfa's culture; digitalization project white papers.

In-depth interviews (see Table 1) were used for the data analysis. Interviews were conducted in three rounds throughout the two years of the case study (2020; 2021; 2022). Informants spanned several managerial functions related to the Digitalization project at the AM workshop. Since the data collection was iterative, two informants (I1 and I9) participated in two interviews. In total, 12 informants were interviewed.

The interviews followed an open-ended procedure, asking how each identified informant interprets the usage and assessing what autonomous workshop entails. i.e. their interpretations, assumptions and expectations of industrial digitalization. All interviews began with questions concerning the informants' work tasks and functions, their involvement in the Digitalization project, and their understanding of industrial digitalization. In addition, they were asked about relationships and collaboration across work groups. e.g. "Can you describe what [core area] in relation to industrial digitalization mean for you?"; "How is industrial digitalization spoken about in your workgroup"; "Is there a consensus on value and means relative to industrial digitalization". The informants were also asked to reflect on why and how their interpretation of digitalization could affect their strategic work, which was relevant when analyzing individual and collective frames of reaching a more prosperous production.

3.3 Data analysis

The analysis facilitated an examination of various informants' perceptions of the Digitalization Project and their knowledge, assumptions and expectations towards and

I-ID	Date of interview	Managerial function
I1A; I1B	Oct 2020; Sep 2021	Chief executive officer
I2	Nov 2020	Group manager business development
I3	Dec 2020	Program manager: model-based definition
I4	Jan 2021	Product developer
I5	Jan 2021	Business developer
I6	Jan 2021	Business developer
I7	Mar 2021	Production manager: AM
I8	Apr 2021	Head of digital PLM
I9A; I9B	Apr 2021; Aug 2021	Group manager: digitalization of AM
I10	Jan 2022	Project manager: AI
I11	Jan 2022	Head of cyber security
I12	Mar 2022	Group manager: VR and AR

Source(s): Authors work

Table 1.
Overview informants

within it. The analytical process followed a reflexive approach through abductive engagement with the data and theoretical reasoning (Alvesson and Sköldberg, 2017). The process aided in interchangeably developing, testing, verifying and understanding events seen in the data. This approach emphasizes the interplay between empirical data realized through real-world problems that are inductively obtained in combination with influences from theory that are deductively inferred by viewing data from a theoretical viewpoint or perspective. This tandem nature of the analytical process was conducted to formalize an interpretative understanding of the informants' perceptions regarding the digitalization project in the light of TF to explore patterns of meaning. An interpretation of individual frames was developed by focusing on the informants' stories, metaphors and expressions (Davidson and Pai, 2004). Hence, applying a socio-cognitive perspective on informants' perceptions to understand theory and, in time, empirically formed themes parallel through conceptualization.

The analysis came to recognize the situated aspects across the case while striving for patterns of meaning developed through coding. The coding of the material was reflexively thematic and influenced by the framework of TF. The analytical process included six steps (see Figure 2).

The first step was the act of reading and understanding the content in all data sources, particularly the recorded material (11 h). Systematically, data segments were carefully read through, potentially critical data points were highlighted, and excerpts extracted. This step resulted in 97 initial excerpts in the data set.

The second step was initial data interpretation. This immersion with the data gained deep insight into the content and the need to ask critical questions since being deeply engaged in the dataset–continuously asking *why* and *how* generated an initial label to each excerpt (See Table 2).

The third step was to link each initial label to the technological frames (Orlikowski and Gash, 1994). The analytical attention shifted from smaller meaning units to larger patterns

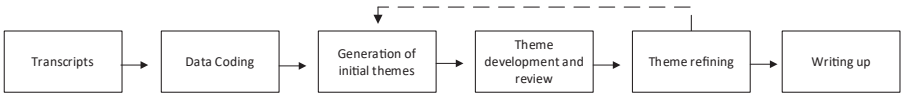


Figure 2.
Overview analytical process

Source(s): Authors work

ID	Excerpt	Initial label	TF	Initial theme	Theme refining
I4	"*There is probably a lot for free. We do not have to reinvent the wheel; enlist the help of other projects around the business within Alfa [pseudonym]. It is a huge company; if you can use everything around here, it is almost a digitization project to capture what already exists*"	Resources throughout the organization; communicate throughout the management team	The nature of technology	Communicating. An experience of misalignment in both communication and competence concerning the individual understanding; willingness to learn with the employees or change structural circumstances	Affective collectivism

Table 2.
Example analytical process

Source(s): Authors work

of meaning. The initial themes were formulated as comments on the relationship between the initial label and the relation to TF. Contradictions in, or dichotomization, formed the basis of the initial themes as individuals' frames, along with the collectives, are argued to affect the belief system, i.e. frames.

Given the reflexive nature of the analytical process, the fifth step of theme refining and defining was to reflect upon whether the determined identification displayed common analytical patterns within each TF domain, making up identified socio-cognitive aspects. This step was a process of continuous adjustment, and the refining took several rounds until the three final themes were identified: Affective collectivism, affective individualism and structural framing.

4. Findings

First, the digitalization project is introduced, followed by the identified three socio-cognitive aspects (themes) - *Affective collectivism, Affective individualism* and *Structural framing*– regarding individuals and the collective knowledge, assumptions and expectations of the digitalization project and the digital technology application within. The findings reflect managers' anticipation of industrial digitalization and their efforts in reaching the next step projected within the Digitalization Project.

4.1 The introduction of the digitalization project

The studied digitalization project of Alfa was introduced as a research and development project in 2015 as the AM workshop pursued its Autonomous AM vision. By the end of 2025, the stipulated goal by Alfa is that the AM workshop will have moved from a traditional workshop to an autonomous one.

Managers had interpreted the perceived fitness of the AM workshop as easy to use and assumed that their employees had the knowledge and know-how. The AM workshop and the 3D printing had been perceived as an opportunity to "*produce wherever or whenever*", leveraging the value chain with machine learning. However, sensing the opportunity of 3D printing had taken much longer than managers expected, and challenges hindering the AM workshop from capturing the value were seen as necessary to identify. The perceived fitness of the AM process was formulated in eight core challenges: material knowledge, design culture, stand-alone software, training, machine performance, quality issues, health and safety concerns and development speed. The latter was pushed as the most essential as the autonomous workshop would be reached by 2025. An important note is that there is a perceived easy-coming, easy-go mentality toward implementing Digital technologies relative to industrial digitalization. The project manager for AI describes this as employees not having a mutual language or point of reference for digitalization initiatives:

> We see the friction: as in where they [colleagues] are currently at and that they [colleagues] need to understand where we are at (I10)

In the citation above, the language in terms of being able to communicate is described as a potential barrier to any further digitalization initiative. Informants explain the communication barrier to differences in competence leading to variety in word usage, definitions of industrial digitalization and misaligned project prospects, e.g. timeframe. Indicating a strong affective process. The Group Manager for Digitalization and Industrialization of AM acknowledged the complexity of the eight identified core challenges:

> . . . We faced opposition from employees saying: no, oh lord, you do not understand anything about the material we receive or how we construct; our software systems are rubbish . . . no one receives any further education, and we have no engineers trained by any education worthy the name. (I9B)

The quote from the manager illustrates the opposition met when introducing 3D printing from a management perspective. In internal documents, management presented the challenge of capturing the value of 3D printing as: "*it is not just 3D printing! It is much more complex* . . ." and in one of the Digitalization project white papers, the AM journey came to be presented as both a hype and a "*valley of tears*".

The Group Manager for Digitalization and Industrialization of AM elaborated on the complexity:

> It was probably not a deliberate misdirection but a lack of knowledge. Management had not realized how hard it is to go through with something, not just the first time – but every time. . . . We faced opposition from employees . . .. (I9B)

Among the informants, a rather disparate diagnostic dimension was shown. The sequence of events layered out throughout the years illustrates a challenge in sensing the problem and having a hard time seizing a solution for the identified problem. Nonetheless, individual frames concerning the technology strategy and technology-in-use were strong, albeit inconsistent throughout the two years. As such, it could be argued that the issue might not be the ability to change the mind but the effort of commencing dominant frames from the management's side. One of the informants' points this out by saying:

> I think we have . . . Partly I think we have different perceptions in the organizations. Where some feel that this [technology-induced change] is more important and others feel that they do not want to be a part of this (I11)

The citation above illustrates how strong individuals' frames concerning industrial digitalization were during these two years and the contradictions within the organization.

4.2 Affective individualism

In response to the disparate collectivism in the previous theme, affective individualism is characterized by separate units of shared understandings among managers and the solid emotional belief that the manufacturing unit is unique compared to the rest of the organization. The manufacturing management bringing forth the Digitalization Project did not succeed in providing a dominant frame concerning the usefulness and meaningfulness of leveraging 3D printing. An early quote from Alfa's Chief executive officer shows how not only does the organization lack a collective understanding of industrial digitalization but also that individuals perceive it differently:

> I do not think the organization has a definition of what it [industrial digitalization] is. I think there are different perceptions among different decision-makers. (I1A)

Among the informants, a strong affective individualism was illustrated: not having trust in the organization regarding industrial digitalization. Some informants displayed that the experienced individualism may stem from the work, and working life, being tightly connected to the organizational structure organized in silos or closed workshop areas. However, transitioning towards a shared collective understanding and ways of working is a tedious process. The quote below illustrates the efforts to organize employees collectively. Interestingly, managers experience efforts to enhance the organizational structure to create a maze of managers:

> If you want to keep industrial digitization together within the group, try it out and explore in one place at a time, and then spread good examples; that sounds very nice in theory. However, we have managed— historically anyway — to make it a bureaucratic fever. That seventy-two decision-makers at very high levels should be involved in things that you may not have full insight into, and they are rather much inhibited as well. (I6)

It is arguably a result of too much dominance on the management level. Despite this, Informants showed a strong emotional belief that their respective manufacturing unit is unique to the rest of the organization. Another notion of perceived affective individualism was the need to individually argue for digital initiatives. Currently, managers would need to pass through an incensement of an initiative by formulating a business case. Some promoted this process by saying that Alfa should not be a "playhouse" but instead focus on well-drafted business cases. Others argued that creativity and shared thinking were being suppressed when one had to pursue a business case. The head of digital product life cycle management explains that many employees experience their workshop unique to the rest of the organization, needing tailored solutions to industrial digitalization:

> Every single time they [employees] say we are special and we are unique — I start digging into it, and every single time I note that, no, it is not like that at all. . . .. Alpha, I would say, has been a little bit unique since we are doing extremely well . . . (I8)

The manager's frame concerning technology strategy is practically the same as his colleagues, whom he stomped upon for saying their unit is unique. This situated frame is one example of managers having different frames for the identified problem. Some of them were aware that this existed yet failed to recognize their dimension to it. This could illustrate the difficulty of diagnosing and prognose problems of organizational capabilities related to industrial digitalization. In turn, managers' affective individualism could affect the ability to recognize shared organizational action.

Individual managers could share an understanding of why the organization needs to implement digital technologies in smaller coalitions. However, the value of sharing experience was disparate both among individuals and within smaller groups of employees. This disparate sharing of experience can also be interpreted as poor strategy formulation for the Digitalization project. It could be interpreted that the dividing lines between the individual's understanding of digital technologies and the organizations' application show an incongruent technology strategy frame. In general, the managers' frames of technology in use were very much influenced by the visibility of digital technology. The group manager of digital AM expresses this:

> I think leveraging industrial digitization and solutions becomes clearer when you remember a time when you have not had it; when you expect digitization to be omnipresent, you might easily become blasé. (I9A)

As the above illustrates, managers say that they have found their way of interpreting and following guidelines from the organization, reflecting the lack of sensemaking among the collective. Although managers might be blasé, they have neither succeeded in communicating how they interpret industrial digitalization nor their everyday use. Given that managers at the various functions did not agree or had the same interpretation of strategy and guidelines, the actual use (technology in use) was affected, and a disparate view of the Digitalization Project grew.

Given that separate units of understanding formalized the "bureaucratic fever", as previously stated, it could respond to the manifested affective individualism within the workshops and throughout the organization. It could be interpreted as the different individuals having access to different parts of the organization and thus having a different repertoire of frames. Over the two years, informants describe difficulties passing on the meaning of industrial digitalization to colleagues resulting in sheltered resources and competencies. As a result, many of the informants do not share the same understanding of industrial digitalization, while some even have a profound emotionally driven individual understanding compared to the organization at large. These clusters indicate a difference in frames concerning technology in use.

4.3 Affective collectivism

Affective collectivism is characterized by the informant's firm belief that ideas and solutions to leverage the production process already exist in the organization- Insinuating that informants experience a sense of togetherness. This view was interpreted as shared by the manufacturing unit at large, and the perception of technology implementation and technology use took place at the management level. However, in terms of production managers communicating how to reach the desired value, there is a perception of misalignment in communication and competence among production managers.

Regarding competence, one function might not have enough knowledge or resources to convey the contemporary understanding of the company, working group, or function. All the informants had a background in the manufacturing industry, and most had worked entire careers. In discussions with the informants, this fact was highlighted as a double-edged sword. On the one hand, the great knowledge many of the employees had generated formulated affective collectivism from years of shared experience. On the other hand, it also formulated a systematic perception between managers as well as among them.

The informant's group perception of leveraging 3D printing in the AM workshop indicated that the perceived usefulness of leveraging digital technologies is highly connected to the overall organizational structure. The chief executive officer at Alfa explains his interpretation of perceived usefulness:

> . . . if you digitize, then one work between flows. You connect purchases with spare parts, with invoicing, and you do it seamlessly–Then you have digitized. (I1A)

Regarding communication, data demonstrated that managers perceived ideas and solutions to achieving industrial digitalization already exist in the organization but are not communicated throughout the organizational structure. The product developer illustrates this frustration by saying:

> I think you would need to have the opportunity to capture more things from each other and learn from each other. A group that captures good things but also bad things too–if you work across the organization . . . (I4)

The empirical data illustrates that affective collectivism does not allow for abilities, skills and accumulated knowledge to be shared outside groups. Instead, many managers hold on to their beliefs or struggle to share them with those close. This holding of belief is a contradictory behavior, as some of the informants stated that the sharing of accumulated knowledge is an important task:

> There is probably a lot for free. We do not have to reinvent the wheel; enlist the help of other projects around the business within Alfa [pseudonym]. It is a huge company; if you can use everything around here, it is almost a digitization project to capture what already exists. (I4)

The quote above illustrates the hardship of paying attention to different organizational and technological frames. While a sense of togetherness through shared collectivism is taking place, attention is not given to how different configurations and accompanying behaviors may be triggered and the consequences of these understandings—arguing that a better approach could be to understand the spectra of technological frames occurring within the various functions and address the affective collectivism of the entire organization.

The manager's group perception of the Digitalization Project in the organization indicated that they have difficulty formalizing shared meaning. For example, managers expressed that industrial digitalization as a phenomenon still generates many questions on what should be done or not, implicating that the existing frames are not always congruent. In fact, contradictory outcomes are not only due to technological misfits but are also affected by organizational norms, beliefs and routines. The program manager for model-based definition

illustrates the understanding of usefulness (technology strategy and technology in use) as: "*For many individuals, industrial digitalization is merely a large cloud*". However, it is also pointed out that industrial digitalization is a worn-out word that merely holds a political status quo:

> Industrial digitization as a word will have a value for another 3–4 years if we take the political dimension—precisely the power of digitalization. However, I think we will work with the actual doings of digitization for a long time. I believe it will be like a tool among other tools. No one is saying that you work with automation anymore, but in practice, we do. Nevertheless, the word lost validity as a status marker in the early 90s but we are still working with it. (I1A)

The intent to create congruent technological frames cannot only occur in silos. In Alfa, managers describe the organization's guidelines (technology strategy) as aspirational, e.g. having visionary behaviors towards industrial digitalization. However, the coherent view of what type of tone and words should be used in the Digitalization Project was not shared. This indicates that the manager's understanding of industrial digitalization will have an important impact on achieving leverage 3D printing in the AM workshop, but it might not have momentum throughout the organization.

As argued above, shared understanding is essential for sensemaking. Individual managers could share an understanding of why the organization needs to implement digital technologies in smaller coalitions. However, the value of sharing experience was disparate among managers and smaller groups of employees. This disparate sharing of experience can also be interpreted as poor strategy formulation for the Industrial Digitalization project. It could be interpreted that the dividing lines between the individual's understanding of digital technologies and the organizations' application show an incongruent technology strategy frame. In general, the managers' frames of technology in use were very much influenced by the visibility of digital technology. The group manager of digital AM expresses this:

> I think leveraging industrial digitization and solutions becomes clearer when you remember a time when you have not had it; when you expect digitization to be omnipresent, you might easily become blasé. (I9A)

As the above illustrates, managers say that they have found their way of interpreting and following guidelines from the organization, reflecting the lack of sensemaking among the collective. Although managers might be blasé, they have neither succeeded in communicating how they interpret industrial digitalization nor their everyday use. Given that managers at the various functions did not agree or had the same interpretation of strategy and guidelines, the actual use (technology in use) was affected, and a disparate view of the Digitalization Project grew. For example, managers expressed that industrial digitalization as a phenomenon still generates many questions about what should be done or not—implicating that the existing technological frames are not always congruent. In fact, contradictory outcomes are not only due to technological misfits but are also affected by organizational norms, beliefs and routines. The program manager for model-based definition illustrates the understanding of usefulness (technology strategy and technology in use) as: "*For many individuals, industrial digitalization is merely a large cloud*". However, it is also pointed out that industrial digitalization is a worn-out word that merely holds a political status quo:

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The empirical data illustrates that informants do not strive towards mutual sensemaking or make room for accumulated knowledge and variance in interpretations of industrial digitalization. Instead, managers seem to hold on to frames created individually rather than shared collective understandings. The missing act of re-framing the collective understanding was vital for the digitalization project. This line of citations suggests that formulating collective assumptions, knowledge and accumulated knowledge is critical, mainly since socio-cognitive aspects are indicated to shape how managers sense and seize organizational capabilities.

4.4 Structural framing

Two types of boundaries showed: The structural boundary and the emotional boundary, which interchangeably affect one another. Regarding the structural boundary, individuals are experiencing a structural boundary due to a high focus on the technological aspects of implementing digital technologies. The perceived structural boundary within Alfa influenced the technology implementation and technology use. The local managers had the mandate to choose what type of digital technology to engage with or proceed with but often struggled to formulate a business case. Managers formulated the business case process to ease the process of bringing forth digital initiatives. For those going through this process, it was interpreted as a high level of belief in the ability to account for the return on investment and a high level of belief in the trial-and-error process. Both in which money is the driving force creating creativity and inertia. Managers' perception of the Digitalization Project indicated that they first saw the usefulness and meaningfulness of leveraging 3D printing. However, they also pointed out that digitalization processes differ from other business development processes. Emphasizing the perceived rigid structural framing:

> I think you have this hierarchical order for a reason. One needs to get through every single manager upward. A project you want to run must be approved at every stage; it must be explained and budgeted. In the end, it becomes too big, and it turns out that you spend more time convincing the managers than you spend on the project itself. The hierarchy is too sluggish. It takes too long (I4)

Regarding the emotional boundary, individuals struggle to affect the meaningfulness of the organization due to too tight or heavy organizational structures. With a high focus on the technical aspects of leveraging 3D printing, managers argued that the actual use (technology in use) was overlooked. One such incongruence could arguably be the perceived meaningfulness and its fit to the structural framing. The chief executive officer describes that the risk of letting the technical aspects rule the structural framing is that you lose the human in it by saying:

> I think we fall into the trap if we let the engineer control too much. You lose the human being. I am kind of an engineer myself. (I1A)

The statement above illustrates that managers struggle to look at problems or structures from a new perspective despite being aware of the complexity. In other words, they do not act as if the socio-cognitive aspects can be merged or even considered in the routines and processes of formulating a Digitalization Project. Alfa's strategy and guidelines did not manage to influence or affect the technological frames of managers. Instead, the collective

frames were influenced by the affections dominant within the organization, which greatly influenced the activity of not wanting to engage in change on various levels. The spectra are reaching from verbally making a standpoint of being against change, and hence not feeling committed, to feeling a bit committed and having made sense of the change. As a result, the emotional boundary depends on individuals' percpetion of the usefulness of digital technologies. The head of the digital production lifecycle management explained how the individuals struggle to perceive the meaningfulness of the organization due to too tight or heavy structures:

> If they were to step into the change and help with the blockade instead, we would have the opportunity also to take care of the local needs. It often happens that the local managers are not contributing, so people get up and sit in the stands and scold the referee instead. I mean, why don't you try to influence it? So it is clear to me that it goes sideways. (I8)

Alfa was more prone to work in silos rather than sharing experience over function and working group. Individuals described an experience of misalignment in communication and competence concerning the individual understanding and the Digitalization Project. Managers described the Digitalization Project provided by the management group as focused on individual use cases:

> We start to have solid use cases that are deployed all over different organizations. We are not only a digitalization department; We have many other functions in Alfa. There are some nice, interesting people with great ideas. Moreover, I see they are also working on their projects, and we are collaborating, exchanging information, and trying to help each other. (I12)

In their respective function, many managers perceive that activities leveraging production are not given more time. Similarly, some managers also express that they do not prioritize such activities, which makes the silo structure more emphasized. Especially topics such as development speed were perceived to require not only competence and upskilling, but a mental shift was interpreted as structurally bound. An important note was the insight that almost every function would answer that resources and competence are lacking. However, not all are prone to formulate a more precise topic. This distress makes an essential base for strategizing organizational capabilities: e.g. Digitalization project.

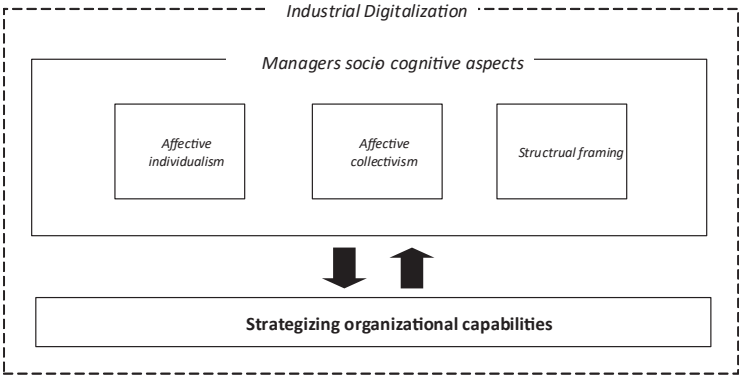
5. Discussion

This case study aimed to explore how strategizing organizational capabilities for industrial digitalization could be understood through managers' perceptions of digital technology applications. Findings show that despite strategies and efforts aiming for an autonomous AM workshop, Alfa failed when overlooking the socio-cognitive aspects. This concurs with previous research that argues that much focus is on industry-level outcomes, while socio-cognitive and intermediate outcomes of strategizing organizational capabilities have been foreseen (Carlsson *et al.*, 2022; Raffaelli *et al.*, 2019). It is argued that the configuration and re-configuration of organizational capabilities are context-dependent and emotionally affected by the setting in which capabilities are formalized and developed, see Figure 3.

As such, strategizing organizational capabilities is recognized to depend on managers' ability to illuminate frames situated in the given context, i.e. the socio-cognitive aspects. The socio-cognitive aspects influencing production managers' frames are herein identified through three themes: Affective individualism, Affective collectivism and structural framing.

5.1 Affective individualism

Managers indicated a solid emotional belief that the AM unit and Alfa are unique compared to the rest of the organization or other manufacturing organizations. Managers sensed their part



Source(s): Authors work

Figure 3.
Overview of managers' socio-cognitive aspects affecting strategizing organizational capabilities

of the organization was unique and acted upon this subjective perception (Demeter *et al.*, 2021). Arguably, the manufacturing management bringing forth the Digitalization Project failed to provide a dominant frame (Orlikowski and Gash, 1994) concerning the usefulness and meaningfulness of leveraging 3D printing. It can be argued that the different managers have access to different parts of the organization and thus have different repertoires of frames (Grover *et al.*, 2022). One explanation is that managers struggled to perceive the meaningfulness of industrial digitalization for the organization due to too tight or heavy organizational structures. Similar results were found in earlier research (Björkdahl, 2020; Colli *et al.*, 2022; Raffaelli *et al.*, 2019). Managers individually formulated responses based on their subjective perceptions rooted in affectivness towards the ability to build, integrate and reconfigure organizational resources. I.e. the perception of how technology can be used in everyday practice and the possible consequences related to this (technology in use) (Eggers and Kaplan, 2013). In turn, managers' affective individualism could affect the ability to recognize shared organizational action (Ocasio, 1997). This could explain the difficulty of diagnosing and prognose problems of organizational capabilities related to industrial digitalization (Mishra and Agarwal, 2010) since emotionally bound individualism formulated separate units (islands) of shared understanding among managers.

Shared understanding in smaller coalitions of managers formulated the means of why and how the organization needed to implement digital technologies. In turn, the smaller coalitions led to a certain use of phrasing to enhance the timeliness and the need for internal funding in business cases. These coalitions led to different understandings of why the organization needs to implement the technology (*technology strategy*), particularly regarding why a technology-induced change was needed. Interviews showed a disparate view of the meaningfulness of digital technologies, such as 3D printing, which again points to the nature of the technology frame domain (cf. Orlikowski and Gash, 1994). As argued in previous research, an organization's response to environmental-driven change, such as industrial digitalization, is affected by managers' subjective perception of the environment, which implies that the existing TF is not always congruent (Orlikowski and Gash, 1994).

5.2 Affective collectivism

Findings recognize that managers strongly believe that ideas and solutions to the Digitalization Project already exist in the organization, along with the potential of information sharing and supporting each other. Most managers recognized the importance

of the collective and emphasized the risk of skepticism and frustration if no affective collectivism were in place. Many of the managers' great knowledge formulated affective collectivism from years of shared experience. It also formulated a systematic perception, concurring with previous research arguing that employees' responses to industrial digitalization depend on their ability to display competency (Solberg *et al.*, 2020). Organizational actions depend on how management allocates attention to information and how such information is interpreted (Ocasio, 1997). Given that action is the last step in the information processing sequence, understanding shared (collective) cognition is needed to tackle industrial digitalization. This understanding, however, did not reach beyond the close working group in Alfa, affecting the managers' interpretation of technology and their understanding of its usefulness and meaningfulness (The nature of technology).

As shown in previous research, the organization must put much effort into sensemaking toward industrial digitalization as a collective (Volberda *et al.*, 2021). This indicates that the manager's understanding of industrial digitalization will have an important impact on strategizing organizational capabilities (cf. Ocasio, 1997), but it might not have momentum throughout the organization. Arguably, the dividing lines between the managers' understanding of digital technologies and the organizations' application show an incongruent technology strategy frame (Orlikowski and Gash, 1994). Although managers might struggle to formulate a collective understanding, they have neither succeeded in communicating how they interpret industrial digitalization nor their everyday use (Young *et al.*, 2016). As organizational action is directly dependent on managers' communication patterns and interpretation of information (Ocasio, 1997), the collective affectedness is perceived to need a stronger shared understanding. This view was interpreted as shared by the company at large, and the perception of technology implementation and technology use (Orlikowski and Gash, 1994) took place at the management level. However, in terms of communicating how to reach the desired value, there is an experience of misalignment in communication and competence.

Given that managers at the various functions did not agree or had the same interpretation of strategy and guidelines, the actual use (technology in use) was affected, and a disparate view of the Digitalization Project grew, which generated emotion-based collectiveness instead. Hence, strategizing organizational capabilities could be understanding the socio-cognitive aspect of shared experiences that ultimately affect the ability to strategize organizational capabilities.

5.3 Structural framing

Managers reported experiencing a structural boundary due to much focus on the technological aspects of implementation and an emotional boundary where individuals struggle to alter the meaningfulness of the organization due to too tight or heavy organizational structures. The perceived structural boundary within Alfa influenced the technology implementation and technology use (Orlikowski and Gash, 1994). Meanwhile, assumptions, knowledge and expectations were much related to emotional bonds, situated in an understanding or interpretation of what meaning or use organizational capabilities have entitled and how they were perceived to be configured or re-configured in relation to the structural framing.

The managers' abilities, skills and accumulated knowledge were captured by the individual or potentially in an employee group. However, neither the individual nor the employee group "reframed" (Orlikowski and Gash, 1994) or seized to re-configure, and as a result, the organization was unable to adjust with the employees or change structural circumstances.

The business case illustrated the managers' perceptions that the organizational structure is too hard to navigate. The technology implementation and technology use (Orlikowski and Gash, 1994) are channeled through a business case, and each individual is responsible for

writing up and conveying their business case. Yet, when the organizational structure became too "*sluggish*", it became a hemming aspect – making managers question the usefulness and meaningfulness of digital technologies.

With a high focus on the technical aspects of leveraging 3D printing, the actual use (technology in use) was argued to be overlooked as the human aspects were not seen (Orlikowski and Gash, 1994). As argued in previous research, incongruences among managers may provide different characteristics of challenges or opportunities; hence, the nature of navigation may shift over time (Carlsson *et al.*, 2022).

6. Conclusion

This single case study drew on the TF framework (Orlikowski and Gash, 1994) to further understand the organizational processes of strategizing. The study aimed to explore how strategizing organizational capabilities for industrial digitalization could be understood through managers' perceptions towards digital technology applications.

6.1 Implication for research

The study has identified three aspects that affect strategizing organizational capabilities: Affective collectivism, Affective individualism and Structural framing. The three aspects show how cognitive aspects may shape the organizational frame and thus affect how managers assemble and recognize strategizing organizational capabilities. More importantly, the emphasis on *affective* indicates that all employees must be able to identify themselves as a vessel for the cognitive frame. The usefulness and meaningfulness must be understood by the individual and recognized through structural and emotional bonds within an organization. It is suggested that the individual not only needs to form an affective bond with digital technologies, but the collective needs shared assumptions, expectations and knowledge of the perceived technology-induced change. Nevertheless, shared understanding should also be promoted from a management perspective, where structural boundaries must be in tune with the shared frame.

6.2 Managerial implications

The study contributes to practice by bringing attention to the disparate view on strategizing organizational capabilities, i.e. capabilities, abilities, and accumulated knowledge. The results could be helpful for practitioners when initiating a digitalization project or initiative. Arguably, early articulation of means, reflection, discussion and daring to re-configure structural constructions may reduce the likelihood of unintended misconceptions or perceptions of organizational capabilities. The ability to strategize organizational capabilities heavily depends on the shared understanding of why the organization needs to implement digital technologies and the structures that allow sharing such means. By illustrating how socio-cognitive aspects shape strategizing organizational capabilities, this study could offer managers valuable insight into the relationship between an organization's capabilities, the individual and the shared cognitive structures affecting technology-induced organizational processes.

6.3 Future research and limitations

The intention was to contribute by illuminating socio-cognitive aspects of managers' perception of reaching for a more prosperous production by interpreting how perceptions of industrial digitalization affect strategizing organizational capabilities. It is recognized that other manufacturing organizations may have a different organizational culture affecting TF. This study only examined the digitalization project related to the AM workshop in Alfa.

There might be limitations due to the single case study approach. However, the intention was to bring forth an in-depth case study analysis contributing to how production managers strategize organizational capabilities for industrial digitalization and not to generalize. Future studies are encouraged to cover multiple cases or even different business sectors to examine socio-cognitive aspects of managers' perceptions further. Distinguishing further structural or emotionally bound aspects may give more information on how a socio-cognitive aspect influences strategizing organizational capabilities within industrial digitalization.

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