After the Plan: An Exploration of the Digitalization Application Barriers

Completed Research

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Abstract

This qualitative exploration study based on interviews analyses the situation of three organizations having started a digital transformation. Professional surveys and research projects hint that organizations are stagnating in the realization of their digital strategies and roadmaps. We seek to uncover where the organizations face barriers. Findings suggest that some barriers are elements that would be better planned before starting the digitalization, like knowledge of an organization’s core values and a digitalization vision. Others represent opportunities to adapt to emergent change, such as the development of agile business capabilities and flexibility in the strategic objectives. This study leads to the formulation of seven research propositions to guide future studies on the organizational change induced by the digitalization.

Keywords

Digitalization, digital transformation, roadmap, strategy, organizational change.

Introduction

Managers of German enterprises do not evaluate they are closer to their digitalization goals than two years ago (“Bitkom Digital Office Index 2018” 2018). According to a 2018 study of more than one thousand respondents, the average self-evaluation level of their state of digitalization was 5 out of 10, the same as in 2016. This paper aims at exploring the reasons behind this stagnation, in particular whether there are barriers to the transformation, where these might be and whether they can be planned. Several explanations are given in the professional survey, including the scarcity of financial and human resources, data security issues and how enterprises have difficulties applying the strategies and roadmap they developed (“Bitkom Digital Office Index 2018” 2018). This observation was also made by several researchers who note the lack of studies to address this gap (Issa et al. 2018; Liere-Netheler, Vogelsang, et al. 2018; Vogelsang et al. 2019).

Previous research on the digitalization examine the motivations to a transformation. Internal drivers seem to be the dominant motivation, notably the desire to improve processes, the workplace environment, and the vertical integration of information (Liere-Netheler, Packmohr, et al. 2018). Reflections on changes to management practices are formulated (Shamim et al. 2016). What constitute a successful digitalization is also studied, with dimensions such as a strategy, data integration and stakeholders interest (Liere-Netheler, Vogelsang, et al. 2018). Challenges are identified by some researchers (Erol et al. 2016; Pessl et al. 2017), but few studies focus on the barriers to the digital transformation (Vogelsang et al. 2019), and these barriers are studied in a general digital transformation context. To the best of our knowledge, the identification of the areas where enterprises struggle in their digitalization plan was not studied and few studies have adopted a change management point of view (Bordeleau and Felden 2019). Therefore, this study aims to answer the following: where are companies facing barriers in the application of their digital plan? We wish to highlight the context surrounding these struggles, to be able to formulate research propositions. This paper contributes to the discussion by providing propositions to allow researchers to design future studies. They also support companies in the identification of barriers to face to have a better success with their digitalization. The paper starts with the previous studies on the initial steps and the barriers to the digitalization. Then come the research design, the narrative of each enterprise and the cross-case analysis.
Previous Studies

Previous studies have different definitions of the digitalization. We present some, along with studies about change management and the start of the digitalization. Then, we summarize the literature on the barriers that companies face in their digitalization. This resulting theory is used as an analysis tool for the interviews.

Defining the transformation

There is an agreement in the scientific literature on some staples of the digital transformation and Industry 4.0: the integration of data across the organization and the increased collaboration between human and cyber-physical systems (Liére-Netheler, Vogelsang, et al. 2018; Schneider 2018). For some, “Industry 4.0” is the German branding of the larger digital transformation phenomenon (Issa et al. 2018; Liére-Netheler, Packmohr, et al. 2018). Schallmo et al. (2017) studied several definitions of the digital transformation before settling on networking, analytical capabilities, the application of technologies, and the development of skills to increase business performance. They consider “digitalization” to be a synonym of “digital transformation”. Finally, Liére-Netheler et al. (2018) focus on the change of paradigm concerning business processes. For this study, we adopt the definitions of Schallmo et al. (2017) and Liére-Netheler et al. (2018).

Change management in the digitalization

In the change management literature, a distinction is made between planned approaches, which see change as a predictable event that can be managed through a series of steps, and emergent approaches, which state that change should be facilitated rather than managed, since it is not predictable (Bamford and Forrester 2003). Both approaches are represented in the change literature specific to the digitalization, for example steps suggesting to “initiate, analyze, debate and act” (Hansen et al. 2011) and facilitating conditions, as “discover, make a path, transform” (Trübswetter et al. 2018). Few arguments are made as to why one is more appropriate than the other in a given context (Bordeleau and Felden 2019). Change management approaches aim to succeed in the implementation of change initiatives (Bamford and Forrester 2003).

Starting the transformation

Digital strategies date back to the first computers, but are adapted to integrate business processes supported by digital technologies (Schallmo et al. 2017; Vogelsang et al. 2018). Digitalization projects represent large investments and a high level of uncertainty for organizations, thus a structured approach in their first steps can help mitigate the risks of failures (Erol et al. 2016). Several approaches are suggested in the literature, such as a vision, strategy through a roadmap and a list of projects (Erol et al. 2016) or steps including a digitalization assessment and the identification of use cases in line with the strategy (Issa et al. 2018). Another process is articulated around the analysis of the current situation and the definition of targets and projects (Pessl et al. 2017). As seen above, the first steps of digitalization are often the establishment of a vision, the formulation of a strategy, and the planification of several projects in a roadmap. These components are referred to as “digital plan” in this study.

Several problems hinder the digital plans. They are defined as barriers and can of a technical, individual, organizational, or environmental nature (Vogelsang et al. 2019). New technologies bring concerns of fit with the organization’s strategy and competencies (Pelletier and Cloutier 2019). While they can learn from successful organizations near them (Hansen et al. 2011) or from internal and external IT specialists (Pelletier and Cloutier 2019), organizations also benefit from an assessment of their readiness to digitalization before starting the projects (Erol et al. 2016; Issa et al. 2018; Pessl et al. 2017), among other change management approach available in a digitalization context (Bordeleau and Felden 2019).

The identification of the areas where enterprises face difficulties, to the best of our knowledge, has not been made before. Vogelsang et al. (2018) studied the implementation of the digitalization across the value chain activities. Others studied the elements of the business models that are impacted by the digital transformation (Teece and Linden 2017). Most focused on one element, such as the strategy (Erol et al. 2016). In a previous study of the literature (Bordeleau and Felden 2019), we identified the following subjects as areas of study of the digitalization: business processes, business models, managerial practices, strategy, enterprise architecture, organizational structure, and organizational culture, in order of the number of articles studying the subject. These seed subjects are represented in Figure 1.
The above subjects are used for the interviews, to encourage discussion on specific subjects rather than the larger digitalization theme. They are business aspects that change as part of the digitalization. Barriers can appear for any of these subjects. This study will explore which kind of barriers can appear in which area, and whether they are better solved by a careful planification or by adapting to emergent change.

**Research design**

This exploratory qualitative study aims at discovering the areas in which some companies struggle in the application of digitalization projects once they have established a plan, and the context leading to these struggles. In the information systems field, qualitative research based on interviews can orient research objective towards a greater relevance for the practice, because it helps develop a deep understanding of the business environment (Conboy et al. 2012). Interviews in business research are useful to generate research propositions to guide future studies (Bryman et al. 2011). Multiple cases are suitable to understand the context leading to observations, especially when relying on representative or typical cases (Yin 2009).

We led three interviews in three organizations, which were chosen based on personal contacts to cover different industrial sectors, geographic locations and stage in their digitalization. The organizations were coded GER1 and GER2 for those situated in Germany and CAN1 for the Canadian organization. Organizations from at least two countries help limit eventual cultural bias. We interviewed one representative from the management team dedicated to the digitalization for GER1 and CAN1. For GER2, we interviewed together a manager of Information Technology and a manager for the Digitalization team, at their request. All interviewees have been working for these organizations for more than two years, and all but one of the GER2 interviewees have more than 5 years of experience in their current positions. Organizations were purposefully chosen to reflect different stages of completeness of their digitalization objectives and different geographical areas, to explore different context (Yin 2009). The description of the organizations is presented in Table 1.

<table>
<thead>
<tr>
<th>Industrial sector</th>
<th>GER1</th>
<th>GER2</th>
<th>CAN1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geographic location</td>
<td>Germany</td>
<td>Germany</td>
<td>Canada</td>
</tr>
<tr>
<td>Interviewee</td>
<td>Digitalization project manager (one among a team)</td>
<td>IT manager and digitalization coordinator</td>
<td>Digitalization project manager (only one)</td>
</tr>
<tr>
<td>Transformation</td>
<td>Highly structured</td>
<td>Low structure</td>
<td>Aim to structure</td>
</tr>
</tbody>
</table>

**Table 1. Description of the interviewed organizations**

The interviews were unstructured, with the seed concepts used to trigger conversation on a subject (Bryman et al. 2011). Interviews lasted approximately one hour and notes were taken by two interviewers when possible. Interviews were started with an introduction question of the type “what is the digitalization for your organization” and the different seed concepts were introduced as follow-up questions as they were mentioned, or as direct questions if it was not mentioned. For instance, a mention of the digitalization of systems field, qualitative research based on interviews can orient research objective towards a greater relevance for the practice, because it helps develop a deep understanding of the business environment (Conboy et al. 2012). Interviews in business research are useful to generate research propositions to guide future studies (Bryman et al. 2011). Multiple cases are suitable to understand the context leading to observations, especially when relying on representative or typical cases (Yin 2009).
the two main change management perspective of the planned and emergent change. Research proposition emerge for some of the seed concepts and are presented in the discussion.

Interviews

**GER1**

This manufacturing company is based in Germany. The interviewee has an IT background, is a representative from the department of digitalization and is in charge of several digitalization projects across the organization. The digitalization efforts started in this company in 2015. Of all three companies, it is the one with the longest ongoing digital transformation, and the company with the most structured and planned transformation. Consultants were hired to help develop a digital strategy, which was then declined into a roadmap and several projects by the internal digital department. The director of this department reports directly to the board, in an effort to push the digital transformation projects. Several projects, notably in the manufacturing activities, were successful, however after three years the members of the board realize they are behind in the completion of their roadmap. This was especially true in the administrative and support processes. They wish to reorient their digitalization efforts, but do not know how to do it. They rely on trials and errors in the application of the roadmap and the digital strategy. Their latest effort implies the nomination of “digital ambassadors” inside the departments. However, there are concerns inside the digital department that the roles and responsibilities of these ambassadors were not sufficiently defined. These ambassadors should help employees and managers understand the need to transform their processes and adopt the digital technologies, but have not been in place long enough as of the interviews to see significant results.

This company operates in a traditional and low-regulated manufacturing industry. Analytics technologies are used to complement existing products with new data-based services. The company is performing well in several of their traditional segments. They are less competitive in the segment of the new services. Since the services represent only a small portion of their revenues, the employees and several managers perceive little pressure to adopt the digitalization, especially of the administrative processes. The company does not perceive an immediate threat by their competitors in this domain; rather, they estimate their direct competitors are in a similar position regarding digitalization. Additionally, the company receives many orders, which pressures employees and gives them the impression that there is little remaining time for improvement projects, as the digitalization is perceived. Finally, while there is a pressure by the management to digitalize the processes directly linked to the customers, purely internal processes are still nondigital, or digital but not integrated.

The company is structured in hierarchical and siloed departments. Managers want to share information across the departments, but the structures are not always in place and the departments are not well informed on the needs of the other departments. Managers are generally committed to digitalization and understand the need to change. However, this commitment sometimes stops when their business processes are concerned. The automation of manual administrative processes is especially difficult to accept for the concerned managers, which means the general acceptance for the administrative employees is also low. The digital department reports complaints of lack of time, change for the sake of change, and fears that the period of transition would impact the customers, something the company cannot afford. When asked to identify the areas where the company faced the biggest struggles in their digitalization, the interviewee immediately cites the culture, and especially the mindsets of the managers and the employees.

<table>
<thead>
<tr>
<th>Digital plan</th>
<th>Established; in reevaluation following the low completion rate of the roadmap.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business model</td>
<td>Objectives are set and accepted.</td>
</tr>
<tr>
<td>Organizational culture</td>
<td>Identified as a major issue, especially the mindsets of some managers and employees who do not want to change their practices.</td>
</tr>
<tr>
<td>Organizational structure</td>
<td>Identified as a minor issue, especially rigid and siloed structure.</td>
</tr>
<tr>
<td>Enterprise architecture</td>
<td>Not identified as an issue.</td>
</tr>
<tr>
<td>Management practices</td>
<td>Not identified as an issue.</td>
</tr>
<tr>
<td>Business processes</td>
<td>Is identified as a major opportunity, but changes are blocked by the culture.</td>
</tr>
</tbody>
</table>
Workshops, discussion sessions and specific training was seen as a way to reduce undesirable tasks. To help with individual change resistance factors, they organize the automation of administrative processes, and workers resistance was not an issue since the projects were mostly driven by the business units, with IT professionals in support. Projects include the implementation of new intranet, or the consolidation of several chat tools into a single application. This approach gives a greater transparency as all business units are aware of all the projects. It also changes the role of the managers, reduces micro-management and facilitates the flattening of the hierarchy since power is decentralized. This organizational form is not used to its maximum potential; one of the objectives is to consolidate the tools used by the business units. The idea is to apply the lean principles of waste reduction and optimization of existing capacity, but at the same time being more agile and innovative. They aim to be strong in what they see as the two extremes of an axis, but not somewhere in the middle.

Their digitalization effort is centralized around a team which acts as a steering committee. Business units submit their ideas, which are approved by the steering committee. Objectives are sets: quantitative or qualitative goals, and learning opportunities which should be investigated. Projects are led in an agile-inspired way, in sprints, with a total project duration of three months. Project leaders and team members mostly come from the business units, with IT professionals in support. Projects include the implementation of new intranet, or the consolidation of several chat tools into a single application. This approach gives a greater transparency as all business units are aware of all the projects. It also changes the role of the managers, reduces micro-management and facilitates the flattening of the hierarchy since power is decentralized. This organizational form is not used to its maximum potential; one of the objectives is to consolidate the tools used by the business units. The idea is to apply the lean principles of waste reduction and optimization of existing capacity, but at the same time being more agile and innovative. They aim to be strong in what they see as the two extremes of an axis, but not somewhere in the middle.

At the time of the interview, there is no global vision or strategy leading the digitalization projects in all the organization. Late in the interview, after several questions, the interviewees recall a set of general objectives initially given by the senior management. This confidential document serves as general guidelines for the organization. Late in the interview, after several questions, the interviewees recall a set of general objectives initially given by the senior management. This confidential document serves as general guidelines for the organization. Thus, they see the digitalization as an opportunity to modify their organizational structure and managerial practices, with technology as support to these changes. Their other motivation to organize their digitalizing efforts was to keep up with their mother company, as an internal will rather than a pressure. In the last 20 years, the IT manager from this company considers they have done a lot in the domain of digitalization. The manual processes were digitalized; some were automated. Over the years, they have built and maintained an extensive IT infrastructure. This infrastructure is not used to its maximum potential; one of the objectives is to consolidate the tools used by the business units. The idea is to apply the lean principles of waste reduction and optimization of existing capacity, but at the same time being more agile and innovative. They aim to be strong in what they see as the two extremes of an axis, but not somewhere in the middle.

User resistance to change was evaluated early as a major potential barrier. However, in projects involving the automation of administrative processes, workers resistance was not an issue since the projects were seen as a way to reduce undesirable tasks. To help with individual change resistance factors, they organize workshops, discussion sessions and specific training when needed. They do not measure directly the

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**Table 2. Interview Summary, GER1**

The statements of the digital department representative according to the study’s dimensions for GER1 are summarized in Table 2. The relative evaluation of the issues represents the perception of the interviewee.

**GER2**

Based in Germany, this energy utility company considers the digitalization as a shift in the relationship between IT and business units, which is a unique view amongst the three interviewed company. One of the interviewees in an IT manager, the other is a project manager from an information management background. Until recently, IT was seen as a support unit. Recently, they wondered if the agile way the IT units were managed could be beneficial to the entire organization. Thus, they see the digitalization as an opportunity to modify their organizational structure and managerial practices, with technology as support to these changes. Their other motivation to organize their digitalizing efforts was to keep up with their mother company, as an internal will rather than a pressure. In the last 20 years, the IT manager from this company considers they have done a lot in the domain of digitalization. The manual processes were digitalized; some were automated. Over the years, they have built and maintained an extensive IT infrastructure. This infrastructure is not used to its maximum potential; one of the objectives is to consolidate the tools used by the business units. The idea is to apply the lean principles of waste reduction and optimization of existing capacity, but at the same time being more agile and innovative. They aim to be strong in what they see as the two extremes of an axis, but not somewhere in the middle.

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At the time of the interview, there is no global vision or strategy leading the digitalization projects in all the organization. Late in the interview, after several questions, the interviewees recall a set of general objectives initially given by the senior management. This confidential document serves as general guidelines for the selection or projects and the establishment of objectives, but it is too vague to be considered a digital vision. This was a conscious choice by this organization, to start projects before a vision is formed. As of yet, it is too early to evaluate if this choice will lead to a greater transformation.

<table>
<thead>
<tr>
<th>Digital plan</th>
<th>Initial objectives defined by the management. No formal plan outside of these.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business model</td>
<td>Business units are master of their business models. Digitalization supports the units.</td>
</tr>
<tr>
<td>Organizational culture</td>
<td>Some elements of culture were identified as barriers, but there is a wish to keep the central cultural elements of the organization unchanged. Which elements are central remains to be determined.</td>
</tr>
<tr>
<td>Organizational structure</td>
<td>Modified to accommodate agile projects and change management; still in progress.</td>
</tr>
<tr>
<td>Enterprise architecture</td>
<td>Is considered well managed before the digitalization effort. Is not seen as a barrier.</td>
</tr>
<tr>
<td>Management practices</td>
<td>One of the biggest areas that needs to change, with agile management influencing managers in several of their responsibilities.</td>
</tr>
<tr>
<td>Business processes</td>
<td>Are the responsibility of the business units. If changes are needed, business units must bring the desired changes to the steering committee.</td>
</tr>
</tbody>
</table>

**Table 3. Interview Summary, GER2**

User resistance to change was evaluated early as a major potential barrier. However, in projects involving the automation of administrative processes, workers resistance was not an issue since the projects were seen as a way to reduce undesirable tasks. To help with individual change resistance factors, they organize workshops, discussion sessions and specific training when needed. They do not measure directly the
satisfaction of the users, but plan to incorporate elements like perceived usefulness in the objectives of future projects. A summary of the interview is presented in Table 3.

**CAN1**

This Canadian company operates in the logistics and manufacturing sectors. The interviewee, which identifies himself a business administration professional, is in charge of the digital strategy. The company has just started looking into Industry 4.0 and smart technologies, they are thus the less advanced in their transformation. They are interested in the potential for the production and the customer relationship. The board does not feel external pressure. Their competitors have not implemented advanced technologies and their customers do not request data-based services. They wonder if the talks of digitalization in the media and in professional gatherings really translate to changes in local businesses, since they are not aware of companies outside of “showcases” that have implemented Internet of Things in their processes. They categorize digitalization and Industry 4.0 projects as Internet of Things applications that should be carefully evaluated, if possible in the context of management research projects, before they can become a business reality. The digital manager mentions that the technologies showcased in the Industry 4.0 examples are not new themselves, it is their business application that makes them potentially innovative.

The board looks positively to the potentials of the Internet of Things, analytics and automation. They suspect these can lead to increased productivity and operational efficiency, but are looking into the best way to deploy the technologies. The upper managers have what the digital manager describes as a conservative and cautious mindset, characterized by the idiom “if it isn’t broken, don’t fix it”. Before they grant budget to a technology-related project, they wish to see a strong business case and a risk and benefits analysis. This is why the digital manager has identified two key areas for digital projects in the roadmap he submitted to the board: improvement of the customer relationship through the offer of additional services, mainly logistics decisions support and order tracking information, and the introduction of information tracking in the production processes to improve productivity and efficiency. These two areas are well publicized in the professional literature and are often presented as example cases by consulting firms. The business case and return on investment analysis would thus be easier to make than more niche applications where less documentation is available. The digital managers think they should eventually look into operations management processes, but does not think there is a great business potential in the digitalization of administrative processes, once an organization has an ERP and uses it.

<table>
<thead>
<tr>
<th>Digital plan</th>
<th>Not looking for a formal strategy, rather a vision and a project roadmap.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business model</td>
<td>Believes Industry 4.0 doesn’t impact the business model, only complements it.</td>
</tr>
<tr>
<td>Organizational culture</td>
<td>Not identified as an issue.</td>
</tr>
<tr>
<td>Organizational structure</td>
<td>Not identified as an issue.</td>
</tr>
<tr>
<td>Enterprise architecture</td>
<td>Indirectly a critical point (integration of data and software, compatible solutions).</td>
</tr>
<tr>
<td>Management practices</td>
<td>Can become an issue if the middle management does not accept the projects.</td>
</tr>
<tr>
<td>Business processes</td>
<td>Can become an issue if employees and managers perceive a loss of control.</td>
</tr>
</tbody>
</table>

**Table 4. Interview Summary, CAN1**

The digital manager has the full support of the upper management. At the beginning of the interview, he mentions believing this support would be enough to eliminate all change resistance from the employees and the middle management, since they would have no choice but to acknowledge the desire of the upper management. However, throughout the discussion he recalls past projects where the production management showed opposition when the project caused them to lose some control over the operations. This manager would be the first concerned by the improvement projects to the operations. They could feel the digitalization of the management of the production activities gives them less control over the information. The digital manager recognizes by the end of the interview that this could become a major issue. He does not, however, know how to deal with this situation proactively and assumes he will have to show the production manager how their job would be made easier by Internet of Things applications. When the production manager realizes the digitalization will improve the productivity of the department, they will accept the changes. Table 4 summarizes the statements of the digital manager.
Discussion

A recurring point in the three interviews is the lack of knowledge on some subjects and the desire to learn how to overcome the barriers and have success in their digitalization. In this analysis, we attempt to distinguish between elements that should be planned, in opposition with elements that requires flexibility and would benefit from an emergent approach. This latter category implies the need to learn how to change, while the first category implies a greater preparation phase. These are presented in Table 5 and are discussed in this section.

<table>
<thead>
<tr>
<th>Business areas</th>
<th>Planned approach</th>
<th>Emergent approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital plan</td>
<td>( P_1: ) Vision, goals, initial strategy</td>
<td>( P_5: ) Flexibility in strategic goals</td>
</tr>
<tr>
<td>Business model</td>
<td>( P_2: ) Desired business model</td>
<td></td>
</tr>
<tr>
<td>Organizational culture</td>
<td>( P_3: ) Core values</td>
<td></td>
</tr>
<tr>
<td>Organizational structure</td>
<td>( P_4: ) Bottom-up project suggestion</td>
<td>( P_6: ) Agile structures</td>
</tr>
<tr>
<td>Management practices</td>
<td>( P_7: ) Decision-making style, acceptance</td>
<td></td>
</tr>
</tbody>
</table>

Table 5. Elements of planned and emergent change

**Planned change**

**Proposition 1:** A vision, goals and an initial strategy are necessary to a successful digitalization. The interviewees have different formalisms in the definition of the digitalization objectives. While GER1 defined a vision, a strategy and a project roadmap, GER2 only defined four general values. In the middle, CAN1 is looking to formulate a vision and a project roadmap but without a fixed strategy. Arguments for the establishment of a formalized vision and a strategy include an easier communication and increased transparency with employees and stakeholders (Erol et al. 2016). It also facilitates the management of the digitalization projects and track the success of the initiatives (Erol et al. 2016; Pessl et al. 2017). In the absence of a planned vision and strategy, GER2 starts a lot of projects but these and not necessarily related to each other and the interviewees have trouble precisng how these projects can help the organization reach their goals. In the long term, this could lead to missing some objectives of the digitalization.

**Proposition 2:** A planned business model is necessary to a successful digitalization. The business model also seems to be defined in the initial steps. CAN1 and GER1 have identified that their business model will essentially stay the same, but their existing offer will be complemented with new data-based services. In the case of GER2, the business models are the property of the units, and thus not under the responsibility of the digitalization team. In all cases, the reflection and changes to the desired business model were made before or during the initial preparation to the digitalization, which is a good practice previously identified in the literature to ensure that the changes will be profitable (Teece and Linden 2017).

**Proposition 3:** Identifying the core values is necessary to a successful digitalization. The major barrier to the digitalization as seen by GER1 is a lack of information-sharing culture. Almost on the contrary, in GER2, no targets for a change of culture were identified. They know that some core values will not be changed, but have to identify which. This uncertainty poses the same risks as not having clear objectives: risking wasting resources in initiatives not supporting the organizational goals. Furthermore, organizational culture is a notable factor influencing the change initiative (Bamford and Forrester 2003), and thus, identifying the change management approach that would be successful. These elements lead to the following proposition. Based on these observations, we suggest that changing the organizational culture is less important than making sure there is an alignment between the core values of the organization and its digitalization vision.

**Proposition 4:** A bottom-up structure for projects’ suggestion is necessary to a successful digitalization. In all three enterprises, changes to the management style, including decision making, and on the business processes, including automation, were initially estimated to be faced with human resistance to change. CAN1 mentions opposition of the production manager to changes in their decision power. GER1 reports that managers opposed to changes in the processes they supervise and named digital ambassador to alleviate this opposition. GER2 hired a specialist and organized workshops to alleviate resistance to change, but still expected resistance to automation in administrative processes. The assumption, supported by the literature, is that workers will fear a loss of control and changes in their responsibilities (Vogelsang et al. 2019). The identified solution is to involve workers in the discussions, and if possible the decisions (Trübswetter et al. 2018). However, in the case of GER2, workers were delighted rather than afraid of the
changes. The interviewees attribute this to a real improvement in the work-life of the impacted employees. GER2 has a bottom-up approach to the digital transformation, where each unit and team can submit projects, so a greater alignment between the digitalization projects and the workers’ needs is to be expected. The surprise of the digitalization team to the absence of change resistance leads to believe that the digitalization is perceived, at least in this organization, as a conflict area between workers and management. User acceptance is facilitated with genuine participation of employees, which include the employees in the suggestion and the selection of projects rather than being only consulted (Trübswetter et al. 2018).

Traditional change management literature states that in a fast moving and unpredictable environment, such as the current context, planned approaches to change are outdated and don’t lead to durable change (Bamford and Forrester 2003). However, change literature specific to the digitalization include several planned approaches (Bordeleau and Felden 2019) and it seems appropriate for some specific subjects, such as the establishment of initial vision and desired business model. In the context of internet-based business models, it is easy for companies to set aside profitability goals, but it is not a sustainable approach (Teece and Linden 2017). Planned approaches also include employees early on, by including structures to gather their needs and their suggestions as well as ensuring the core values of the organization are respected.

**Emergent change**

**Proposition 5:** A digitalization strategy that evolves is necessary to a successful digitalization. GER1 realized after three years that their objectives would not be reached. This left them in an unknown and uncomfortable situation, knowing that starting the strategy elaboration process again would be long and costly. Thus, while the process gave them a systematic and detailed view of their objectives, it also forced some rigidity in their transformation process, which are the downfalls warned about by the critics of the planned approaches (Bamford and Forrester 2003). The digitalization manager from GER2 mentioned a desire to stay agile, to identify the final goals as the projects are deployed, as the main reason to not establish a digital strategy and a roadmap. Early conceptual research suggests shorter technological development cycle and long term development of capabilities facilitates a greater compatibility with the principles of Industry 4.0 (Shamim et al. 2016). In exchange, it makes the management of the digitalization more difficult, by potentially pursuing projects not directly linked to the business strategy or by continuing projects not supporting the business objectives (Vogelsang et al. 2018). In summary, a rigid strategy can inhibit an organization’s adaptability to the digital transformation, while no strategy can waste resources and projects not relevant for the organizational goals.

**Proposition 6:** Flexible organizational structures are necessary to a successful digitalization. In industrial history, organizations oscillated between structured and organized forms, represented by the metaphor of a well-oiled machine, and flexible, changing and in harmony with their environment forms, metaphorically described as organisms (Shamim et al. 2016). An organic form is thought to be more appropriate in periods of change and uncertainty such as an industrial transformation era, while a mechanistic form allows for high performance in periods of stability (Shamim et al. 2016). Influenced by agile practices developed in IT management, several traditionally, or mechanically, organized enterprises are adopting agile team organizations and project management based on cross-functional teams (Gerster et al. 2019). It also allows to be more open to bottom-up change, which is a characteristic of emergent approaches (Bamford and Forrester 2003). This implies that organizations stay alert to emerging conditions more favorable to agile structure. However, as is the case of GER2, the only organization in this study that engaged in structure changes, there are no longitudinal studies to determine whether agile organization structures are a long-term transformation or a transition. The interviewee of GER2 state that their digitalization is a change program with a fixed end date, but made no mention of whether the new structures will stay after the transformation, if it will revert to a more traditional structure, or if something else will emerge.

**Proposition 7:** Agile management and decentralization of decisions are necessary to a successful digitalization. In addition to flexible structures, decentralized decision-making process contributed in GER2 to a greater success in the projects, notably by reducing the load of the middle managers and micro-management, empowering employees to make suggestion improving their work conditions and allowing for a flatter hierarchy. In opposition, the will to keep a centralized decision in CAN1 is translated in a potentially greater opposition of the middle management caused by a perceived lack of power and in GER1 by a lack of information sharing. There are preliminary evidence that agile management in business units increases organizational flexibility (Gerster et al. 2019), a potential contributor to digitalization success.
It has been suggested that instead of replacing the planned approach to change, the emergent approach is a complement that represents a view of change as a “becoming” exercise (Liebhart and Garcia-Lorenzo 2010). Managers intuitively understand that continuous change as described by the emergent view can be facilitated by bottom-up decision making as is the case with GER2 to increase the chances of success. They also understand that a transformation is not indefinitely ongoing, as mentioned by both GER1 and GER2, and the projects will eventually need to conclude to reap the expected benefits. Questions remains as to whether managers can effectively differentiate between the context more appropriate for a rigid planification or for adaptability to emergent conditions. The paradox of the digital strategy is an example. Evidence from the literature show that there are benefits to a formalized planification of the digital transformation (Erol et al. 2016). The absence of such a planification means that the managers responsible for the digitalization in GER2 have difficulties in demonstrating how the current projects will help the organization achieve its goals. Yet, there is also evidence that companies are either slow to complete their objectives or cannot achieve their goals (“Bitkom Digital Office Index 2018” 2018), as the case of GER1 illustrates. In conclusion, if initial planning seems necessary, there comes a moment where the internal and external environment have changed enough that the strategy needs to be adapted. Questions remains on the degree of flexibility required and what are the appropriate methods to manage the adaptation of the strategy and subsequently its realization.

Similar questions remain considering the level of user participation and the degree of decision decentralization. Planned approaches typically rely on a project manager, which leaves little decision power to employees (Bamford and Forrester 2003). GER2 has try to reap the benefits of employee participation by introducing structures to allow the employees to have an active role in the projects, and thus improve acceptance (Trübswetter et al. 2018). The downsize is the potential loss of focus, since there is no central plan to make sure the change initiatives focus on the organizational goals. Emergence should not be used as a mechanism to increase the burden of responsibility on employees, but rather to encourage a view of the world where the organizations and individuals interact in a positive way to create a better future in which stability and a level of planification remain critical elements (Liebhart and Garcia-Lorenzo 2010).

Contributions and conclusion

Organizations apply their digital plans and face barriers. They need to identify change management approaches to overcome these barriers, but these approaches have limited impact. We aim to help organizations identify where their barriers really are and of what nature, to eventually choose an appropriate change management approach. We interviewed digital managers in three organizations of various industrial sector and geographical area about their digitalization activities and the challenges they face. We analyzed the three cases according to key business areas and formulated seven research propositions organized around the two classical approaches to change management, planned and emergent change. We notably suggest that although a digital vision and a strategy are essential starting points, some flexibility to modify strategic objectives along the way is beneficial. Regarding organizational structure, incorporating more flexibility can help overcome additional barriers that were not controlled by the human and technological aspects. Finally, organizations do not take the sufficient time to identify their core values around which to organize their digital transformation. By splitting the research propositions, we answer our research question by helping managers to orient their change management approach.

The contribution of this study is as follow. From a research point of view, this study helps understand the context behind the barriers to the transformation, and gives research proposition to highlight research opportunities. Managers can gain a better understanding of their own situation. The results of this study must however be considered carefully, due to the low number of enterprises interviewed. Future studies could aim at a further exploration surrounding the research propositions, with qualitative and quantitative methods, and relate the barriers to appropriate change management approaches.

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