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Digitalization Canvas – Towards Identifying Digitalization Use Cases and Projects

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Abstract: Nowadays, many companies are running digitalization initiatives or are planning to do so. There exist various models to evaluate the digitalization potential of a company and to define the maturity level of a company in exploiting digitalization technologies summarized under buzzwords such as Big Data, Artificial Intelligence (AI), Deep Learning, and the Industrial Internet of Things (IIoT). While platforms, protocols, patterns, technical implementations, and standards are in place to adopt these technologies, small- to medium-sized enterprises (SME) still struggle with digitalization. This is because it is hard to identify the most beneficial projects with manageable cost, limited resources and restricted know-how. In the present paper, we describe a real-life project where digitalization use cases have been identified, evaluated, and prioritized with respect to benefits and costs. This effort led to a portfolio of projects, some with quick and easy wins and some others with mid- to long-term benefits. From our experiences, we extracted a general approach that could be useful for other SMEs to identify concrete digitalization activities and to define projects implementing their digital transformation. The results are summarized in a *Digitalization Canvas*.

Keywords: Digitalization, Business Process Management, Big Data, Machine Learning
Categories: E.m, H.4.m

1 Introduction

Digitalization is often expected to lead to *disruptive* innovations. Markides distinguishes disruptive technological, business model, and radical product innovations [see Markides 2006]. He defines disruptive business model innovation as the discovery of a fundamentally different business model in an existing industry, e.g., as Amazon did in book selling. This means that a business model innovator does not invent a new business model, but instead that an existing product or service is

redefined. Radical product or service innovations create products that are new to the world, e.g., mobile phones and drones establishing new devices, or Facebook establishing social media. They change value propositions and consumer behavior in major ways. Such innovations are disruptive to existing businesses and allow for improvements through automation and optimization, as well as for new business models. Usually, digitalization in SMEs does not lead to disruptive innovations and disruptive business models cannot be applied one-to-one on SMEs. But considering the principles and analyzing the business models of Uber, Facebook and co. can be useful to identify opportunities and new options for an SME's existing business.

However, companies—especially small- to medium-sized ones—face a lot of more fundamental and basic challenges on their digital transformation path. New competitors in their current business, new technologies, and new business models lead to many and often big changes on the existing business processes. This changes the structures, the roles and the required know-how, affects the people in the organization, and requires careful change management. Companies can measure their digital maturity with models like Digital Maturity Model – University of St. Gallen [see Back and Berghaus 2016] but when it comes to the concrete implementation of digitalization, they struggle with many questions:

- What to digitalize, which technologies to use?
- What to do first, how to do it and then how to proceed?
- Which changes in the organization are needed with respect to skills and roles?

Gartner distinguishes between digitization and digitalization: "Digitization is the process of changing from analogue to digital form", [Gartner 2017a]. "Digitalization is the use of digital technologies to improve the existing business model and create new revenue and value adding opportunities", [Gartner 2017b].

Digitization is required for successful digitalization to implement or to support business processes by software: Obviously, improved and new business models rely heavily on automated processes managing large user groups at low transaction costs and with as little human interaction as possible. Business Process Management (BPM) requires data and communication of data to be digital, in order to avoid media gaps, e.g., if a document is sent by fax and has to be digitized before it can be processed further. For many years, automation and software-controlled processes have constituted an essential part of BPM in companies in, e.g., the finance, manufacturing or logistics industry. With the new technologies there is a huge potential for improvements and higher automation levels. In short, business strategies and processes drive digitization that possibly impacts the entire value chain. It improves existing business processes and creates new business models and opportunities. We thus recommend a *top-down* approach to create a portfolio of digitalization projects.

On the other hand, available data sources and the technologies to exploit them open up new business opportunities which business strategists did not anticipate. Data is considered to be the new oil for the industry. Users consume services from companies and provide their data instead of paying. For instance, Facebook or Google provide their services for free, but users pay with their private information. With the new digitalization technologies, e.g., (I)IoT, more and more data is collected. On these data sources, machine learning and artificial intelligence are applied to learn,

predict and estimate future situations, e.g., the behavior of a customer or the volume of a business, or to create recommendations for the business. Data is also used to automate activities that have to date been performed by humans. For instance, AI software can decide in complex situations, learned on earlier similar situations. So, data collection and data usage will become or already have become an essential driver in businesses. It is actually the driver for both digitization and digitalization. Therefore, successful digitalization initiatives should also have digitalization technologies as drivers. We thus recommend a *bottom-up* approach in parallel to the top-down approach for creating digitalization projects.

The present paper describes a hands-on approach to support SMEs from the identification of digital use cases to the definition of a portfolio of short-, mid-, and long-term digitalization projects. Section [2] sets the scene by introducing prerequisites and drivers of top-down and bottom-up approaches to digitalization. Section [3] describes our digitalization project with a real-life customer and section [4] summarizes the experiences and lessons learned form this case. The suggested and conducted approach does not focus on specific aspects of Industry 4.0 or manufacturing in smart factories. It can be adapted to different industries and might give companies a guideline to do the first steps of the digital transformation before hiring consulting companies for high daily rates. Such a generalization is suggested in Section [5]. Section [6] discusses related work. Section [7] concludes the paper.

2 Approaches to Digitalization

Digitalization supports a company's vision and strategy. If these are not clearly defined, it will be the first activity to clarify the digital vision with senior management and business experts.

Digitalization affects the entire value chain of a company. So, each process and all the sub-processes are candidates for improvements or adaptations. The knowledge about processes, their weaknesses and opportunities are in the head of the different experts of the company. Some parts of the value chain are under full control of the company and so might be adapted without consideration of other actors. Nevertheless, especially the interaction with other actors has a large potential for improvements, e.g., optimizing the information flow or aligning the processes. Moreover, the interfaces to supplier processes are interesting. Here it is crucial how much influence a company has on its suppliers and what contracts exist. For example, car manufacturers determine the interaction with their suppliers and so are able to dictate interfaces and standards.

There are two principle approaches to digitalization:

- *Top down*: What is the current business model? How can digitalization add to and optimize the business model and its implementation? What is the benefit for the company?
- *Bottom up*: What are the current processes? How can digitalization optimize these processes? Which data sources are available? What insights can be derived from this data today or in the future? Can we further improve our processes? Which data analyses are therefore needed?

The top-down approach has the advantage that disruptive changes are possible.

The disadvantage is that projects changing a business model are usually very big and too abstract to get started. The bottom-up approach identifies the low-hanging fruits. In addition, it creates awareness, understanding and readiness of the organization. But a big organizational change or bigger changes to the business model are not possible. Therefore, from our point of view, a combined approach is useful.

2.1 Digitization as a Prerequisite for Digitalization

Any digitalization approach has to cover digitization first. Digitization facilitates the availability of digital data and pushes automation of business processes. This allows controlling processes by software and enhances the collection of data. Media gaps are eliminated, users are integrated into the process, and software or machines replace manual activities. Implementing automatic activities makes transparent what data is needed in order to do so. Active BPM establishes a continuous improvement process and so drives optimization. Activities will further be automated, e.g., if it is technologically possible or the required data is available. Activities will even be implemented as a self-service for the user if the cost-benefit ratio is reasonable. In addition, faster and automated processes allow for new services or offerings, e.g., immediate decision on a loan request when the customer is in the office or online. Obviously, using digitalization technologies gives new opportunities for automation and optimization as well as for new services and business models. Digitization and BPM are not in the scope of the present paper; these concepts have been pushed for years. Nonetheless, many companies and businesses do not have BPM in place yet.

2.2 New Business Models due to Digitalization (top down)

In the last years, many new companies appeared and revolutionized existing, analogue businesses. Key aspects of the new business models are:

- Two-side markets with network effects and sharing of products, i.e. two large user groups are connected by software to share, e.g., apartments (*AirBnb*), cars (*Uber*), or even funding (*Kickstarter*)
- Products could be virtual, e.g., games, music, apps, or physical, e.g. shoes, clothes or washing machines
- Sales via virtual channels without regional market borders – in contrast to, e.g., to physical grocery stores – allow for highly scalable business
- New monetization models: *Google* and *Facebook* provide their services for free and get paid by data, *Spotify* or *Dropbox* run a model with free service access and payment for extra features (freemium model), and *Netflix* offers a subscription model where the customers pay a fee to get access to the product.

Companies run market places (*Amazon*), offer them to other sellers and so provide hyper market places. Services are sold on demand, i.e., the customer buys access to the product and does not own it anymore (*Spotify*). *Apple* and *Google* have built up eco systems with products and services that bind customers to the company.

Although the principles and ideas cannot be applied in every market, disruptive innovations are a real threat for existing businesses and it is worth analyzing the principles behind to learn for ones own business. Actually, these new business models

inspired the business experts in our case study to develop new ideas for their own business.

2.3 Data as a Key Resource in Digitalization (bottom up)

Data is a key resource in digitalization. In every company, there exist many data sources. Not all of them contribute to value creation today, because the data is not collected, the data is not digitally available, or the data is collected but is not used. As memory is cheap, we recommend collecting data, even if the use is not clear today. Data privacy and protection regulations have to be obeyed while doing this.

Data sources can be categorized as follows:

- Data that is or could be collected from the execution of (automated) business processes, i.e., data that is used in business process management to optimize processes. For example, the average time needed for an activity or the execution of a complete business transaction, the number of faults, and much more.
- Data that is available in the different information technology (IT) systems of a company, e.g., in the customer relation or contract management system (CRM, CMS), and so on. Data related to customers is especially valuable.
- Events and data from (I)IoT, e.g., from smart devices or about machine usage, environment parameters etc.
- Data from external sources that have an impact on business processes and results, e.g., weather data, or social media data.

Business experts use data to enable or support business activities referred to as Business Intelligence (BI). For example, knowing the preferences of a customer allows for more specific offers. IT experts are looking at data from a systems perspective. This enables technical planning and optimizations, e.g., minimizing slack times and wastage. Predictive maintenance of products is another way of utilizing data in industry, e.g., applied to reduce maintenance costs of elevators (*ThyssenKrupp*) or heavy vehicles (*Volvo* and *Danfoss*).

2.4 New Technologies as an Enabler of Digitalization (bottom up)

There exist several new technologies that are useful or even drive digitalization. They are the “usual suspects” that can be helpful for implementing a company’s digital stories. A company’s business and IT experts should be aware of these technology opportunities and their potential benefits.

There are numerous new devices and device improvements that should be considered including:

- Mobile devices for interaction with humans, i.e., smartphones and tablets
- Smart devices that produce/collect/process data: (I)IoT devices with sensors and communication features, drones, usage of Radio Frequency Identification (RFID) tags or Near Field Communication (NFC)
- Autonomous intelligent vehicles, drones, and robots
- Wearables: glasses (e.g., Microsoft’s HoloLens, Google Glasses), smart watches and trackers
- Virtual and augmented Reality: e.g., Facebook’s Oculus VR

3-D scanning and printingBig Data summarizes technologies for analyzing data sets and streams to gain knowledge about technical, scientific, sociological or economical phenomena. We distinguish data from information and knowledge. *Data* subsumes symbols, signals, bits & bytes, words, numbers, tokens, etc. *Information* is data interpreted in a context adding a meaning to data.

Knowledge is actionable information, i.e., insights that allow us to control processes and to give predictions. Machine learning and artificial intelligence used, e.g., in BI and predictive maintenance, is one way of automatically transforming data into knowledge.

What is considered *big* data lies in the eyes of the beholder and is a moving target. It refers to challenging quantities that go beyond the capability of humans and commonly used software tools, ranging from a few dozen terabytes (10^{12}) to many petabytes (10^{15}) today.

It is, however, not only the sheer *volume* that makes it challenging to transform big data into knowledge. Depending on the data sources, it could also be the data

- *variety*, i.e., the heterogeneity of data from different sources, which makes it hard to integrate and commonly process data from these sources,
- *velocity*, i.e., the rate at which data is generated, which forbids storing data and leaves only small time windows to process it,
- *validity* and *veracity*, i.e., how correct is the data and how trustworthy the data source,
- *value*, i.e., the questions whether it is possible at all to gain knowledge from data and whether this knowledge has indeed a business value.

Cloud computing is an underlying concept that provides scalable and potentially indefinite computing resources needed, e.g., for big data storage and processing. Actually, most contemporary software solutions are based on or rely on cloud services.

3 The Case Study

Södra is Sweden's largest forest owner association with more than 50,000 forest owners as its members. Södra is also an international forest industry Group, with operations based on processing its members' forest raw material. In 2016, the wood volume was 15 million m³sub (cubic meters *s*olid volume *u*nder *b*ark), Södra's sales amounted to more than SEK 18 billion and the number of employees was approximately 3,600.

Södra's overall assignment from its owners is to promote the profitability of their forest estates by providing advice and support for responsible and sustainable forestry, and to contribute to a market-based rate of return on their forest products. Södra purposefully focuses on innovation to develop new products based on renewable wood raw material.

The wood from the owners' forest estates is processed in Södra's mills and becomes sawn and planed timber, interior wood products, biofuel and market pulp that is sold on the open market. Södra's three pulp mills generate surplus energy and the production is almost fossil-free. This energy is sold as bio-based products, such as

green electricity and district heating. Södra has one of the largest sawmill operations in Sweden and is one of the biggest suppliers of softwood sulphate pulp to the European pulp market. Södra organizes its activities in three business areas:

- Södra Skog[1]—where the case study documented in the present paper was conducted—supplies the Group's industries with forest products and offers forestry services.
- Södra Wood produces sawn timber, interior wood products and bioenergy.
- Södra Cell produces softwood sulphate pulp and textile pulp, supplies green energy from the mills.

Södra Skog contracts wood and provides forestry services such as harvesting, forest management plans, site preparation, selective plant material from own nurseries, planting, cleaning and forest-economic advisory services. Södra Skog's vision it to be the most digitalized company within the forestry sector.

3.1 The Task

Södra Skog had a need to explore what this vision really meant and how to implement this vision. In order to accomplish this Södra Skog started to collaborate with Linnaeus University[2], which allowed investigating Södra Skog's digitalization challenges from a scientific perspective.

Södra Skog has different questions and issues with respect to digitalization:

- Where do we stand in digitalization? How far have we come compared to others?
- Where do we have optimization potential?
- What has to be done to benefit from digitalization? In which order?
- Who can help us to implement the digitalization projects?

From these questions we derived the following tasks for the case study:

- Identify optimization potential in general and specifically with the focus on data.
- Provide an initial map of relevant data sources.
- List and assess the potential of concrete digitalization project ideas.

Obviously, both domain knowledge and digitization and digitalization experience is necessary to do such a project. This is an issue for an SME, because experts having both competences are hard to find. In our case, the person who worked on this project was an expert in software architecture and digitalization, but without knowledge in the forestry domain. Hence, domain knowledge had to be built up during the project.

Initially, the following activities were planned:

- Perform interviews with Södra Skog experts.
- Discuss and align the results with management and business experts.
- Create an aligned map of relevant data sources and optimization opportunities.
- Define an initial project portfolio with prioritized and roughly estimated ideas.

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[1] Skog is Swedish for forest.

[2] Andreas Heberle was the principle investigator of the study. He spent his sabbatical at Linnaeus University in the spring term 2017.

The necessary domain knowledge was acquired along the way in discussions with the Södra Skog's domain experts.[3]

3.2 The Approach

In order to analyze all relevant aspects, experts from different units of operation within Södra had to be interviewed including managers, business experts, and IT experts. The interviews were specific to the interests and expertise of an expert. For instance, it does not make sense to ask a business expert about the technical details of the software or one should not ask IT experts about customer segmentation. Still the different perspectives became relevant during each interview and the interviewer had to bring in the respectively missing perspective(s). This means that a business expert has to become aware of technical options or technical aspects relevant in the own and other units and an IT expert has to become aware about the business context. Some experts are able to take various perspectives, but that is the exception rather than the rule. The interviews were performed in units along Södra Skog's value chain [see Figure 1].

Figure 1: Value Chain of Södra Skog

Business development evaluates what the members, i.e., the forest owners, want/need and adjusts services and products to these needs. The *Sales* team is responsible for the direct interaction with the forest owners. Over 200 forestry inspectors consult owners and buy wood and sell Södra services. *Forestry planning* provides a plan how an owner's forest can be managed economically, e.g., when to seed plants or when to harvest wood. *Production* organizes activities in the forest (harvesting, thinning, forwarding) to fulfill the needs of the industry. External entrepreneurs that have contracts with Södra perform these activities in the forest. The *Transport* unit plans and organizes the delivery of the forest output to the industry sites again with support of external carriers. The production and transport groups together organize the delivery to the pulp and timber industries. *Bio fuel* is specific with respect to the product itself, e.g., it does not have a deadline to be processed but special machines are needed to chip and transport the wooden parts and the production processes. Thus, a separate group at Södra organizes production and transport of bio fuel raw material.

Additionally, experts from supporting units *Sustainability and Nature Conservation* and *Member Support* and experts responsible for important IT systems, such as CRM and geo information system (GIS) have been interviewed as well. An independent company provides the information hub SDC[4] for the Swedish forestry industry. SDC manages product data, data on stock movements and measurement data for timber, transport and biomass fuel transactions.

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[3] Anders Gustafsson was the major point of contact at Södra.

[4] Originally, SDC was the abbreviation of "Skogsbranschens Datacentral", Swedish for "Forestry industry's Data Hub". Today the name of the company is SDC without any meaning.

3.3 Interviews based on a Digitalization Questionnaire

In order to perform structured interviews, we defined a digitalization questionnaire upfront. With this questionnaire, we addressed the top-down and the bottom-up approaches to digitalization. Questions regarding the business potential are for people that are concerned with the various aspects of the company's business in their daily work. Questions on data sources are relevant for business experts and technicians. But they are detailed differently. For instance, a business expert was asked for data or information from users while an IT expert was asked for the systems that could provide such data. The third perspective is project portfolio management. Questions regarding this third perspective aim for the implementation of topics. This considers both benefit and effort. In fact, effort should be analyzed in more detail, e.g., regarding risk or required and available resources. Answers to questions in this third perspective are relevant for managers and project leads. Business experts have to provide the information on the business benefit and so make the expected benefit concrete, comparable and transparent.

The interviewer took care that all relevant questions were answered and that irrelevant questions were omitted in order to perform the interviews as efficient as possible. We started with interviews of two hours' length and scheduled additional meetings if necessary.

Below we discuss the questions related to the three perspectives. We do not claim the questionnaire to be complete and, depending on the target company, other questions might be useful, as well.

3.3.1 Business Potential

These questions support the top-down investigation of digitalization potential.

Question	**Explanation**
What is your group's or your personal vision in a digitalized world?	• The vision of the group/area, • The company's vision.
Which concrete scenarios or use cases would you like to be implemented to digitalize your business?	• Specific scenarios in the persons circle of influence, • Scenarios in other areas, • Priorities.
Which effect would you like to achieve with the digitalization?	• Optimization, e.g., automating activities, decision support, or cost reduction, • Risk Mitigation, e.g., by predictions of expected output/revenue, • New services or products, • Value-adding services, e.g., the end user gets additional information or workers in the field know exactly how to do something, • Improved planning by incorporating weather information or better reporting.

Which kind of digital support are you thinking of?	• Implementation of a new business function, e.g., calculating a credit risk, • Provisioning and visualization of existing data in order to get a better understanding, • Machine learning, e.g., for recommendations or predictions.
Who are the stakeholders having benefit of the digital support?	• Internal stakeholders, • External stakeholders, e.g., customers or suppliers.
Which data would you like to have? Which scenarios would you like to implement?	• If you could wish, although you don't know how to implement it. • Crazy ideas.

Table 1: Questions to identify business potential

3.3.2 Data Source Perspective

The questions are supposed to reveal existing and unused, but valuable data sources. Amongst other aspects, the volume, variety, velocity, veracity/validity of data [see section 2] are considered. Business experts will answer these questions on a different level than IT experts: IT people talk about systems and integration of data sources while business people refer business entities.

Data privacy and protection are also very important. The Regulation (EU) 2016/679 of the European Parliament, coming into effect in 2018, states: "Non-compliance with an order by the supervisory authority [...] be subject to administrative fines up to 20 000 000 EUR, or in the case of an undertaking, up to 4 % of the total worldwide annual turnover of the preceding financial year, whichever is higher." (The European Parliament and the Council of the European Union, 2016).

Question	**Explanation**
Which data sources do you see in your area? Which are the most important ones?	The following questions have to be answered for each data source.
In which form is the data available?	Data Variety • Digital form, e.g., an order represented by a data set, an Excel sheet, a digital picture, • Analogue, e.g., as an order form on paper.
Who is the data provider?	• An internal system or an expert group in the company, • An external system like a weather forecast service or a GIS, • A user who collects the data maybe by using a mobile device; a user who

	provides the data from additional sources, e.g., from a drone flight.
How is this data used today?	• The data is used by other systems, • The data is used or could be used to support/enable activities in a business process, • The data is not used at all.
How can this data be accessed?	• An API or a system interface exists, • The data is stored in a database or data warehouse, • The data is currently not accessible.
Does the data source provide personal data? How will this data be processed?	• Personal data might have privacy restrictions and processing might require the admission of the person. • Processing might require security measures
How is the validity of the data, with respect to correctness, consistency, and completeness? Is the data always up-to-date?	Data Veracity/Validity
What volume has the data?	Data Volume • How many Giga Bytes (estimations)?
How often is data from the source updated?	Data Velocity • Data from transactions is collected and updated periodically by batch processing (pull), • A transaction, e.g., cutting down a stem, causes the immediate update of the information (push), • A continuous stream of data, e.g., sensor data.
Are there any compliance requirements with respect to using the data?	• Restrictions on specific user roles • Processes • Documentation

Table 2: Questions on data sources

3.3.3 Project and Portfolio Management Perspective

These questions allow for concrete planning and management of the various ideas. The goal is to have a prioritized project portfolio at the end. Several aspects determine the priority of an idea:

- The expected business value is estimated, as it is hard to determine the business value quantitatively without further analysis. Thus, we evaluate it with *high / medium / low.* Nevertheless, the business value should be analyzed in more detail to avoid spending money for rather optimistic business ideas.

- The effort needed to implement a story is, for a first assessment, estimated qualitatively as *high / medium / low*. The assessment has to take into account:
  - The complexity of the implementation, because high complexity introduces risk.
  - The availability of resources, which is especially important in digitalization, because there are lots of new technologies and it is not clear if resources with the specific knowhow are available in the company or have to be hired from the market.
  - Prerequisites, e.g., a supplier has to provide data digitally that is currently provided in a form on paper, or dependencies on other ideas and stories.

Question	**Explanation**
What is the expected benefit and for whom?	• Can the benefit be quantified? Otherwise estimate high / medium / low.
How expensive/complex is the implementation?	• Can the costs be quantified? Otherwise estimate high / medium / low.
Is the required know-how for the implementation available in-house?	• If not, is the know-how available on the market, • What are the costs to hire experts?
What is the technical complexity of the implementation?	• Which systems are incorporated? • Which technologies are required to implement the scenario? • Which external services and products are required? • What is the impact on the overall architecture?
What is the priority of the story?	• With consideration of cost and benefit.
Does the story depend on other stories?	• Do we need to implement another story first? For example, we need to tap a data source before we can use the data in another story.

Table 3: Questions on project management aspects

3.4 The Results

In the interviews, a lot of information and ideas surfaced. The interviewer questioned the statements of the experts, brought in their own ideas, structured and clarified the statements, and concretized digitalization aspects. To do so, the support of and the discussions with a client-internal information architect were helpful.

The interviews were standardized, following the digitalization questionnaire, and the results were documented with a standard scheme as well. The information collected was structured along the business units, highlighting *issues and pain points* of each unit, *optimization opportunities*, relevant *data sources*, and concrete digitalization *ideas*. Due to space restrictions, we just present a selection of the over

50 different ideas and omit some details. In addition, details of the business processes and the important IT systems have been discussed and analyzed, so that the interviewer was able to gain the necessary domain knowledge. Below we summarize the collected information for the respective units.

Although important, data privacy and protection was not in the focus of the interviews because the customers of Södra are also the owners of the company. Also the project took place in Sweden which has more relaxed data protection laws compared to, e.g., Germany.

3.4.1 Business Development

The business development department analyses regularly the needs of the forest owners.

Issues and pain points	• The owners do not feel well informed and the outcome/revenue of a service diverts from the owners' expectations. • The owners have problems to get in touch with the Södra experts, especially, with the forestry inspector.
Optimizations and improvements	• Improving the information flow to the forest owners. – The owners get informed on each terminated step in the process. – Additional information on activities is available in the web portal, e.g., when harvesters will start working at the owner's property. – Improving the quality of information, e.g., giving better predictions on expected volume output and residue. – Introducing a messenger to chat with Södra experts. • Products should be traceable from production to the industry. • Improving the availability of contact persons – Use asynchronous communication, e.g., by messenger, to communicate with a forest inspector or other Södra experts. – Enable the owners to find answers to their questions in the web portal or by using bot technologies and machine learning to answer questions automatically.
Data sources	The focus of the discussions was on products and services; data sources have not been discussed.
Ideas	• Improve information flow by a push messages and a chat function in the mobile app. • Provide relevant information on activities in various channels. • Business Development is also thinking about new services, e.g., business scenario planning for owners to figure out the financial consequences of different sales strategies for products from their forest.

Table 4: Information from the Business Development department

3.4.2 Sales

The sales people, the so-called inspectors, are the direct point of contact to the forest owners. They are consulting the owners and make the contracts to buy wood. A forestry inspector is responsible for about 200 members and thus needs very good tool support to operate efficiently.

Issues and pain points	• Overlap of data sources, e.g., forestry plan and forest base data. • Quality of data used for planning is low because data is outdated or missing. • Digital support to improve the interaction with the customer is lacking. • Market changing offerings of competitors, e.g., the wood exchange market "Virkesbörsen".
Optimizations and improvements	• Analyze data to improve transparency, to quantify performance and to get a better understanding of issues. • Use machine learning to provide better predictions, e.g., on the situation in the forest. • Replace manual activities of experts in the forest by software.
Data sources	• Official registers of forest properties, • Member register, • Forest inventory, • Forest plan, • CRM system.
Ideas	• Analyze customer, stand and contract data to get a better understanding of the forestry inspector's performance and issues. • Predict characteristics of new stands from surrounding, already known, stands instead of visiting a spot. • Combine data on work orders and contracts with information from satellite images to improve data quality and check predictions. • A long-term goal is building an ecosystem for forestry stakeholders, comparable to Apple's or Google's ecosystems.

Table 5: Information from the Sales department

3.4.3 Forest Planning

Forest planning is the link between sales and production. The experts provide plans that advise the forest owners how to manage their forest. The plans are updated periodically and the forest owner pays for this service.

Issues and pain points	• Quality of the forest data. – Sensor data is too old, – Data is missing, because not all updates are integrated, • Too many manual updates of data.
Optimizations and improvements	• Bringing together different, already existing, data sources, e.g., aerial images and laser images. • Predict characteristics of forest stands from already known stands being close to.
Data sources	• Experts in the forest provide information every 10 years for the new plans. • Government systems for aerial images and maps. • Satellite images. • Laser images (available from 2009–12). • Drone images (not yet available).
Ideas	• Provide self-services for the member to update the forestry plan or document certification activities. • Bring together different data sources to get up-to-date information in forestry plans. • Predict characteristics of new stands from surrounding, already known, stands instead of visiting a spot.

Table 6: Information from the Forest Planning department

3.4.4 Production

Production planning is driven by the sells of the owners (i.e. volume available in stocks at the road) and the needs of the industry.

	• Planning is done manually with map support and manual look up in other systems. • A lot of data is collected, but not used, e.g., to optimize harvesting quality or to improve planning.
Optimizations and improvements	• Predict the volume and the quality of a stand more accurately. • Automate planning and integrate production more tightly in the overall process. This means, implementing a pull model where industry needs determine the production. • Reduce production cost.
Data sources	• Production data from the machines monitoring of production and operation, • Price and length needs from the industry, • Contracts provided by the forestry inspectors, • Geographic Data from GIS, • SDC.
Ideas	• Analyze the effect of different machine types to the output volume and costs in an area. • Analyze the quality of the different entrepreneurs.

Table 7: Information from the Production department

3.4.5 Transport

Transportation is one big cost driver. The different materials, stems of different species and residues, require different transports and are processed by different factories. Transportation planning optimizes cost per cubic meter and kilometer and is constrained by industry needs of stock level, cutting time of the timber (no longer than 6 weeks ago) as well as transport capacities of the carriers and available storage at the factories. An external optimization tool supports transportation planning.

Issues and pain points	• Industry and production planning are not really connected. Industry pulls while production pushes, but pulls do not initiate production activities directly. • Master planning is done in Excel manually. • There exists accurate information on the harvested stocks. However, when collecting and transporting the different stocks, this detailed information is lost. It is impossible to keep track of each stock outputs from the forest to production. • Cost cannot be related to transport orders in sufficient quality because entrepreneurs are allowed to trade transport jobs between each other, which is not documented in the transport management system.
Optimizations and improvements	• Automate planning activities. • Analyze the quality of the current planning to get a better understanding of issues. • Introduce a pull model where industry needs drive the production and the transports.
Data sources	• Industry needs, weekly adjustments are possible. • Production output. • Carriers and their contracts, e.g., volume. • Geo data, e.g., roads, sites, areas, carrier locations, etc. The transport team is supported by a system to plan and control transports, an optimization tool that supports planning, the carrier management system and the central data hub SDC.
Ideas	• Use existing data on harvested volume to crosscheck stock level information. • Analyze transport cost and volume output in more detail to get insights in the quality of transportation. • Optimize flow plans in transport based on actual data instead of historical data.

Table 8: Information from the Transport department

3.4.6 Bio Fuel

Beside wood, Södra also delivers residues from harvesting and by-products from industry, e.g., saw dust, to bio fuel producers. This is a special kind of production and

transport, but planned and managed by a separate team with different processes. The process is driven by weekly orders from the industry. The products are measured in different units, e.g., volume or load, but at the end, the factories pay for the energy content in MWh. Some customers order a specific tree species on a specific daytime. The price of diesel has an impact on the prices the industry customers pay.

Issues and pain points	• Södra has a price risk with respect to uncertain energy content of bio fuel. • The calculation of the energy content takes some time so that Södra has to plan with inaccurate data. • Industry customers are not connected to the central data hub so that measuring has to be done separately. • Weather and other external factors have short-term impact on demand and supply.
Optimizations and improvements	• Better measurement tool support for drivers and customers. • Optimized planning and supply by predicting – the customer demand over the year, e.g., before and after Easter holidays, – the output of sawmills, – the output from the forest based on harvested volume, and – the energy content based on attributes of production and historical data. • Automate planning activities.
Data sources	• Customer needs. • Estimated output of industry by-products and residue volume in stocks. The bio fuel team is supported by a system to plan and control transports, the carrier management system, and the central data hub SDC.
Ideas	• Analyze historical bio fuel orders to find patterns with respect to time, e.g., winter/summer, holidays, or weather. • Use historical data to predict customer demand in energy, expected energy output of forest bio fuel, output of sawmills and energy content of bio fuel. • Use existing data on harvested volume to crosscheck stock level information.

Table 9: Information from the Bio Fuel department

3.4.7 Member Service

Member Service answers member questions regarding administration and forest. Most of them are money related. Only eight employees deal with about 25,000 phone calls and 15,000 contacts by email or via the portal.

Issues and pain points	• 5–10% of the member base data is not up-to-date. • Inspectors are performing activities that can be done by the owners themselves. • Usability of portal services.
Optimizations and improvements	• Analysis of customer segments and behavior usable in daily business. • Provide better self-services and information sources to the owners. • Improve communication channels, e.g., introducing chat bots to answer owner questions much faster.
Data sources	• Official register of property, a register owned by the state. • Address and contact information with consistent updates. • Own member information. • Analytics information on web portal usage.
Ideas	• Identify upcoming activities based on existing data and recommend next steps to the members automatically. • Provide a map service with improved usability. • Get a better understanding of the customer groups by analyzing the customer data.

Table 10: Information from the Member Service department

3.4.8 Nature Conservation and Sustainability

The nature conservation and sustainability team monitors environmental aspects and supports owners in nature conservation tasks. In Sweden there exist different certification systems: the Forest Stewardship Council (FSC) and the Programme for the Endorsement of Forest Certification Schemes (PEFC). Certified forests yield an extra bonus per m^3 when harvested and sold to Södra.

3.4.9 Information from Other Interviews

The GIS provides services and integrates various data sources with

- background data, e.g., official records on property or addresses and contact information from the tax authorities as well as many open data sources with road or sensing data.
- Data from Södra's business systems, e.g., forestry plans, contracts with owners, data on industry sites or certified owners.

Hence, GIS is the data warehouse for forestry data. One pain point with the GIS is the quality of data, because updates are not incorporated timely and information from the forestry inspectors is missing or is incorrect.

The innovation team thinks about financial services, e.g., optimized tax or loan offers considering the actual forest status, and insurances for the owners. The team sees high potential in using combined information about members, the forest and the market.

Issues and pain points	• Data was collected the last 20 years without connection to geo information. So, the data is either not digitally available or it cannot be related to spots. • The relevant spots in the forest are very small. • Many manual activities to be performed by the experts.
Optimizations and improvements	• Better tool support to make the job of the forestry inspector more efficient. • Provide services to delegate jobs to other, e.g., self-services for owners to update/collect information. • Predict/recognize interesting spots on a site using areal images, laser scans, information from the forestry inspector, the entrepreneur or external sources. • Improve the data quality.
Data sources	• Environmental experts, walking through the forest and collecting information manually, • Forestry inspectors, • Harvesters, • Areal images and laser scans. Interesting data: moisture classes, surface, types of trees, lakes or water sources, dead woods and instructions for the owners and the entrepreneurs
Ideas	• Provide information to owners about the benefits from saving species / dead woods. • Support the forestry inspectors with a checklist to identify spots with high conservation potential. • Analyze the information and documentation quality from forestry inspectors.

Table 11: Information from the Nature Conservation and Sustainability department

3.5 Resulting Implementation and Research Projects

In the interviews and in the following discussions, a list of over 50 concrete implementation and research ideas was created. These ideas were different in nature, i.e., they address implementation topics or business models, data or machine learning aspects. Some even require further research together with scientist. We categorized the different ideas in:

- *Data acquisition*, e.g., incorporate road information from the government with timely updates.
- *Data analysis*, e.g., identify relevant attributes to predict volume and quality of a stand to be harvested.
- *Machine Learning*, e.g., use historical data to predict for example customer demand
- *Planning and Simulation*, e.g., incorporate road and weather data to improve production planning.
- *Digital Business*, e.g., develop a marketplace for services, wood and information.

- (Just) *Implementation*, e.g., provide push messages in the mobile app for the members.

The ideas vary in development effort and business benefit and, during the interview phase, they have neither been prioritized regarding their potential nor have they been estimated regarding their implementation effort. Since one goal of the project was to identify short-, mid- and long-term projects, we had to do further investigations. Thus, in order to collect, prioritize, and estimate the ideas, a workshop was conducted with all internal experts and researchers from university. The format of the workshop considered time restrictions and the number of ideas that had to be assessed.

Goals of the workshop were:

- Agreeing on the statements and identified ideas.
- Providing an initial project portfolio with priorities and an assessment of effort and benefit for each idea/bundle of ideas.
- Bringing in the scientists from university to address topics that require further research.
- Defining sub-teams with one responsible lead to drive the next steps of the implementation.

The ideas were assessed roughly with respect to effort and benefit. The priority of an implementation project depends on actual benefit and effort required to implement a story (idea). Starting with ideas focusing on the highest benefit is not necessarily the best idea. Imagine a story with very high business value but with huge changes in processes because a new business model is introduced. Such a project will take very long and has also a high risk to fail. Smaller projects with smaller benefits and shorter implementation times will lead to quick wins. We recommend to start with the quick wins, where short-term value can be gained and experience in new technologies can be built up at the same time. Mid- and long-term initiatives have to be started early, but have to be broken down to manageable increments with short-term results that can be evaluated. So, following the agile philosophy to develop in increments, providing results early, and adapt the next steps according to the feedback of the stakeholders.

At the end, we had identified several topics to be researched with the university, e.g., working out the eco system model for Södra, estimating the actual situation in an owner's forest based on existing data, simulation of different algorithms/strategies to optimize production and transportation. The different groups in Södra Skog are now aware of ideas in their field and are now breaking the topics down to implementable packages.

Figure 2: Assessing the benefit and required effort of projects

3.6 Digitization and Digitalization Goals

As a side effect of the investigations, Södra Skog's digitization and digitalization goals could be formulated, which bridges the gap between the digitalization vision and the concrete project ideas:

- Forest information made available via a mobile device should be better than information available when standing in the forest. This requires a better use of relevant data in a particular context and an improved access to data and functions for the different stakeholders.
- Being smarter, cheaper, faster and providing better quality by automated business processes. This requires digitization of today's manual business processes and the integration of the various IT systems.
- The forest owner should be able to directly decide and conclude their contracts with Södra without the help of an agent. Currently, the forest owner interacts with the forestry inspector (agent) who meets the owner every ½-3 years to discuss the operational plan with the owner. Then they decide, face-to-face, on the necessary activities and the Södra services involved.

4 Experiences from the Project

In the current case, about 50 ideas with different complexity were identified. The experts tend to favor the more complex stories and improvements. But often there exist stepping stones that contribute to the final solution. Implementing the stepping stones first reduces the risk of failure and allows for quick wins. Especially in the context of big data and machine learning, a step-by-step approach makes sense. The following steps describe a standard data science approach, which gives a useful decomposition into smaller and less complex activities that produce useful results much earlier.

(1) What is the question to be answered?
(2) What data is available/needed to answer the question/analyze the situation? For instance, analyze historical data and identify relevant attributes with impact on: Harvested wood volume, harvested bio fuel volume, delivered bio fuel volume energy of delivered bio fuel.
(3) What kind of solution is appropriate? Tapping data sources, visualization for expert analysis, machine learning with Clustering, Classification, Regression, or others? For instance, use historical data to predict customer demand in energy, expected energy output of forest bio fuel, energy content of bio fuel (incorporate weather data).
(4) How will you measure success?

If one started with the solution in step 3, the implementation project would be quite complex and success could only be checked right at the end. The data science approach produces useful intermediate results early. For example, analyzing data in order to identify characteristics or to find attributes having impact on the estimation of a property does give valuable insights upfront and is a prerequisite to decide for an appropriate big solution.

In order to identify valuable quick wins and to reduce complexity of the implementation projects, it is necessary to open the eyes of the participating experts. We therefore recommend giving an introduction to the following topics in advance:

- Digitization: business process management,
- Digitalization: new business models and technologies,
- Data science.

The interviewer can also support the experts in identifying useful ideas and quick wins directly. This requires, that (s)he has a profound understanding of digitization and digitalization topics. Since appropriate usage of data has huge business potential, experience with data analysis and machine learning is helpful. Expertise in the business domain is of advantage but is not mandatory, because the know-how is available in the company.

Usually, SMEs do not have the experts to run digitalization initiatives in the company. So, external resources are required. Research institutions are a very interesting option: they aren't competitors, they have broad and up-to-date know-how, they are interested in real-life data and applications to have a foundation for their research, and the cost are lower than hiring consulting companies. In the current project, experts from different areas, e.g., software architecture, data visualization, analysis and machine learning, forestry, contributed and are still working on the different topics. On the downside, research institutions have goals (non-profit oriented) and time lines (long-term) that differ from businesses. They are therefore excellent partners in exploration and long term-research efforts but lesser suitable for short-term business critical projects.

5 Towards a Standardized Approach

The case study has shown that digitalization requires an approach that considers the business and the IT perspective. An integrated top-down and bottom-up approach addresses both perspectives: top-down to identify the business potential and bottom-up to realize what is technically possible and feasible.

5.1 Steps of the Approach

The knowledge about existing processes, pain points and threats, and new business opportunities on the one hand and the existing IT resources and technical expertise on the other hand is in the heads of a company's employees. So, in order to identify improvements, valuable new services and new business models and to break that down to concrete implementation projects, the first step is to tap the knowledge by interviewing the experts. Identification of the "right" persons along the value chain is crucial. Moreover, these persons are usually very busy. So, it is quite helpful if a senior manager supports the study and one internal person organizes the meetings and provides the necessary information prior to the interviews.

The interviewer does not need to be an expert in the business but has to have an overview on the processes in the value chain. Since the interviewer controls the progress of the discussion, (s)he has to understand the principles of new digital business models, should know the current and upcoming technological options and should be experienced in process optimization in general. Preferably, the interviewer is an external resource. This avoids being caught in internal discussions and patterns of thinking. Even more important, an outsider is allowed to ask critical questions and can challenge "holy cows".

We recommend the following activities:

(1) Determine the strategy and vision of the company.
(2) Define and analyze the current value chain.
(3) Interview experts from each part of the value chain.
(4) Document the results of the interviews in a Digitalization Canvas (see 1).
(5) Review the Digitalization Canvas with selected experts from the company and experts in the different areas.
(6) Run a workshop with representatives of the different areas:
    - Finalize the Digitalization Canvas.
    - Create the initial version of a portfolio of project ideas (roughly estimated and prioritized).
    - Define sub-teams being responsible to drive the next steps of the implementation.
(7) Create a final report with necessary actions.

During the interviews, ideas on various abstraction levels might come up. We thus recommend to take this into account and to allow for describing the ideas on different levels of detail. In agile development, user stories, epics, and themes have successfully been used to describe requirements from a user perspective on different levels [Cohn, 04]. This is appropriate to describe many of the ideas. Since we do a bottom-up approach as well, some ideas are more concrete and it is appropriate to

specify these ideas as use cases [Cockburn 2000], e.g., according to the UML specification [OMG 2015] so that the specification can be used for implementation. Depending on the detail level, it is a task for the next steps to provide a more detailed specification or to run activities to elaborate the ideas in more detail.

The result of the workshops is documented according to a structure, which we refer to as the *Digitalization Canvas* [cf. Section 5.2]. After the interviews, a preliminary version is created that is then reviewed and extended by the different experts in the company. To bring in independent expertise, preferably, external experts in Big Data and Machine Learning, Software Architecture, and the business domain should review the canvas, as well. Inviting experts from university is an interesting option. Digitalization and the corresponding technologies are currently in the focus of researchers. However, as digitalization is in the focus of many companies it might be difficult to find expert resources.

In a final workshop with all the experts (internal and external), the Digitalization Canvas is finalized. The format and the detailed goals have already been described in [Section 3.5]. At the end, a final report with concrete action items is created to summarize the results.

5.2 Digitalization Canvas

The Digitalization Canvas [see Figure 3] represents the results of the approach with the focus on digitalization use cases and user stories, their value proposition and their implementation in concrete projects.

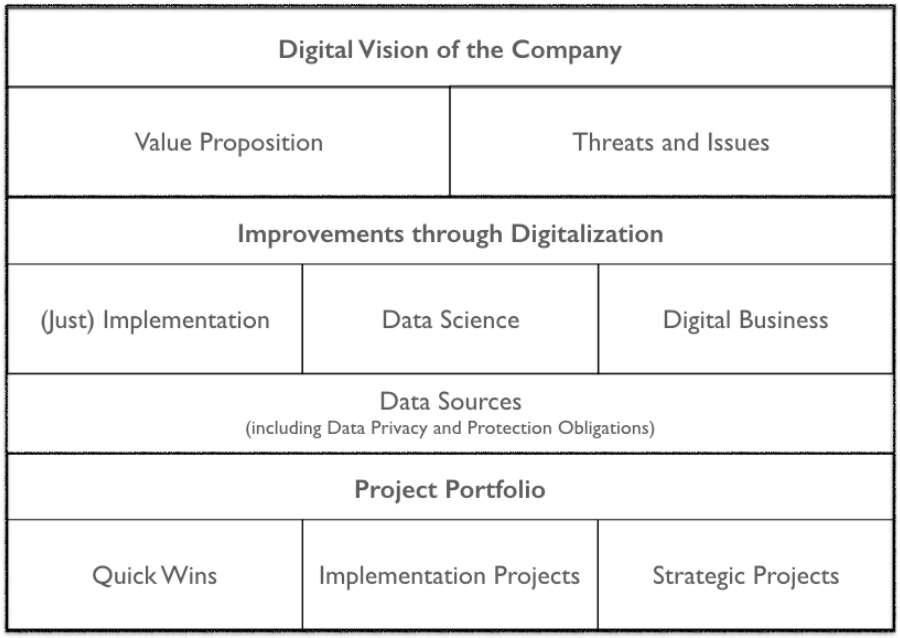

Figure 3: Digitalization Canvas

The dimensions of the canvas are:

(1) The business perspective represents an extract of the company's business model with focus on digitalization aspects. If the company defined a business model canvas this provides the relevant input on vision, value proposition, threats and issues.
(2) Digitalization benefits can be achieved through:
    a. (just) implementation of useful features
    b. automation and optimization, e.g. analyze forest pictures to estimate forest state or wood volume instead of visiting a forest and assessing the state by a human or providing self services for customers
    c. using a data science approach, e.g.
        (i) Tapping data
        (ii) Analyzing the quality of a supplier to prefer suppliers providing better quality
        (iii) Learning from existing data to predict/estimate future aspects
        (iv) Simulating a process and evaluate improvements before starting an expensive implementation project
        (v) Using new technologies to produce data and to improve business, e.g., use RFID tags to introduce/improve tracking and tracing
    d. new digital business models.
(3) Data Sources are used to improve processes and business. They can be categorized as
    a. useful/available/accessible (integrated)
    b. wished, but not available. Perhaps, it is not even known how to get the data.
(4) The portfolio of prioritized projects to implement the digitalization with rough cost and effort estimates.

The *Improvements through Digitalization* part of the canvas could be structured according to the nature of the use cases. For example, Deil suggests the focus on information & analytics and automation & control, [see Deil 2017], with use case clusters "enhanced situational awareness", "decision analytics", "tracking behavior", "optimized resource consumption", "process optimization", "complex autonomous system", and "remote control" as suggested in [Chui et al. 2010].

6 Related Work

We have discussed most of the related concepts already in the different sections.

The Business Model Canvas was intended to describe all the relevant building blocks of a business model – the key partners, the key activities, and the key resources; the company's value proposition; the customer relationships, channels, and customer segments; the cost structure and the expected value streams [Osterwalder and Pigneur 2010]. The canvas is widely accepted and in particular seems to have replaced the traditional business plan. Although the scope of the Business Model Canvas is different, our Digitalization Canvas has a similar purpose: show all the relevant information of digitalization activities in a structured and visualized model. If a company had already defined a business model canvas, it could be used as the starting point for discussing digitalization activities. Through the investigation of

digitalization opportunities and projects, new business ideas might come up and cause an update of the business model canvas.

There exist different maturity models for digitalization, e.g. Digital Maturity Model – University of St. Gallen [Back and Backhaus 2016] or the Digital Maturity Model developed by tmforum.org [tmforum, n.d.]. These models usually assess the relevant dimensions for digitalization, i.e. strategy, leadership team, customers, products, culture, people or technology and then derive the maturity level of a company. Such a measurement shows where a company is on the digitalization path, also in comparison to other companies. The results also recommend high-level actions, but they do not propose concrete and detailed activities the company should perform.

Reference architectures for (I)IoT, e.g. the Industrial Internet Reference Architecture (IRA) [IIC 2017], and Industry 4.0, e.g. the Reference Architecture Model 4.0 (RAMI) [DIN 2016], address technical, functional and organizational aspects. They define quite holistic architectures that a company can use to structure its processes and organization as well as its IT application landscape to implement digitalization. But, these models try to be applicable for many industries and companies, so they are quite general and deriving specific actions is difficult or even impossible for a small to medium sized company that lacks the necessary digitalization know-how.

7 Conclusion

In the present paper, we described an approach to start with digitalization in a small to medium sized company. We applied the approach to identify digitalization ideas and opportunities in the forestry industry and used the experiences from that project to improve the initial approach. Although our approach is very pragmatic and focused on gaining as much benefit as possible for the company, we believe it can be used in other companies and industries, as well. The digitalization questionnaire does not contain any question specific to the industry case. It can therefore be reused or adapted to the specific conditions of different industries and companies. The *Digitalization Canvas* together with a project portfolio defines a concrete roadmap to digitalization and summarizes the arguments to apply for the necessary budget. Business as well as implementation topics are addressed. Therefore, the digitalization questionnaire and canvas give a company a jump-start to implement its digitalization vision in concrete projects. The classification of use cases and projects helps to find the right experts and allows for a focused implementation.

From our point of view, the approach is useful to analyze SME businesses and to identify valuable quick wins and more strategic or mid-/long-term project. In addition, during the process new ideas and improvement opportunities can be identified that lead to new project candidates. Furthermore, bringing together the experts from different areas and focusing on the digitalization topic initiates intensive discussions across departments and reveals optimizations that are more global. In the current study, the experts appreciated even the existence of a list of digitalization (and digitization) ideas as a very valuable asset. The skills of the interviewer or consultant are crucial for the success, because (s)he has to winkle out the information and ideas from the heads of the experts.

The next step, the concrete implementation of digitalization projects, requires budget and resources. Support of the senior management is indispensible. In the considered company, some of the ideas would change the business model and would imply new monetization models. The effort to realize such projects is very high and will change the organization with its roles, competences and required knowhow. Hence, beside implementation activities such a digitalization initiative is also a large change management project. Nevertheless, the experts agreed on the need of changes in the current business due to new competitors and known deficiencies in the current processes.

From a scientific perspective, concluding and generalizing from a single case is not adequate. It is therefore necessary to apply the method described above in more case studies in different industries before the claimed benefits can be supported scientifically. This is matter of current and future work.

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