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Päivi Parviainen

VTT Technical research centre of Finland

Maarit Tihinen

VTT Technical research centre of Finland

Jukka Kääriäinen

VTT Technical research centre of Finland

Susanna Teppola

VTT Technical research centre of Finland

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Tackling the digitalization challenge: how to benefit from digitalization in practice

Päivi Parviainen

VTT Technical research centre of Finland Ltd
Tietotie 3, Espoo, 02044 VTT
Finland
www.shortbio.net/paivi.parviainen@vtt.fi

Jukka Kääriäinen

VTT Technical research centre of Finland Ltd.
Kaitoväylä 1, 90571 Oulu
Finland
www.shortbio.net/jukka.kaariainen@vtt.fi

Maarit Tihinen

VTT Technical research centre of Finland Ltd.
Kaitoväylä 1, 90571 Oulu
Finland
www.shortbio.net/maarit.tihinen@vtt.fi

Susanna Teppola

VTT Technical research centre of Finland Ltd.
Kaitoväylä 1, 90571 Oulu
Finland
www.shortbio.net/susanna.teppola@vtt.fi

Abstract:

Digitalization has been identified as one of the major trends changing society and business. Digitalization causes changes for companies due to the adoption of digital technologies in the organization or in the operation environment. This paper discusses digitalization from the viewpoint of diverse case studies carried out to collect data from several companies, and a literature study to complement the data. This paper describes the first version of the digital transformation model, derived from synthesis of these industrial cases, explaining a starting point for a systematic approach to tackle digital transformation. The model is aimed to help companies systematically handle the changes associated with digitalization. The model consists of four main steps, starting with positioning the company in digitalization and defining goals for the company, and then analyzing the company's current state with respect to digitalization goals. Next, a roadmap for reaching the goals is defined and implemented in the company. These steps are iterative and can be repeated several times. Although company situations vary, these steps will help to systematically approach digitalization and to take the steps necessary to benefit from it.

Keywords:

digitalization; digital transformation; systematic change; case studies; transformation method.

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1. Introduction

Digitalization has been identified as one of the major trends changing society and business in the near and long term future [1]. The impact of digitalization will be major; it has been compared to the industrial revolution by several authors [2]-[5]. In this paper, digitalization is referred to as a more fundamental change than just digitizing existing processes or work products. The term digitization refers to “the action or process of digitizing; the conversion of analogue data (esp. in later use images, video, and text) into digital form.” According to literature, digitalization, or digital transformation, refers to “the changes associated with the application of digital technology in all aspects of human society” [6]. Digitalization is also known as the “ability to turn existing products or services into digital variants, and thus offer advantages over tangible product” [7],[8]. According to Brennen and Kreiss [9] digitalization refers to “the adoption or increase in use of digital or computer technology by an organization, industry, country, etc.” The Finnish Tax Administration exemplifies the difference of digitizing and digitalization in the taxing of citizens; if the Tax Administration would have digitized their process, they would have implemented the tax reporting form as a digital form instead of a paper form and enabled attaching receipts and certificates in an electronic format as well. Instead, the Tax Administration renewed the entire process so that the tax authority electronically receives tax information directly from employers, banks, and other income sources of citizens, then the Tax Administration sends taxing proposal form to the citizens. If the proposal is correct, the citizen does not need to do anything.

Based on previously introduced definitions, digital transformation is defined as changes in ways of working, roles, and business offering caused by adoption of digital technologies in an organization, or in the operation environment of the organization. This refers to changes at several levels, including the following:

- *Process level*: adopting new digital tools and streamlining processes by reducing manual steps;
- *Organization level*: offering new services and discarding obsolete practices and offering existing services in new ways;
- *Business domain level*: changing roles and value chains in ecosystems;
- *Society level*: changing society structures (e.g., type of work, means of influencing decision making).

This paper focuses on the first three levels: the process, organization and business domain levels of digitalization and especially on how companies can tackle the change and benefit from it.

The potential benefits of digitalization are high; already by digitizing information-intensive processes, costs can be cut by up to 90 percent and turnaround times improved by several orders of magnitude. In addition, replacing paper and manual processes with software allows businesses to automatically collect data that can be mined to better understand process performance, cost drivers, and causes of risk. Real-time reports and dashboards on digital-process performance permit managers to address problems before they become critical [10.] According to Sabbagh et al. [11] digitalization offers incremental economic growth; countries at the most advanced stage of digitalization derive 20 percent more in economic benefits than those at the initial stage. Digitalization has a proven impact on reducing unemployment, improving quality of life, and boosting citizen access to public services. Finally, digitalization allows governments to operate with greater transparency and efficiency.

Even though the importance of digitalization is well known, companies are often struggling to understand the potential impact and benefits of digitalization. In practice, there are many obstacles to digital transformation. According to Henriette et al. [8], a digital transformation project involves implementing digital capabilities to support business model transformations impacting entire organizations, especially operational processes, resources, internal and external users. This is a major change in habits and ways of working, which is based on collaboration and intensive interactions. The Digital Business Global Executive Study and research project from 2015 [12] by MIT Sloan Management Review and Deloitte focused on more than 4800 business executives, managers and analysts from organizations around the world and how they saw the digitalization in their company. This study found that 76% of respondents felt that digital technologies are important to their organizations, and 92% believed that digitalization would be important in three years. Additionally, 60% of respondents mentioned that digital technologies would have the potential to fundamentally

transform the way people in their organization worked, and 76% saw that digital technologies would disrupt their industry greatly or moderately in the near future. The research further asked how the participants saw their company maturing for the digital transformation. The results show that 26% of the responding companies found themselves in the early stages of maturity in digitalization, 45% considered their company to be developing, and 29% of the respondents considered themselves to be mature companies in terms of digitalization. Mature companies typically had a clear digital strategy combined with a collaborative culture and leadership that was driving the transformation and encouraged risk taking. However, in many companies, failed implementation of enterprise resource planning was common, many times due to previous generations' knowledge management systems. The transformation did not succeed because organizations did not change mindsets and processes or build a culture that could foster the change. Lack of an overall digitalization strategy and competing priorities were the most typical obstacles for digitalization, together with security concerns and insufficient technical skills.

As introduced before, digitalization affects many aspects of organizations, including information technology, strategy and business models, products and services, internal and external processes, organization and company culture, etc. In this paper, the phenomenon of digitalization, especially digital transformation, is discussed from viewpoints of literature and experiences gathered from case studies. Finally, the produced synthesis - a model of conceptual framework - is introduced and discussed.

This paper is constructed as follows: first, we will introduce main observations based on literature reviews. After that, in section 3, research design with selected research methods are introduced. In section 4, case studies utilized in results' synthesis phase are described, and in section 5, the main result, a conceptual model of the framework, is presented in details. Finally, in section 6, research limitations and further research is discussed with the conclusion explaining the main research results.

2. Related work

In this paper, digital transformation is understood to induce a broad spectrum of changes in all human society areas [6]. However, there is very little scientific research published on digital transformation, as most published work is related to digitizing information, not the transformation of an organization or the ability to use digital means in the organization. Similar conclusions were reached in a systematic literature review carried out by Henriette et al. [8]. Their review showed that most existing papers regarding digitalization dealt with technological innovations (e.g., mobile technologies, analytics solutions), even though digitalization actually covers a wider scope. Furthermore, this study also identified a lack of research regarding the realization of digital transformation projects, i.e., research on how to manage a digital transformation and how to identify and manage the costs of this transformation.

A systematic literature review on digital transformation is currently being completed by the authors. According to results of this review, the pace of scientific publishing related to digital transformation is increasing, but literature on the topic still remains scattered and focuses predominantly on technological or other relatively narrow aspects of digitalization, often in the context of specific sectors such as healthcare, transportation, education, retail, manufacturing, smart cities, or public services and e-government (e.g., [13],[14]). A number of publications examine, often through case studies involving specific companies or regions, the digitalization-induced disruptive changes that have affected the business models, consumption, and audiences in media and music industries in which digital transformations started relatively early (e.g., [15],[16]).

Digital strategies and organizational changes needed in industries seeking to successfully execute digital transformations are discussed in a number of publications, again typically via case studies (e.g., [17],[18]) incorporating concepts, such as innovation capacity, capability frameworks, organizational ambidexterity, and digital maturity models, which link business processes and organizational cultures to exploitation of digital technologies (e.g., [19]). Recent works have called for wider perspectives, considered fundamental paradigm shifts and societal impacts in wider contexts, and outlined more comprehensive approaches and frameworks for treating digital transformation, either in specific industries or business functions (e.g.,[20]-[22]), or more generally, across different industries or sectors of

society (e.g., [23]), seeking to understand and support flexible transformation of business processes, information systems, and societies. Other efforts focus on identifying gaps in understanding and scientific knowledge that stand in the way of successful digital transformations (e.g., [24]) and identifying traits of effective digital enterprise [25].

Digitalization is currently a hot topic in non-scientific publications; there are many white papers, reports and blog writings available on the topic. Also, consulting companies are creating services to help companies in their digital transformation. However, these sources are usually based on opinions and speculations, and thus it is difficult for companies to know how reliable and suitable for their situation the information is.

3. Research design

3.1 Impact of digitalization

As pointed out, digitalization is already impacting business environments and the corporate way of working. Neglecting digitalization could create a risk of losing the game in the highly competitive markets. Digitalization can impact a company's entire operation environment and internal functioning. Digitalization can also bring new business opportunities, change the roles of operators in a value chain, and end existing business. For example, digitalization may remove traditional intermediates in the supply chain and create new intermediates. This can be due to, for example, direct access to consumers and the increased use of mobile devices.

Thus, the impact of digitalization, and the goals of digitalization for an organization, can be identified from three different viewpoints:

1. *Internal efficiency*; i.e., improved way of working via digital means and re-planning internal processes;
2. *External opportunities*, i.e., new business opportunities in existing business domain (new services, new customers etc.);
3. *Disruptive change*; digitalization causes changes business roles completely.

These three impact viewpoints of digitalization can be presented as shown in Fig. 1.

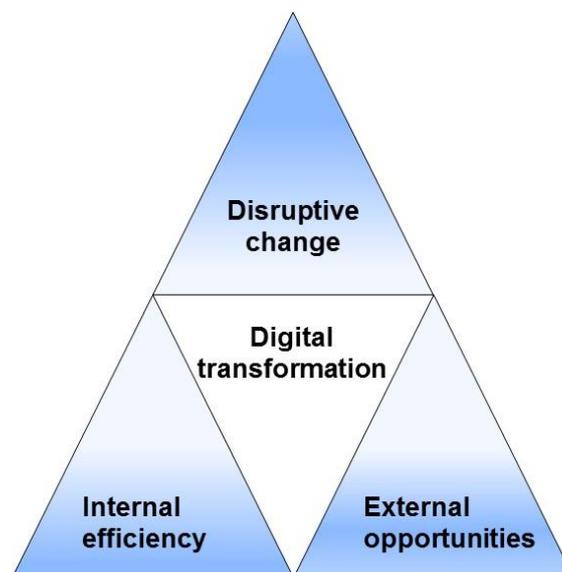


Fig. 1. Digitalization impact

The potential benefits of digitalization *for internal efficiency* include improved business process efficiency, quality, and consistency via eliminating manual steps and gaining better accuracy. Digitalization can also enable a better real time view on operation and results, by integrating structured and unstructured data, providing better views on organization data, and integrating data from other sources. Furthermore, digitalization can lead to better work satisfaction for employees through automation of routine work, thus freeing time to develop new skills. Digitalization also improves compliance via standardization of records and improves recovery via easier backups and distribution of storage.

External opportunities include improved response time and client service, as well as possibilities for new ways of doing business. New digital technologies can create opportunities for new services or advanced offerings to customers.

Disruptive changes involve changes in the operating environment of the company caused by digitalization; for example, a company's current business may become obsolete in the changed situation (e.g., manual scanning of invoices replaced by electronic invoice). On the other hand, digitalization can create completely new business, such as inclusion of an e-invoice operator, for example.

3.2 Research methods

Digital transformation is a new and often misunderstood phenomenon. A case study research approach [26] was used to better understanding of digital transformation, as case studies often examine complex and not repeatable circumstances and, in this way, gather information for the creation of new knowledge [27]. Furthermore, the Grounded Theory [28] has been applied to analyze collected data and to develop theory from the data.

This paper provides evidence from various case studies. There were several industrial cases involved the research projects, such as, PROMES ITEA 3 project (2014-2016, URL: <https://itea3.org/project/promes.html>), DIGILE Internet of Things - programme (2014-2016, URL: <http://www.internetofthings.fi/index.html>), TINTTI project (2015-2017, URL: <http://www oulu.fi/oulubusinessschool/node/41286>), DIMECC N4S program (2014-2016, URL: <http://www.n4s.fi/en/>) and DIC1 project (Competitiveness from digitalisation in clothing industry, 2016-2018). The phenomenon of digital transformation was approached according to grounded theory with questions of "What's going on with or via digitalization in the company?" and "What is the main problem/improvement target; and how those are trying to be solved?" For providing synthesis of observations, case studies were described formally, including descriptions of "Drivers and impact", "Current state", and "Approach", as introduced in section 4. Our hypothesis was that some clear drivers or impact goals of digitalization accelerate change(s).

Several case studies were carried out to collect data from several companies during years 2014 - 2016 (in several projects as described above), and a literature study was carried out to complement the data during the second half of 2016. However, the literature study revealed that there is not much literature on digital transformation as we defined it. Thus, we relied mostly on case study data. Multiple case studies are needed due to diversity of both the phenomenon and the subjects (companies and their situations). The case studies were diverse and thus not structured similarly, as we wanted to gain information as widely as possible. The gathered data was sorted and synthesized through qualitative coding related to different aspects of digital transformation. Thus, we were able to identify patterns in the case study data. The model for digital transformation was built based on the analysis of the patterns. The four case studies are described in section 4 and the patterns are included in section 5.

4. Reflecting digitalization via case studies

Recently, challenges to benefit from digitalization in practice have been increasingly discussed among companies. In this section, four examples from the case studies are introduced to provide understanding of the phenomenon and the research context. The cases are from companies that we have been collaborating with in research projects as described in section 3.2, and that have been experiencing digitalization and changes caused by it.

4.1 Automation systems provider and the digitalization of service processes

In this case, a company that produces automation systems is moving towards service business that has been seen as a trend in their business environment. Company aims to utilize the possibilities of digitalization to improve their service processes as well as to collaborate better with organizational units and customers.

Drivers and impact: The main driver for a company to take on service business is that business can increase. Therefore, service processes need to be digitalized in order to improve the efficiency of operation and surviving in global competition so that more money comes from services rather than product sales.

From a technological point of view, the technical deterioration (technology, commercial-off-the-shelf (COTS) - components, standards, etc.) of older automation systems is an industry problem. It has been estimated that the value of the worldwide installed base of automation systems reaching the end of their useful lives is approximately 65 billion dollars [29]. The reliability of technical systems will decrease over time if companies ignore industrial services; in fact, “for a typical automation/IT (information technology) system, only 20-40 percent of the investment is actually spent on purchasing the system; the other 60-80 percent goes towards maintaining high availability and adjusting the system to changing needs during its life span” [30]. One key service business process affected by this situation is an upgrade service, which is used to keep the customer’s automation system up-to-date by upgrading it based on a jointly (customer – provider) agreed plan. Therefore, in the best case, a process such as upgrade service provides a stable income stream for the automation system vendor. Since services are implemented in close collaboration with customers, it is important to better understand individual customer service needs to detect business potentials related to a customer’s personal automation system. Therefore, knowing the status of the customer’s automation system through its lifecycle is the basis for industrial services.

Current state: Automation system vendors have upgrade or evolution programs that aim to systematically and controllably evolutionize installed automation systems. These vendors seek to protect their customer base and prevent a situation in which the installed system reaches a point where a major investment in their automation plant is the only way to ensure its survival. Instead, automation system vendors provide a cost-effective path for a customer automation systems to evolve through a series of small and manageable steps in order to meet changing needs.

The upgrade process starts with identification of upgrade needs, and then the customer’s automation system configuration needs to be identified. The InstalledBase tool was used to identify this information, even though the coverage and usability of the tool was sub-par. Upgrade opportunities and impacts need to be analyzed based on automation system configuration and life cycle rules (rules that indicate the life cycle constraints and possibilities for different components and technologies). These rules impose a complicated dependency matrix between components and technologies. Finally, based on analysis, the lifecycle plan will be manually created and it will be modified together with the customer by taking into account schedules and budgets. Furthermore, the company has an extranet solution for exchanging information with the customer, but it does not provide more advanced communication and collaboration functions.

Approach: The target was to improve the Upgrade process with digitalization. The best possibility for improvement was estimated to be the InstalledBase tool. Other improvement items were life cycle rules, lifecycle plans and customer extranet for online customer collaboration. Since the easy to use InstalledBase tool with respectable coverage is the basis for all industrial services, the company selected it as a top priority improvement action. With up-to-date installation information, it is possible to provide more accurate and intimate services for customers. The customer extranet tool was prioritized as a solution that will be implemented later on. Furthermore, the automation of the creation of the lifecycle plan was studied since the creation of this plan is quite time-consuming. However, it became obvious that there needs to be flexibility in the creation of the plan. Therefore, the company ended up with a semi-automatic solution wherein the user could export the preliminary plan from the tool and then modify it based on negotiations (budget, schedules) with the customer. The future plan includes the development of a customer extranet tool, which will be a more sophisticated medium for vendors and customers to exchange lifecycle plans, comments, notifications, feedback and other material related to the configuration of the customer’s automation system.

4.2 Energy utilities

This case focused on the technological needs created for electric utilities towards making a better use of smart metering and other smart grid data. The focus was not on single company, but the electric utility domain as a whole.

Drivers and impact: The changes caused by digitalization, i.e., digitalization drivers, were seen to be technological developments, such as emergence of electric cars, and the smart meters, changes in the operational environment such as the increasing number of micro producers (e.g., utilizing solar power, or wind energy), and regulatory aspects relating to tariffs, etc. These changes were seen as causing potential changes on the energy utilities business and operating environment. The impact of these changes could be related to the requirements of the electricity network, balance management, and pricing mechanisms.

Current state: In their current state, the electricity grids aim to provide a constant unidirectional flow of energy to their customers and to gain knowledge of the end user's energy consumption via a unidirectional data flow from the energy meter. Consequently, the communication infrastructure related to electricity grids is very rigid and asymmetric by its nature. In order to enable the essential features of a Smart Grid, i.e. flexible switching of energy flows and real time interaction between the energy provider and the consumer, a truly interconnected architecture of electricity grids and communication networks is required. Moreover, in order to guarantee the delivery of energy under special circumstances, e.g. grid or network fault situations, there must be more than one route through which the control and monitoring data can be exchanged.

Approach: Storing and analyzing this data provides significant potential for utilities to improve the use of their network, to plan their investments better, and to have more accurate information on which to base their pricing. Of particular interest was increasing the knowledge of consumer and industrial use of electricity, which offers great potential benefits for utilities, especially when combined with demand side load management.

4.3 Virtual factory

This case dealt with a company producing embedded software systems in Electronic Manufacturing Service (EMS) partners. The case company deals with highly regulated product domain solutions tailored to B2B (business to business) customers. Delivered products share a common technology platform but include a wide range of features targeting individual customer needs.

Drivers and impact: The drivers for digitalization came from the business environment which required fast adaptation to customer specific needs, as well as customer intimacy, but at the same time even better efficiency, reliability and advanced technological competence in the fast changing domain area. Also, the need for using supply chains and the increasing need for product maintenance, along with decreasing the amount of human resources were the drivers for digitalization. To ensure that customer special needs were taken into account, close interaction between customer, company, and partners throughout the design and delivery process was required. However, there were blind moments in the delivery process, especially while the products were being manufactured at the EMS partner.

Current state: The case company had already improved the transparency of the delivery process to stakeholders by using shared tools and dashboards for monitoring project activities and performance in real time. However, visibility and level of digitalization in the processes that spanned over the supply chains and EMS partners was still low. Specifically manufacturing still included several manual steps in the form of specifications, status reports, quality control, etc. This step of the delivery process was a black box type of solution, which started from delivering specifications to the EMS partner and then getting the device back after manufacturing. The goal of digitalization was to improve the company delivery process by making it less risky regarding false release estimations and poor product quality. By starting the process of digitalizing their manufacturing in the delivery process, the target was to build capabilities to monitor and measure the manufacturing process in real time, and that way to find reasons for complicated quality problems and identify risks before they turned into issues, as well as to support maintenance activities.

Approach: By establishing digital and transparent methods, the company has defined important data that they want to collect from the manufacturing process in the supplier chain. This data involves important measurements regarding functional performance and quality of the manufactured devices and manufacturing process data. Data collected in the manufacturing process were connected to the other data sources of the company in the data warehouse. Combining master data, different data sources, and measurements across various processes impacted overall quality control positively, as well as performance monitoring, product lifecycle management and overall customer satisfaction in regard to delivered products. By creating a virtual factory solution, the company could monitor the feature performance and process of manufacturing in real time but also give better estimations for future delivery processes. The solution also gave the company better methods to control the manufacturing process and prepare for risks, change their EMS partners, update the test software with little time, and protect their IPR (intellectual property rights) better at the EMS partner.

4.4 After sales IT system provider utilizing industrial internet

Case company Absent Oy (<http://www.absent.fi/en/>) provides IT systems related to the different post manufacturing and after sales operations, such as sales configurators, customer support systems, etc. They aim to extend their offering with real-time continuous monitoring and analysis solutions that can be used, as an example, for predictive maintenance services.

Drivers and impact: The driver for digitalization was the recognition of business potential of Industrial Internet (II). Technology and II solutions. The prices of the components related to these solutions (e.g. sensors) are cheaper, and the awareness of digitalization and II is spreading across the industry. Furthermore, the need for new industrial service business and the rationalization of service business processes is emerging among industrial customers in order to survive in international competition.

Current state: The case company began developing solutions that manufacturing companies can use to provide new data-based service for their customers, e.g. predictive maintenance. This is not possible without applying II technology for data collection, monitoring, transfer, and analysis. II enables cost-efficient solutions for this.

The case company provides different kinds of after sales IT systems that help manufacturing companies and their partners in maintenance, reselling and warranty operations, as examples. So far, the bottleneck in this offering has been the lack of the data monitoring and analysis solution that can be used to collect and analyze data from the machines and equipment while they are in use in end user premises.

Approach: The case company has the roadmap for the solution implementation and production. The steps include the implementation, piloting, and production of the solution, and in parallel with the technical implementation, the business planning is ongoing. The case company aims to pilot the solution in its customer companies of different domains and investigate the potential of this solution in them. The case company implemented the new solution and gained the ability to integrate it with their customers' existing IT systems. A data collection bundle takes care of data collection, pre-analysis, and data transmission to data analysis services. Data analysis service signals are based on the rules that have been selected from algorithm database, through which a variety of services can be triggered in response to the data collected in the field. A data collection bundle with an analysis service can be used as a stand-alone solution, or the company can integrate it with its other IT system offerings. Integration with AfterSales IT system, for example, enables sophisticated lifecycle management and services for the whole fleet of equipment/machines.

5. Model for tackling digitalization in companies

The importance of digitalization is becoming understood, but the question now is how to do it in practice in order to best benefit from it. As a synthesis of gathered feedback and experiences from the case companies, a conceptual framework was created. The main goal of the framework is to provide a comprehensive model for supporting organizations in their digital transformation. The framework is intended to be general at this level so that it fits in

different situations. The framework needs to be detailed when more understanding of different situations is gained. In this section, the conceptual framework, a model for tackling digital transformation, is introduced.

The model focuses on tackling digital transformation in a company, as illustrated in the following figure (Fig. 2). The model follows commonly known plan-do-check-act principles [32] for improvement at a high level.

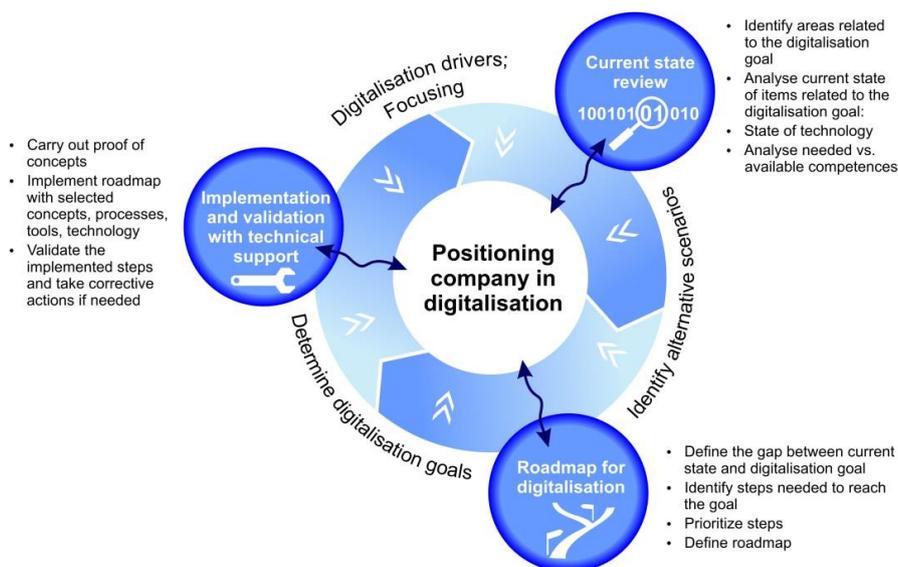


Fig. 2. Model for tackling digital transformation

The first step is to analyze the potential impact of digitalization for the company and decide on the position that the company wants or needs to take in the change. The second step is to review the current state of the company with respect to the desired position and the impact of digitalization, as well as to identify the gap between the current situation and the wanted future. The third step defines the approach that needs to be taken to close the gap from the organization's current state to the desired position and defines the concrete actions needed to reach the desired position. The fourth step is about implementing and validating the actions and returning to previous steps if needed. The model is used iteratively to gradually build the solution and fine-tune digitalization goals and plans, if needed. Next, each of these steps is discussed in more detail.

5.1 Positioning a company in digitalization

This step is divided into four sub-steps: digitalization impacts, digitalization drivers, digitalization scenarios, and digitalization goals. In order to define the position of the company, the digitalization impacts for the company should be analyzed first through identifying and analyzing current and upcoming trends of digitalization and the relevance of these trends to the company's business domain. Also, how far the business domain already is in adopting these trends should be analyzed. The trends can be categorized using SWOT (strength-weakness-opportunity-threat) analysis into topics that are strengths or weaknesses or can create opportunities or present threats in the business domain. This analysis sets the basis for positioning the company in digitalization.

Next, digitalization drivers should be identified for the company using the trend analysis results. This is done by looking at the relevant trends for the business domain and analyzing impact on the company. The importance of each of

these drivers should be defined in order to scale the next steps. For example, if it seems possible that the current business of the company will become obsolete without changes (e.g., due to new actors in the market that have invented a new business model), also the actions that are taken to avoid this, should be radical.

Based on the driver analysis, potential scenarios for the company's future should be analyzed for the most important drivers. This is done in order to understand the potential impact of the company's digitalization. As discussed in section 3.1, these impacts can be related to internal efficiency or external opportunities, but they can also be disruptive. Alternative scenarios for digitalization are identified and analyzed. This analysis involves evaluating the cost of implementing the scenario, benefits of implementing the scenario, and risks involved in both implementing and not implementing the scenario. Based on the scenario analysis, the best alternatives are chosen for the company.

The final task is to define the goals of the company's digitalization process by analyzing the selected scenarios and their feasibility for the company. These goals can differ in various situations depending on the potential impact of digitalization for the company. For example, the goal can be as narrow as utilizing a technology for faster operations or as broad as a complete renewal of business. When goals are defined, they should formulate to business related indicators through which improvements can be evaluated against the baseline situation and further improvements can be conveyed. The digital transformation is not a one-time-exercise in a company; instead, it is a continuous adaptation and streamlining to meet the changing demands of the business environment.

The result of this step is pinpointing the goals for a company's digital transformation.

5.2 *Review of the current state*

In this step, the current situation of the company is analyzed from the viewpoint of the defined goals. This step is divided into two sub-steps, which include analyzing impacted areas and analyzing the situation with respect to the goals. First, the impacted areas, or the issues related to the goal, are identified and analyzed. In case the goal is related to internal efficiency, the related processes, tools and resources are identified (these more detailed elements of the areas are called as issues). If the goal is related to external opportunities, customers, competitors, and external resources and processes are identified. If the goal is related to disruptive change, it is likely that all of the company is impacted.

After the impacted areas are identified, their situation in respect to the goal is analyzed. The questions to be answered vary based on the goal. If the goal is internal efficiency, the questions relate to the currently used practices—for example:

- How is the issue handled now, and how satisfied are the stakeholders with the current situation?
- What is the state of technology used to handle the issues?
- What main bottlenecks exist in the current practice?
- What current competencies related to the goal are available?
- What are restrictions for change relating to the issue?

In case the goal is related to external opportunities, questions are related to the business case, including, for example:

- What are the current company offerings?
- Who are the current customers and what are the current customer segments?
- What is the competitive advantage of the current offering compared to competitor offerings?
- What are the potential new customer segments and who are the potential new customers?
- What is the current state (e.g., competitors offering) in the new segment?
- What would be the competitive advantage of the company in the new service or segment?
- What is the cost of implementing the new offering?
- What risks are involved?
- What is the impact on the company's current offering and business?
- What is the window of opportunity?

In case the goal is related to disruptive change, the following questions are related to all the company's areas:

- Which current company offerings are impacted?
- How dramatic is the impact on each offering (offering becoming totally obsolete, current customers of the offering leaving to find opportunities in other segments, etc.)?
- Which processes are involved with the change?
- What competencies and resources does the company have?
- Where can these competences be utilized in the future?
- What is the timeframe of the change?

As a result, a detailed description of the current state with respect to the digitalization goal is described.

5.3 Roadmap for digitalization

In this step, the detailed plan for reaching a goal is defined. This step is divided into four sub-steps, including identifying the gap between current state and goal, planning the actions needed to close the gap, analyzing feasibility and prioritization, and creating a roadmap. First the gap between the digitalization goal and the current state is determined in detail. In case the goal is related to internal efficiency, the current state of the processes and technology used is analyzed against the goal, and desired changes are identified. In case the goal is related to external opportunities, the definition of the gap involves a definition of the work that needs to be done to develop the offering for the new customer or segment, including needed competences, development work, and possible changes in the current offering. In case the goal is related to disruptive change, the gap analysis involves defining the current issues (competences and offerings) that can be utilized in the new situation, as well as identifying missing issues.

When the gap is defined, actions to close the gap should be defined. In case of an internal efficiency-related goal, the actions can be taking on new technologies (e.g., IT tools) and optimizing an existing process or re-defining processes utilizing digital opportunities. When improving internal efficiency with digital opportunities, the current way of working should not just be digitized, but functionalities should be defined so that digital opportunities are used optimally. This analysis should consider which processes would have the highest potential to benefit from digitalization and the criticality of the processes to improving business. Key Performance Indicators (KPI) should be re-evaluated and updated to better meet new business targets. In case of external opportunities and disruptive change goals, the actions could involve defining and developing new offerings, acquiring new competences, analyzing potential new markets, and rearranging internal resources.

When actions are identified, the feasibility of these actions should be analyzed and prioritized. Feasibility analysis involves, for example, a cost-benefit analysis, an impact analysis on existing practices, offerings and resources, a risk analysis, and an analysis of constraints. Common costs of digitalization include the technology needed for digitalization, training and support for staff involved in digitization work, and maintaining the digital data. Also, as digitalization involves change, all common costs related to changing the way of working apply. Part of feasibility analysis can be trials and prototypes of the potential solutions in order to gain deeper understanding of the actions needed. Then the actions are prioritized considering dependencies between the actions and views of relevant stakeholders. Also, the organization's ability to change should be considered so that the correct pace of change can be implemented.

When the actions are prioritized, they can be arranged into an actual roadmap, defining the order, importance, and responsibilities for the actions.

5.4 Implementation with technical support

This step is about implementing and validating the actions defined in the road map. It is often useful to first implement proof-of-concepts when new technical advancements are attempted. As this step is highly dependent on the goals and planned activities of previous steps, there are no generic sub-steps identified.

Digital transformation involves a change, and thus all facets of change management should be considered including: managerial disputes about the nature of advancement, a socio-cultural challenge resulting from the organizational effects on the involved people (which may lead them to react against those changes), and a technical challenge, which is due to the difficulty in understanding and adopting a new technology.

The validation of actions should analyze whether the actions lead to desired impacts, and corrective actions should be considered in case desired impacts are not met.

6. Conclusion

The current trends of digitalization change the environment where companies operate. In this paper, changes were considered at the process, organization and business domain levels. The changes can be new possibilities to do things more effectively or affordably, but they can also be disturbing to a company's current operations, as digitalization fundamentally changed a company's business opportunities. Digitalization is not about turning existing processes into digital versions, but rethinking current operations from new perspectives enabled by digital technology. In this paper, the phenomenon of digital transformation has been discussed in the context of case studies, and through introducing the model for tackling the change and getting most benefit from it.

Well-known examples of digital transformation include Uber disturbing taxi business, Airbnb disturbing hotel business, and streaming of music and movies disturbing record company, cable television, or movie network business. Digitalization affects all businesses, and the impact will only increase in the future. Therefore, it is important that companies take a proactive approach, rather than waiting to see what will happen or thinking that their current position in the markets will remain the same if they do not do anything.

Digitalization is the key enabling issue for providing internal efficiency in organizations, or for providing external opportunities such as new services or offerings to customers. In addition, there can be disruptive changes in the operating environment of the company caused by digitalization. All of these changes can be translated into success even though digital transformation is a monumental and multi-dimensional concept. Each company's situation is different, as is clear from the case studies described. Thus, there is no silver bullet for tackling digitalization.

This paper explains a starting point for a systematic approach to tackle digital transformation that will help companies analyze the impact of digitalization and the needed steps for their specific environment. The method describes four main iterative steps: first company must define its position with respect to digitalization as well as goals that the company wants to achieve. Then the work needed to reach these goals must be defined based on identifying the gap between the goals and current state, which is followed by systematically planning a roadmap for success, and implementing the roadmap into practice utilizing proof of concepts as needed.

This paper describes the first version of the digital transformation model, derived from synthesis of diverse industrial cases carried out and existing literature. However, this model is currently quite generic, and further studies are needed to add detail and bring it closer to practice. In the future, we plan to further evaluate and develop the model in additional case studies and modify or bring details into the model as needed.

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Biographical notes**Päivi Parviainen**

Dr. Päivi Parviainen received her M.Sc. in Information Processing Science from the University of Oulu in 1996 and her PhD in Information Processing Science from the University of Oulu in 2013. She is currently working as a Principal Scientist in the Digital Transformation team at VTT Technical Research Centre of Finland Ltd, in Espoo, Finland. She has worked at VTT since 1995. Over the years she has authored over 35 publications. Her research interests include digital transformation, product and digital service development practices and global software development practices.

www.shortbio.net/paivi.parviainen@vtt.fi

**Maarit Tihinen**

Dr. Maarit Tihinen works as a Senior Scientist in the Digital Transformation team in VTT Technical Research Centre of Finland Ltd. She graduated in the department of Mathematics and received her PhD in 2014 in the department of Information Processing Science from the University of Oulu, Finland. Tihinen has worked in various national and international research and customer projects. Her research interest includes e.g. global software development, process improvement, measurements and metrics, Internet of Things, Industrial Internet, and digital transformation.

www.shortbio.net/maarit.tihinen@vtt.fi

**Jukka Kääriäinen**

Dr. Jukka Kääriäinen works as a Senior Scientist at VTT Technical Research Centre of Finland Ltd in the Digital Transformation team. He has received PhD degree in 2011 in Information Processing Science from the University of Oulu. He has over 10 years of experience with configuration management and lifecycle management. He has been involved in various European ITEA, ITEA2 and Artemis research projects.

www.shortbio.net/jukka.kaariainen@vtt.fi

**Susanna Teppola**

Mrs. Susanna Teppola works as a Research Scientist at VTT Technical Research Centre of Finland Ltd since 2000. She has over fourteen years' experience in ICT. Her current research interests include product and service management, software development processes and practices. In these areas she has participated in many industrial and industry-driven research projects and project preparations both at national and international level.

www.shortbio.net/susanna.teppola@vtt.fi