



Digitalization of Small and Medium-Sized Enterprises: An Analysis of the State of Research

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Abstract. This paper gives an overview of the existing research topics in the field of SME digitalization. Digitalization commonly causes severe changes in both, organizational structures, business models and the IT landscape of an enterprise, i.e., there is a need for business and IT-alignment. By means of a literature analysis and a subsequent systematic mapping study the paper examines on which areas current research work in the field is focused and where potential research gaps exist. The literature analysis has its focus on already existing literature analyses in order to get a comprehensive overview. All identified papers are subsequently classified and visually represented in a diagram. The classification is done in two dimensions. Dimension 1 shows to which step of the digital transformation process the papers refer, dimension 2 refers to the success factors of the digital transformation. The result shows that the focus of recent research mainly was on the analysis of the current situation in companies and that the other steps of the digital transformation are largely ignored. The paper also concludes that there is no step-by-step guide for SMEs that shows how to go through the digital transformation.

Keywords: Digitalization · Digital transformation · SME · Literature analysis · Systematic mapping

1 Introduction

More than 99% of all companies in Europe [11] are small and medium-sized enterprises (SMEs). Research in digital transformation indicates that SMEs consider digitalization and digital transformation as major challenges, in particular due to the effects on both, business and IT. In order to remain competitive and open up new fields of business, the use of digital technologies is often unavoidable. Digital transformation often causes severe changes in business models, forms of organization and work, products and processes [9]. This transformation requires both the use of innovative technologies, such as those emerging in the field of artificial intelligence (AI), and the management and social shaping of organizational change processes [8]. In this context, the present article aims to determine the current state of research on this topic. For this purpose three research questions were formulated.

RQ1: Which areas of digitalization in connection with SMEs did previous research address in literature analyses? The areas of digital transformation can be very diverse. The aim is to find out which ones the researchers focus on. Examples include new technologies, such as the Internet of Things or virtual reality, or the changes in the company brought about by digitalization, such as the new corporate culture or digital leadership.

RQ2: What steps in the process of digital transformation are researchers focusing on? There are various approaches that structure the process of digital transformation step by step. In this paper the process of Klasen [K119] is used. The paper aims to determine which of the steps in the process the researchers are concentrating on.

RQ3: Which weaknesses or gaps in research on the digitalization of SMEs can be identified? The weaknesses or gaps can be, among other things, areas of digital transformation that are not or only marginally addressed by researchers or process steps of digital transformation that are not sufficiently addressed.

The paper starts with a short background on digitalization and business and IT alignment (Sect. 2). It follows a systematic literature analysis (Sect. 3) with primary focus on already existing literature analyses. In Sect. 4, a systematic mapping study is conducted to categorize the literature found and to reveal gaps in research. On the one hand, the steps of the transformation process (Sect. 4.2) are categorized and on the other hand success factors of digital transformation (Sect. 4.3) are considered. The result (Sect. 4.3) shows that most scientific contributions focus on the first transformation process step, analysis. Section 5 discusses the limitations of the work. In the last section, the main findings of the paper are summarized and an outlook on future research is given (Sect. 6).

2 Background: Digitalization and Business/IT-Alignment

Digitalization and digital transformation are topics receiving substantial attention in research and industry. The general expectation is that they will have substantial effects on markets, companies and their operations. Digitalization can be seen, in simplified terms, as a generic term for efforts to convert information, documents, processes, products or services into a form that can be processed or supported by IT. In research, digitalization historically is subdivided into phases which, depending on scientific background, are more technologically characterized, consider the socio-economic change or investigate specific industries [35]. The current phase, denoted “digital transformation”, is often referred to as the “third” or “fourth industrial revolution” [35]. The focus of DT is on the disruptive social and economic consequences, which, due to new technological application potentials, lead to changes in economic structures, qualification requirements for employees and working life in general [34].

Business and IT-alignment (BITA) in general is a continuous process aiming at aligning strategic and operational objectives and ways to implement them between the business divisions of an organization and the organization’s information technology division [7]. Many challenges are linked to BITA since the business environment continuously changes and so does the IT in an enterprise, but the pace of change and the time frame

needed to implement changes are different. Digital transformation is considered as major driver of changes in both, business environment and IT. As a consequence; BITA is of high relevance in digital transformation processes. In this context, the success factors for digital transformation and the different DT phases investigated in the literature study can serve as contributions to structuring the BITA.

3 Literature Review

A systematic literature analysis is carried out to review the existing work. The following section describes the exact procedure of the literature analysis and presents the results.

3.1 Method and Search Term

For the literature review the approach of Kitchenham [13] is used. Kitchenham says that before a systematic review is undertaken it must be ensured whether it is necessary at all. In particular, already existing reviews should be identified and evaluated. This reflects an aim of this paper. For the literature analysis the following steps are taken from Kitchenham's approach: (1) Formulation of research questions, (2) Selection of resources to be searched, (3) Definition of search terms, (4) Definition of selection criteria, (5) Checking the relevance of the results, (6) Analysis of the results found to be relevant. The research questions are already defined in the previous chapter (1). In the next step the resources to be searched are selected (2). Besides Scopus (www.scopus.com), Web of Science (www.webofknowledge.com) and EBSCOhost (search.ebscohost.com) the database AIS eLibrary (<https://aisel.aisnet.org>) is searched. The following search strings are used (3), which refer to the title, abstract or keywords:

- `digi* AND "literature review" AND (sme OR "Small and Medium Enterprise")`
- `Digitalisierung AND Literaturanalyse AND (KMU OR "kleine und mittlere Unternehmen")`

As described by Kitchenham [13] different terms and synonyms are used for the search. Synonyms used for "literature review" are literature analysis, systematic review and structured review. Selection criteria for the results are defined (4). Since the current state of research is of particular interest, all publications before 2016 will be excluded. Furthermore, the search will be limited to German and English language contributions. Based on these criteria a first number of contributions can be identified. For a preliminary evaluation the title and the abstract are read to decide on relevance.

3.2 Evaluation of the Literature Review

Table 1 gives an overview of the results found with the help of the search terms as well as those subsequently found to be relevant. Especially with EBSCOhost a large number of contributions must be declared as irrelevant. The reason for this is that the database also lists so-called "news" that have no scientific background. In addition, EBSCOhost and Web of Science also provide articles that are already included in the Scopus results

set. The abstract is read of those articles that cannot be sorted out at first sight. With the help of the abstract it can be recognized whether the articles explicitly refer to SMEs and whether a literature analysis is carried out. If both points are not evident, the contribution is found to be irrelevant and thus sorted out. Thus, 18 out of initially 70 found contributions can be considered relevant.

Table 1. Results of the literature analysis

| Database | Findings | Results of relevance |
|----------------|-----------|----------------------|
| Scopus | 15 | 10 |
| Web of Science | 7 | 2 |
| EBSCOhost | 45 | 4 |
| AISeL | 3 | 2 |
| Summe | 70 | 18 |

The 18 literature analyses focus on different topics that are repeated in different contributions. Based on these recurring topics, the areas shown in Table 2 were identified. The main focus of research in connection with digitalization of SMEs is mainly on Industry 4.0 and readiness/maturity models.

Table 2. Topics of the articles

| Topics | |
|----------------------------|----------------------------|
| Industry 4.0 | [6, 10] * [18, 19, 23, 27] |
| Readiness/Maturity | [18, 19, 27, 29, 33] |
| Servitization ^a | [17, 25] |
| Big Data | [22] * [23] |
| Marketing/Social Media | [5] * [12] * |
| IT-Governance | [15] |
| Other Topics | [21, 28, 30, 32] |

^a“Servitization is the innovation of an organization’s capabilities and processes to shift from selling products to selling integrated products and services that deliver value in use.” [2].

Due to access restrictions¹, 4 of the 18 papers found to be relevant cannot be read and analyzed in full. As a result, only the results of the available 14 papers are comprehensively examined and included in the Systematic Mapping.

¹ Articles that were not available in full text are marked with an *.

4 Systematic Mapping

In the following section the theoretical basics of Systematic Mapping are presented. This includes the description of the procedure of Systematic Mapping as well as the explanation of the dimensions “steps in the transformation process” and “success factors for digital transformation”.

4.1 Systematic Mapping Process Based on Petersen et al.

Systematic mapping studies are used to categorize research contributions and results and to present them visually [26]. Petersen et al. [26] propose the following process for this study. (1) Definition of the research question; (2) Search for primary literature; (3) Screening of the papers found; (4) Keywording of the abstracts and preparation of the classification scheme and (5) data extraction and mapping

As a literature analysis already was carried out, we continue with step 4. Since the papers identified in the literature analysis are themselves literature analyses, all papers found in the analyses are classified. The classification is based on the abstracts. Deviating from Petersen et al.’s [26] suggestion, classes are defined in advance, i.e. the papers found are only sorted in. The classes are based on business transformation process according to Klasen [14] on the one hand and on the success factors for digitalization based on the dimensions of the Digital Maturity Check of St. Gallen [3] on the other.

4.2 Process of Transformation

According to Klasen [14], business transformation is the strategic reorientation and organizational transformation of a company or one of its parts in order to secure its long-term performance in the market [14]. This reorientation of the entire company can also be caused by the introduction of digital technologies, for this reason the process steps according to Klasen [14] can also be used for digital transformation. Klasen’s approach was chosen because the author not only has a scientific background, but also has practical experience and was able to shape important transformation processes in an entrepreneurial manner. This practical relevance was important to us.

In the first step of the process, the problem that will arise or has already arisen due to certain factors must be recognized and analyzed. Examples of these factors can be: new customer needs, substitute products that make the own product redundant and the related new development of products and services. The next step is to develop a strategy to counteract these problems. According to Klasen [14] the company asks itself the following questions, among others: How will we differentiate ourselves and our products in the market in the future? Which skills must be developed and used in the future?

Before the developed strategy can finally be implemented, a project for its implementation is started. The most important activities for starting a project include setting up the project team, project planning. After project planning, the actual implementation of the goal set by the strategy takes place. The implementation is divided into three phases. In concept planning, a bundle of different solution variants for the implementation of the strategy (or parts of it) is developed, evaluated and the best idea for the company is

proposed for further detailed planning [14]. In the detailed planning phase, the agreed solution variants are worked out and concrete plans for implementation are drawn up so that execution can take place in the third phase. Here it is important that the progress of the measures is regularly measured, evaluated and communicated. Especially if the new strategy to be implemented has an impact on the company’s employees, it is inevitable to include them. Since the acceptance of the new strategy by the employees is of crucial importance, early involvement is essential. This can be done during the project start in order to be able to react to resistance and wishes.

In addition to employees, there are other stakeholders who should be informed about the transformation. This includes, for example, the customers who, for marketing purposes, should also be made aware that something is about to change. At the end of the transformation process is the anchoring. Anchoring includes the documentation of the results and experiences of the transformation process. The results are recorded by the project documentation. A knowledge management system ensures that the acquired knowledge is passed on to colleagues within the project.

The following chart shows the transformation process according to Klasen [14].

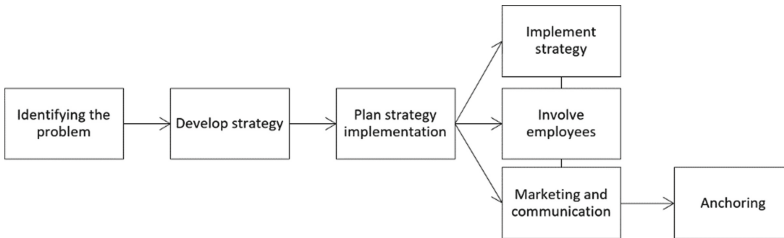


Fig. 1. Transformation process based on Klasen [14]

4.3 Success Factors of Digital Transformation

To be successful as a company in the digital transformation, several factors play a role that must be taken into account. The so-called success factors. The success factors used in this article are taken from the Digital Maturity Model of the University of St. Gallen [3]. The categories addressed in the Digital Maturity Check and listed in Table 3 support the company in reflecting on the effects of digital transformation and identifying possible fields of action and are therefore also suitable as success factors.

Other authors have also dealt with success factors of digital transformation and identified similar factors. However, leadership, governance and network partners (e.g. suppliers) were also mentioned [1, 16] (Table 4).

4.4 Evaluation of the Systematic Mapping

Based on the transformation process and the success factors, a graphic is now created and the identified papers are sorted. The result is shown in Fig. 2.

Table 3. Success factors of digital transformation based on St. Gallen [3]

| Success factor | Description |
|---------------------------|--|
| Customer Experience | The needs and requirements of the customers are known and it is possible to react to changes |
| Product innovation | New products and services are developed through the use of digital technologies |
| Strategy | Digital technologies are firmly anchored in the corporate strategy |
| Organization | The organisation is adapted to the new challenge and has the necessary resources |
| Process digitalization | Processes are adapted to the digital structures and, if possible, are automated |
| Collaboration | Digital technologies are used for more efficient collaboration |
| Information technology | IT infrastructure and information systems enable the use of new digital technologies |
| Culture & Expertise | The employees are open to new technologies and missing digital expertise is being built up |
| Transformation management | Digital transformation is a supported, planned and controlled process |

Table 4. Additional success factors of the digital transformation

| Success factor | Description |
|------------------------------|---|
| Leadership | All managers are involved in the implementation of the digital strategy |
| Governance | The digital activities can be viewed and controlled by the company |
| Network partners (suppliers) | New digital technologies are examined to determine whether a connection to the supplier is possible |

The mapping shown does not contain all identified papers. For some papers it was not possible to sort them into the previously defined classes because they deal with other topics of digitalisation, such as ecological factors or the development of different software. Furthermore, a classification of the contributions of Michalik et al. [17] and Peillon and Dubruc [25] on the topic of servitization into the scheme is not possible. In the remaining 12 contributions examined, a total of 208 papers were identified and sorted into the mapping. It is possible that a paper was sorted into several categories.

The graph shows that most researchers are concerned with the analysis of SMEs. This includes in particular the often mentioned readiness or maturity models. The most

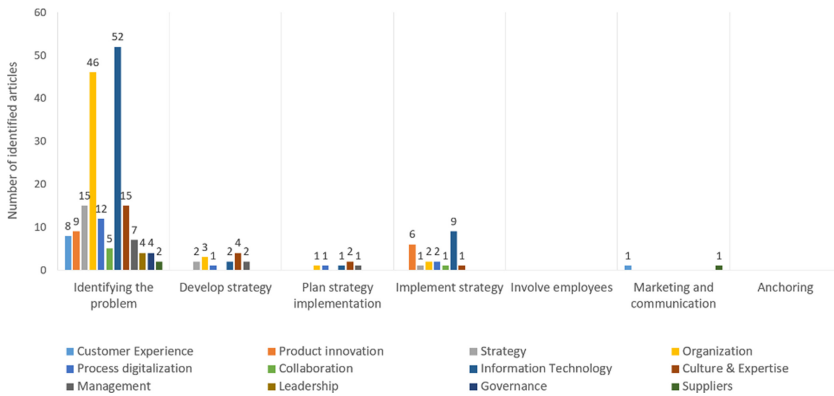


Fig. 2. Systematic Mapping

frequently mentioned dimensions/factors in these models are strategy, organization, processes, technologies and culture and expertise in the company.

Pirola et al. [27] conclude that the existing Maturity models have limitations with regard to their use in SMEs because the structure of the models does not always fit the organizational forms of SMEs. Mittal et al. [18] also state in their research that the models identified in the literature are mainly oriented towards the needs of larger companies and also identify a research gap.

But before measuring the maturity of a company, the question arises: Which factors and resources are relevant for the willingness of a company to respond to the digital challenge [29]? In this context, Sanchez and Zuntini [29] have derived a framework for digital literacy in SMEs. The framework aims to assess organizational readiness in terms of its ability to create value in the new digital environment. For this purpose, the internal and external components are analyzed. Internally, the success of the company in creating value clearly depends on the definition of a digital strategy and the ability to implement it [29]. But although the definition of a strategy is so important, there is no support for SMEs for the next step after the maturity level has been assessed [18]. This is also clearly shown in the graph, the steps after the analysis of the company are not very much discussed in research. Only seven publications² deal with the development of a strategy for digital transformation.

One of the factors addressed in the process step of strategy development is the factor “culture and expertise”. This tendency also coincides with the strategic questions for strategic reorientation mentioned by Klases [14]. For example, it says “What skills must the company develop and use in the future? Constant technological development means that the capabilities of organizations and people must be developed further in order to be able to respond to current and future challenges. In this context, Sousa and Wilks [30] cite disruptive technological capabilities such as artificial intelligence, robotics, the Internet of Things and digitalization. However, it is important to develop not only technological skills, but also skills that contribute to the development of society as a whole. Sousa and Wilks [30] give the following examples: critical thinking and

² Multiple answers are possible in the matrix.

problem-solving skills; network collaboration; adaptability; effective oral and written communication; information evaluation and analysis; curiosity and imagination.

The next process step is “project planning”. According to Klasen [14], this step includes an assessment of the risks of the project. According to Moeuf et al. [20], the biggest risks in the introduction of Industry 4.0 in SMEs include a lack of expertise and a short-term strategic mindset. The contribution of Moeuf et al. [20] also shows that training is the most important success factor, that managers have a prominent role in the success and/or failure of a project and that SMEs should be supported by external experts. Birkel et al. [4] also discuss the risks of introducing Industry 4.0 in their contribution, which the authors divide into 5 categories. Economic risks include the risks associated with high or wrong investments. From an ecological point of view the increased waste and energy consumption as well as possible ecological risks are described in connection with the concept of “batch size one”. From a social point of view, the loss of jobs, the risks of organizational restructuring and the re-qualification of employees, as well as internal resistance are considered, among other things. In addition, risks can be associated with technical risks, e.g. technical integration, information technology (IT) risks such as data security, and legal and political risks, e.g. unclarified legal clarity with regard to data ownership [4].

The second most common process step, yet one that is treated very little, is implementation. In the implementation of digitalization projects, researchers focus primarily on the technology factor. Moeuf et al. [19] identify reasons for the introduction of new technologies. Flexibility, cost reduction and improvement of productivity play an important role here. Nevertheless, Moeuf et al. [19] note that SMEs use newer technologies only to a limited extent. First and foremost, the low-cost but least revolutionary technologies such as cloud computing and simulation are being introduced, while those that enable profound business transformations, such as collaborative robots or machine-to-machine communication, are still neglected. The reason for the hesitant introduction may be that SMEs have a lack of resources compared to larger companies. Among other things, there are no resources to finance research and development activities or to manage computer solutions [19].

The step of involving employees, which Klasen [14] cited as a very important point, as well as all subsequent steps could hardly be identified in the analysis. Only Veile et al. [31] mention in their contribution the communication with suppliers and customers. It is shown that the digital networking of suppliers and customers contributes to the optimization of the global value chain.

5 Limitations

Limitations in the present work should not be left unmentioned. The main limitations lie mainly in the literature analysis itself. On the one hand, only three databases were searched and thus perhaps important contributions were not found. On the other hand, many papers were already sorted out on the basis of their abstract. There is also the possibility that important publications were sorted out by mistake. The limitation to articles after 2015 may also lead to the fact that important contributions were not found. Another limitation of the work may be that some papers may have addressed each other.

For example, Mittal et al. [18] may have referred to the work of Moeuf et al. [19] in the literature analysis for Industry 4.0 and therefore achieve similar results. These references were not reviewed. In addition, papers on the topic of marketing/social media were not available as full-text, which meant that an essential topic was lost. In the case of systematic mapping, the sorting of the papers in the classes was very subjective and was done only on the basis of the abstracts. As a result, contributions may have been sorted incorrectly or not at all.

6 Conclusion and Outlook

This paper has provided an overview of current research on digitalization in SMEs. It is noted that in the last 4 years 18 literature analyses have been carried out on this topic by different researchers from different countries. The focus of the research is mainly on the development and evaluation of readiness and maturity models and Industry 4.0 (RQ 1). This trend is also evident in Systematic Mapping. Research is mainly concentrated on the transformation process step analysis (RQ 2). However, not all success factors of digital transformation are addressed in the same way here, but primarily the organization of a company and the technologies used or to be used are considered, which confirms the trend towards Industry 4.0. Especially neglected at the stage of analysis are the management, IT governance, the cooperation of employees among each other and the connection to or cooperation with suppliers. Although the main driver in change processes is primarily the management of the company [24], this plays hardly any role in research on digital transformation in SMEs. Except in the analysis phase, the factor leadership is no longer addressed. Beyond the process step of the analysis, only isolated publications can be found. Strategy development and the implementation of these are only dealt with in a small number of contributions. However, not all success factors are covered here either. For example, the factors leadership, as described above, IT governance and suppliers are not addressed at all in these stages of the transformation process. In the implementation phase, technologies play a particularly important role. In addition, current research only addresses project planning with regard to the risks of implementing digital transformation, in particular Industry 4.0. In addition to the lack of expertise, management and technologies are also addressed here. The involvement of employees and the anchoring of the implemented strategy are not addressed in any way. Only the step marketing and communication, here especially the communication to suppliers and customers, is mentioned in an article. The present paper thus shows that the main focus of research is on how to measure the digital maturity of a company. After the measurement, however, companies do not receive any support or advice on how to improve the level. It could be recognized that there is a large gap in research on the development of digitalization strategies and their successful implementation (RQ 3). This finding is supported by the fact that very few contributions have been identified in this area.

Future research should focus primarily on how SMEs can go through the process of digital transformation step by step. Here, the first step should be to examine whether and how many general models for digital transformation exist and whether these have already been successfully used before they are adapted to the structures of SMEs.

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