Developing Digitalization Strategies for SMEs: A Lightweight Architecture-based Method

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Abstract

Like larger companies, small and medium-sized enterprises (SMEs) need to develop and implement digitalization strategies. These help to address necessary organizational- and technology-related changes in order to create competitive advantages. However, SMEs often face specific challenges, including a lack of IT know-how, relevant market information and appropriate methods for developing a strategy. In this paper, we present a lightweight, architecture-based method including its underlying model for the development and implementation of digitalization strategies in SMEs. It was developed by following the Action Design Research (ADR) method and in cooperation with two medium-sized companies. Rather than adopting highly abstract and complex enterprise architecture (EA) frameworks, we suggest creating easy-to-use visualizations of the enterprise architecture, the business ecosystem and related cross-layer dependencies. While transferring the discipline of EA into the context of digital entrepreneurship, we derived four design principles which help to enrich the theoretical body of knowledge in this research area.

1. Introduction

As a technology-based change process, the digital transformation (DT) is not limited to large and established companies. In times of a digital economy, enterprises of all sizes and ages need to rethink their strategy, organization and technology use. This has been referred to as digital entrepreneurship in the literature and it results in a variety of change and innovation activities [4, 27, 28]. However, most research in this field is based on the assumption that a professional and sufficiently large IT organization with differentiated roles supports the innovation activities [32]. SMEs, especially away from conurbations, often face special challenges, such as high exploration costs, a perceived imbalance of risks and chances to adopt innovations and technologies, a lack of relevant market information as well as insufficient digital skills among the employees [18, 32]. To anticipate and address potential tensions on multiple organizational levels in the DT process [28], experts from different departments and hierarchies should be involved in the development and implementation process to also include their organization-, process- and technology-related knowledge.

EA (management) finds high acceptance in science and in practice [39]. By supporting the alignment of business and IT with an enterprise-wide view on organizational and technological artifacts [37, 39, 48], the benefits of enterprise modeling are largely undisputed [37]. EA helps to document and analyze the current state as well as to plan future target states of the enterprise [33, 48], and can serve as the basis for developing strategies in the context of DT [51]. However, frameworks such as the Zachman Framework [50] and TOGAF [40] are predominantly complex, highly abstract [14] and criticized with respect to their practical applicability [14, 21, 49]. In the sense of grass-roots modeling [37] and by realizing Winter's idea of architectural thinking for this field [46], we seek to develop a more lightweight solution for SMEs, which is visualization-oriented and pragmatic.

Hence, our research question is: How can a lightweight, architecture-based method support SMEs in developing and implementing digitalization strategies?

The paper is organized as follows: First, we summarize related research and outline our understanding of a digitalization strategy and existing concepts for its development. We highlight the importance of an architecture-based view of the enterprise and its business ecosystem based on results from EA research. Next, we present our research approach which is based on the ADR method by Sein et al. [38] and expound the methods applied in the development process of the two investigated companies. As a result, we present our lightweight, architecture-based method for developing digitalization strategies in SMEs and the underlying lightweight enterprise architecture (LEA) model. In addition, we derive design

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principles to enrich the theoretical body of knowledge in this research area. We conclude with a discussion of our results and implications for further research in this field.

2. Theoretical background

In the literature, the terms IT strategy, DT strategy, digital business strategy, digital strategy, and digitalization strategy in particular are often used synonymously, and their distinction remains unclear [5, 6]. Digitalization describes "the manifold sociotechnical phenomena and processes of adopting and using technologies in broader individual, organizational, and societal contexts" [23, p. 302], and thus goes far beyond a purely technical view [43, 51]. Accordingly, a digitalization strategy "constitutes a holistic intention of a company to streamline all activities regarding the DT process to generate competitive advantages through new technologies and methods" [34, p. 670]. Building on this understanding, in the context of transforming (small and medium-sized) enterprises, for us, a digitalization strategy is transformation- and capability-oriented and goes hand in hand with the business needs and thus the corporate strategy. It takes into account the existing enterprise architecture with all its organizational, process-related and technical dependencies, and incorporates significant influences from the business ecosystem as well as from available and emerging digital technologies.

Digital technologies such as big data and analytics, digital twins and platforms, (advanced) robotics, cloud computing, or artificial intelligence are known for being a major driver of DT [3, 4, 43] and for (re-)defining the value proposition [45]. However, taking such steps also requires a redesign of the software and hardware landscape as well as (digital) process optimization. Nevertheless, the question arises how a digitalization strategy can be developed and operationalized, and which input and influences need to be considered in the development process. The literature on business and information systems already provides important insights in this regard (e.g., [2, 14, 15, 34]) and serves as an starting point for our work. However, most of this work focuses on large companies with significant financial resources and IT expertise, lacks practical implications and guidelines, and only partially considers the requirements of a comprehensive view of internal and external factors as well as of their dependencies.

To that end, the discipline of EA (management) provides important implications for this work, as it offers a solid base for developing a digitalization strategy and planning the company's transformation. EA practice and research have produced a large number of best practices and models [41, 48], which help to map and manage corporate structures. In this field, architecture represents "the fundamental organization of a system, embodied in its components, their relationships to each other and the environment" [19, p. 3]. EA typically comprises five layers: business, process, integration, software and technology (or infrastructure) architecture, whose spectrum ranges from strategic and organizational aspects to (business) processes, data, software and hardware [48]. Building on this, EA pursues the goal of creating a model based on the most important artifacts of an enterprise and their relationships, which is sufficient for the documentation of the actual state and its analysis, as well as for the representation and planning of a target state [48]. In this context, Hanschke provides helpful implications from EA planning to transformation including best practice visualizations [14]. Moreover, EA tools such as Dragon1 [7] and LUY [20] are geared toward a complex representation of the existing EA. However, they only partially fulfill the requirement of a lightweight, intuitive representation of the internal structure and external dependencies as a basis for developing a digitalization strategy, as SMEs may lack knowledge and resources to infill complex architecture models. "As more mature architectures do not necessarily lead to business value" [36], Horlach et al. emphatically suggest creating a value oriented architecture support [17]. This perspective draws on the concept of Winter's architectural thinking, which proposes avoiding heavy and complex models and visualizations of architectural layers [46]. Instead, Winter argues for developing lightweight and pragmatic models and visualizations by pointing out the respective local benefits for individual departments and employees [46, 47]. Thus, to close the gap between theoretical modeling and practical use, we pick up the advantages of EA management and transfer them into the context of digital entrepreneurship by offering a lightweight, and architecture-based method for the development of a digitalization strategy in SMEs.

3. Research approach

While this work seeks to contribute to the information systems research discipline by advancing enterprise architecture modelling and management methods, it also draws upon and contributes to the literature on digital entrepreneurship. In order to address the research question, we developed and evaluated a solution that is both theory-ingrained and practice-oriented by employing the ADR method [38]. ADR focuses on building, intervening and evaluating (BIE) artifacts [38]. These also include methods [16, 24], defined as a "set of steps used to perform a task" [24, p. 257] by "providing guidance on how to solve problems" [16, p. 79]. Thus, ADR allows to co-develop an

approach in practice while also supporting the generalization and theorizing.

During the preparation phase, two companies – an online-agency (case A) with approximately 100 employees, and the headquarter of a more senior company (case B) selling luxury outdoor furniture with approximately 200 employees – were identified as particularly suitable for the development of a digitalization strategy. We illustrate our ADR approach at company A in Figure 1, which resulted in the implementation of a new cloud-based enterprise resource planning (ERP) system. The extraordinary growth of company A despite regional restrictions required, among other things, a re-evaluation of currently used software solutions. Meanwhile, the advanced maturity, expansion efforts and corporate integration of company B, allowed it to focus on new technologies, such as augmented and virtual reality, which served as an interesting contrast.

In the problem formulation stage, we diagnosed the lack of an explicit digitalization strategy in both companies in search of orchestrated DT measures. With special emphasis on the redesign of the software landscape (case A) and the use of new technologies to enter the business to consumer market (case B), the selected BIE form was organization-dominant in both cases as we sought to develop a digitalization strategy. Based on the insights gained from strategic management (e.g., [1, 9, 25, 35]) and EA research (e.g., [8, 48]), we drafted and continuously refined an initial outline of relevant factors influencing the digitalization strategy development.

In the alpha cycle, we iterated and formatively evaluated early designs of the digitalization strategy in workshops with the CEO and the COO (case A) and the Head of IT (case B). For example, the business ecosystem-view [8, 26] served as a first orientation for developing an understanding of the business and its environment. Enterprise systems used therein as well as dependencies were revealed and macroenvironmental influences uncovered. This enabled us to address legal challenges in website design (case A) and environmental challenges in the furniture production (case B), among other issues. Complementing this, the application of Porter's [35] five competitive forces that determine industry profitability helped us to identify relevant market participants as part of the as-is analysis. This was accompanied by an analysis of archival materials, such as industry reports, process descriptions, organizational charts and a transcript of the vision and values as part of the business strategy. Instruments such as the Gartner Hype Cycle of Emerging Technologies [10] supported the identification of potentially relevant technologies. To illustrate inefficiencies and outdated, incompatible software, we mapped existing software to an organization-specific model of Porter's [35] generic value chain. This helped us to review the core processes and served as the starting point for discussing which software will be necessary in the future (to-be landscape).

In the beta cycle, we took our preliminary findings into a wider organizational setting as our know-how was limited in terms of strategy (case B) and software selection (case A). By inviting the CEO, the Head of Sales and other experts from the business departments, we were able to enrich our findings as well as to reveal relevant, process- and technology-related pain points in a workshop (case B). We complemented our data by conducting semi-structured interviews (one offline and seven online) on different levels at company A, including the two CEOs and founders, the COO, four department managers as well as a trainee. These interviews lasted between 20 and 90 minutes depending on the experience and responsibility of the interviewee and covered questions ranging from the individual software usage and acceptance to personnel and strategic issues, such as digital skills and the market environment. By analyzing and coding these with

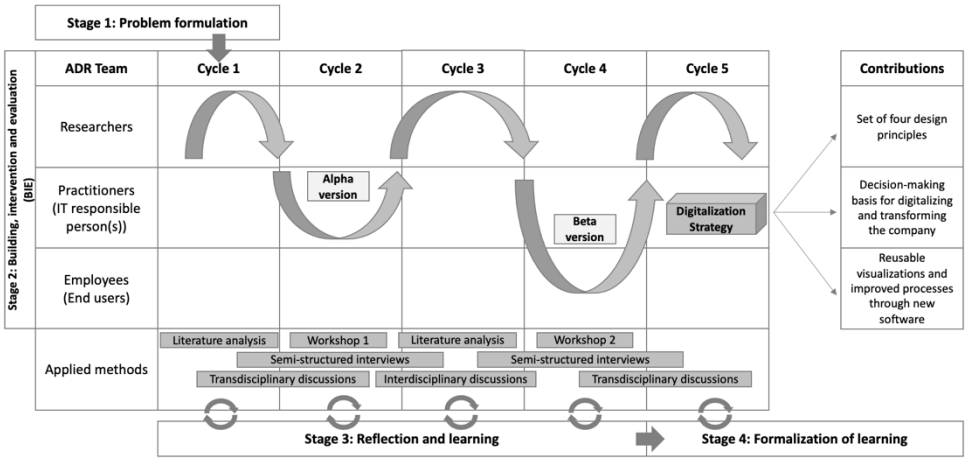

Figure 1. Research design based on ADR by Sein et al. 2011 and Lebek et al. 2013

MAXQDA [42], we were able to further refine our lightweight, architecture-based method by setting priorities as well as our understanding of the internal structure and external factors. In addition, we conducted a subsequent online workshop with the departments that were likely to be most affected by the transformation to identify internal capabilities and prepare the development of the digitalization strategy and roadmap.

Through ongoing reflection during the BIE stage, we evaluated and revised our findings regarding a lightweight, architecture-based method for the development of a digitalization strategy in SMEs engaging in several discussions with the COO (case A) and the Head of IT (case B). We also discovered an initial understanding of relevant design principles presented in the results section. For example, during the workshops and interviews it became clear, that personal and political interests of other departments could influence the success of the DT. From a management perspective, it also became apparent that resource limitations must be considered in the development process, and the benefits of a detailed presentation must be weighed up against the costs. Failed IT projects in the past (case B) also showed, that layer-specific dependencies should be considered in the planning process, and that internal changes as well as those in the market environment require a constant questioning of the status quo.

In the reflection of learning, we reviewed our method and the design principles through interdisciplinary discussions with a group of researchers from different fields, including information systems, strategic management, psychology and organizational science. For instance, we adapted our initial approach slightly after our first meeting with company B for the use in company A, divided the development process into relevant and optional steps (see Table 1) and gave greater consideration to the importance of sensitizing and involving employees from other departments.

In the formalization of learning stage, we formalized the initial design principles representing design knowledge emerging from the application of ADR. With our method, we supported the decision-making basis for the management (case A) and the IT department (case B) and provided a set of reusable visualizations for the employees involved in the digitalization process. Considering the principle of generalized outcomes, these findings contribute to the development of digitalization strategies in other SMEs.

4. Results

Based on the findings of the two investigated companies, we propose a method (Figure 2) and the underlying LEA model (Figure 3) for the development of a digitalization strategy in SMEs, with a special focus on a lightweight visualization of the EA. We provide an overview of required and optional steps (Table 1) as a guideline, which may vary in tool usage or relevant entities (e.g., not all companies have subsidiaries), and finally present four design principles.

4.1. Steps of developing a digitalization strategy

Preparation: First of all, it is necessary to determine who is responsible (0.1) for obtaining information, designing architecture-based views, and developing the artifacts (e.g., to-be scenarios, digitalization strategy, transformation roadmap). This could be done, for example, in the form of a RACI (responsible, accountable, consulted, informed) matrix. Depending on the organizational roles, this can range from the IT and its management, to specialist and

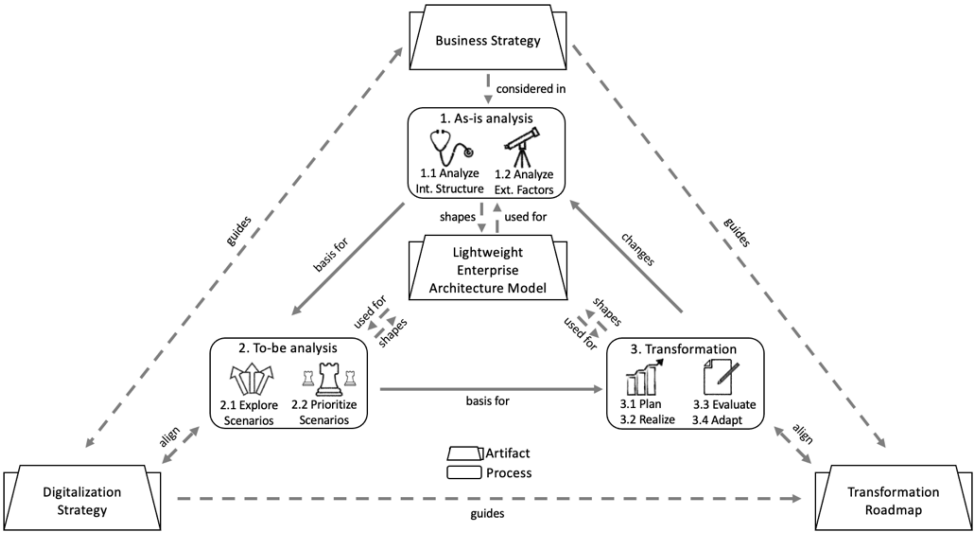

Figure 2. Digitalization strategy development method for SMEs

leading functions from other departments to the top management.

If already developed and spread within the company (e.g., as discussed in management meetings), taking the business strategy into account (0.2) helps to prevent shortsightedness in the development process. It can have a decisive influence on the subsequent design of the digitalization strategy by providing useful business information and industry insights. In this context, a Business Model Canvas [30], which serves as a strategic management and lean startup template, supplemented by a Value Proposition Canvas [31], can provide an understanding of the core activities of the company as a basis for the development of a business strategy. Both strategies influence each other and mutually provide implications for their further development.

As-is analysis: Starting with the development process of the digitalization strategy, an as-is analysis of the internal structure and external factors is crucial to gain a deeper understanding of the existing architecture and the need for necessary changes. It is important not to look at the individual components of the architecture, but to also understand their interrelations.

The internal analysis (1.1) of the organization and its capabilities as well as the (business) processes can be linked to the existing software and hardware landscape to develop a better understanding of potential dependencies. This helps to reduce medium to long-term costs caused by inefficiencies and inappropriate IT investments. Depending on the company, it may be also important to map organizational and technical dependencies with suppliers and customers (see also 1.2) and their interfaces when it comes to selecting, developing or implementing new software. Documents such as organization and capability charts, hardware and software lists, and process descriptions can help to gain a comprehensive picture of the internal structure. As an illustration, it can be advantageous to map the company's software solutions and their dependencies to primary and secondary activities in Porter's generic value chain [35] tailored to the enterprise. The significance of required changes can be pictured, for example, as simple traffic lights (e.g., urgent need for change, needs to be checked, meets requirements). In the case of a multi-divisional organization with several departments, it can also be helpful to represent these as swim lanes and to map existing software to the business activities (e.g., ranging from sales to invoicing and maintenance).

The external view (1.2) comprises the exploration of the business ecosystem as well as the identification of promising and emerging (digital) technologies and IT innovations as well as macroenvironmental forces. For example, joint product development with customers and suppliers can have a significant impact on software selection as part of developing the digitalization strategy. One effective tool for this is Porter's [35] five competitive forces that determine industry profitability, which can serve as the starting point for visualizing the market environment, supplemented, for example, by industry reports. This perspective can also provide interesting information about which technologies and software competitors use. Relevant technologies should be identified to support decision-making for further transformational planning. To gain a comprehensive overview of available and emerging technologies, we propose the use of instruments such as the Gartner Hype Cycle for Emerging Technologies [10] or the screening of current industry and technology reports. Additionally, a macroenvironmental analysis allows to reveal important implications, such as legal or political requirements, for the formulation of the digitalization strategy. For that purpose, the PEST(EL) [1] and the SWOT [44] analyses are popular and easy-to-use tools to support decision-making. After an initial draft of the internal structure and external factors has been prepared, additional employees from the business departments should be involved to discuss and enrich these findings. This may also help to sensitize employees to technical and organizational changes planned as part of the transformation.

To-be analysis: In the next step, promising to-be scenarios (2.1) need to be explored as a foundation for the DT, based on the aggregated visualizations developed in steps 1.1 and 1.2. Accordingly, setting the knowledge gained in relationship to each other is important, as it helps to address gaps and pain points of the current state. Additionally, it supports prioritization and again sensitizes for the transformation process. To identify potential cross-departmental dependencies, the to-be scenarios should be presented to other departments.

After creating a comprehensive overview of the current state, the next step is to prioritize transformation measures, taking available resources and capabilities into account, and select the most promising scenario to develop the business-aligned digitalization strategy (2.2) based on these results. As strategies are developed consciously and purposefully and may be additionally stated explicitly in formal documents [25], the design of a digitalization strategy may include limited transformation goals like achieving cost savings or enhancing the customer experience, but it might also comprise extensive changes which aim at facilitating new business models [5]. Selected tools, presentation software and easy-to-understand visualizations can contribute to the understanding of the intended goals and necessary changes at this point. To cover all relevant aspects of the internal and external analysis, we

suggest creating presentation software slides for all of the relevant entities of the LEA model (Figure 3), including pain points, gaps and possible solutions. In particular, the feasibility, risks and costs of the planning scenarios must be considered at this point [14].

Transformation: To operationalize the digitalization strategy, a transformation roadmap tailored to the company and its capabilities must be developed in close coordination with ongoing and planned company-wide projects (3.1). The goal here is to close the gap between the actual state and the target state and to present (visualized) plans and measures to stakeholders [14]. For this, it is necessary to allocate resources, weigh risks and determine who is responsible for the realization of the (sub-)projects underlying the transformation. Here again, a RACI matrix can be used to define responsibilities. The realization (3.2) of the transformation and its (sub-)projects can be organized and done with the help of agile, plan-driven or hybrid methods, depending on the stability of the project environment and the risk of scope change. In some cases, especially when dealing with new technologies or complex software, it might be necessary to draw on external know-how. If this applies, a selection of possible partners must be made, and their advantages and disadvantages in terms of costs, expertise and capacities must be considered. In any case, the transformation process needs to be evaluated (3.3). This evaluation focuses on the constant monitoring of derived measures in the (overall) project realization, including the assessment of (key) performance indicators. In addition, the up-to-datedness of the LEA model, the digitalization strategy and the transformation roadmap should be constantly checked and, if necessary, adapted (3.4) in order to be able to react quickly to potential internal and external changes and new requirements.

Table 1. Steps of developing a digitalization strategy

0. Preparation
0.1 Define roles (r)
I: (-); **O:** Overview of involved people, tasks and responsibilities; **T:** RACI matrix, project planning tools & methods
0.2 Consider business strategy (r)
I: Business strategy documents, business vision and mission; **O:** Overview of strategic business goals; **T:** (-)
1. As-is analysis
1.1 Analyze internal structure (r)
1.1.1 Layer 1 (Organization)
O1: Analyze organization (r)
I: Archival material such as organizational charts and exports from human resources (HR) software; **O:** (Over-)view(s) & data of relevant organizational aspects; **T:** RACI matrix, stakeholder mapping/ analysis
O2: Analyze processes (r)
I: Archival material such as process descriptions (from business departments); **O:** (Over-)view(s) & data of relevant processes; **T:** Process modeling tools & techniques (e.g., BPMN, eEPC)
O3: Analyze projects (r)
I: Project descriptions (from business departments, e.g., controlling); **O:** (Over-)view(s) & data of relevant past, ongoing and planned projects; **T:** Organization charts, RACI matrix, stakeholder mapping, project planning tools & methods
O4: Analyze capabilities (r)
I: Archival material and exports from HR software (from business departments, e.g., HR); **O:** (Over-)view(s) & data of (business) capabilities; **T:** Capability charts, resource & capability analysis
1.1.2 Layer 2 (Technology)
T1: Analyze software and interfaces (r)
I: Archival material, such as software lists (from business departments, e.g., IT); **O:** (Over-)view(s) & data of implemented and conceivable software including specifications and interfaces; **T:** Software maps, life cycle graphics
T2: Analyze hardware and infrastructure (r)
I: Archival material, such as hardware lists (from business departments, e.g., IT); **O:** (Over-)view(s) & data of existing and conceivable hardware and infrastructure including specifications and costs; **T:** Hardware maps, life cycle graphics
T3: Analyze technologies (r)
I: Archival material, such as technology lists (from business departments, e.g., IT); **O:** (Over-)view(s) & data of technologies in use; **T:** Life cycle graphics, technology maps
1.2 Analyze external factors (r)
1.2.1 Layer 3 (Business Ecosystem)
B1: Analyze customers (r)
I: Industry reports, archival material, lists of customers (from customer relationship management (CRM) software or business departments, e.g., sales); **O:** (Over-)view(s) & data of relevant customers and their interaction with the company; **T:** ABC analysis/ clustering, market analysis
B2: Analyze competitors (r)
I: Industry reports, lists of competitors (from business departments, e.g., sales or management); **O**: (Over-)view(s) & data of relevant competitors (as benchmark); **T:** ABC analysis/ clustering, market analysis, benchmarking analysis
B3: Analyze suppliers (o)
I: Lists of suppliers (from ERP software or business departments, e.g., procurement, or suppliers); **O:** (Over-)view(s) & data of suppliers (of suppliers) incl. (technical and organizational) dependencies; **T:** ABC analysis/ clustering, market analysis
B4: Analyze subsidiaries (o)
I: Archival material such as organizational charts (e.g., from management or subsidiaries); **O:** (Over-)view(s) & data of subsidiaries incl. (technical and organizational) dependencies; **T:** Benchmarking analysis
B5: Analyze partners (o)
I: Lists of partners (e.g., from management, IT, or partners); **O:** (Over-)view(s) & data of relevant and potential partners; **T:** ABC analysis/ clustering, market analysis
(B6: Investigated Company)
For comparison only
1.2.2 Analyze macroenvironmental forces (r)
I: Business strategy, industry reports and market insights (from management and business departments); **O:** Overview of macroenvironmental forces; **T:** SWOT, PESTEL
1.2.3 Analyze emerging technologies & IT innovations (r)
I: Gartner Hype Cycle of Emerging Technologies, fairs, industry reports & insights (from business departments, e.g., IT or research and development); **O:** Overview of (relevant) emerging technologies & IT innovations; **T:** Life cycle graphics, technology maps
2. To-be analysis
2.1 Explore to-be scenarios (r)
I: Developed set of aggregated visualizations from the as-is analysis (layer 4) that reveal dependencies, show pain points and

support prioritization; **O:** To-be scenarios which consider layers 1-4 including the business strategy, macroenvironmental forces and emerging technologies & IT innovations; **T:** (-)
2.2 Prioritize scenarios (r)
I: Explored to-be scenarios; **O:** Prioritized scenarios including a visualization of orchestrated strategic transformation measures incl. personnel and technological aspects to develop the digitalization strategy; **T:** IT roadmap graphic, maturity models, stakeholder analysis
3. Transformation
3.1 Plan (r)
I: Digitalization strategy, data and views from the LEA model; **O:** Transformation roadmap coordinated with other departments incl. identified (key) performance indicators; **T:** KPI analysis, IT roadmap graphic, RACI matrix, project planning tools & methods, risk analysis, make-or-buy analysis, precedence diagrams
3.2 Realize (r)
I: Transformation roadmap, data from implemented projects; **O:** Project plans and documents incl. capability, personnel and risk planning; **T:** KPI analysis, project planning tools & methods (e.g., Kanban, Scrum, Waterfall)
3.3 Evaluate (r)
I: Transformational notes and discussions; **O:** Overview of necessary changes in the LEA model, the digitalization strategy and transformation roadmap, recommendations for action; **T:** KPI analysis
3.4 Adapt (r)
I: Necessary changes and recommendations for action from steps 3.2 and 3.3; **O:** Adapted LEA model, digitalization strategy and transformation roadmap; **T:** (-)

I = Input; O = Output; T = Tools (exemplary)
optional steps = (o); required steps = (r)

4.2. LEA model for SMEs

During the execution of the individual process steps, the LEA model is continuously filled and modified. The main advantage on using the LEA model is its ease of use and quick adaptability. It realizes the idea of "everyone is going to be an architect" [17] which has its roots in the concept of architectural thinking [46]. As the acquisition of EA software as well as its familiarization can be resource-intensive in terms of time and costs, we suggest using presentation software or other easy-to-use tools that are already known in the company. Given that some information might be available before other information, its aggregation in form of visualizations (layer 4) can also be done process-accompanying to a certain extent. Moreover, while some information can be obtained through CRM or ERP exports, or industry reports and archival material, other information may only be accessible through interviews, discussions and workshops. Here, spreadsheets, graphic programs, presentation software and (interactive) whiteboards can help to include this data into the discussions. This can even include handwritten drawings. In order to develop a comprehensive set of relevant data and easy-to-understand visualizations, the most important artifacts of the company must be set in relationship with each other [48]. The following LEA model serves as a basis for creating a grounded digitalization strategy and for deriving adequate measures within the course of the transformation itself. With its proposed entities it is based on the structure of relevant layers from the EA management (e.g., [48]) and on the insights gained during our research project. Relevant data and visualizations can be set in dependency within the individual layers as well as among each other. Due to their modular character, they can be individually supplemented depending on the needs of the company.

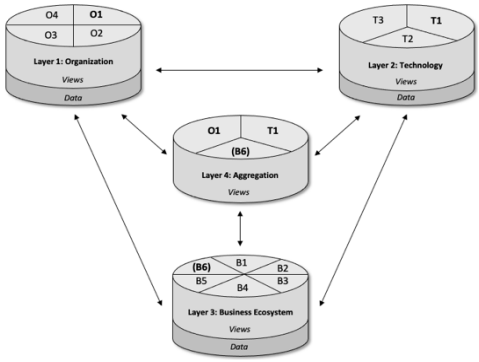

Figure 3. Lightweight enterprise architecture (LEA) model for SMEs

Layer 1 (Organization) captures internal process flows, personnel, and internal capabilities to implement projects and drive change which can support the identification of essential organizational and process-related transformational needs; for example, an integration of available personnel and capabilities for project planning (O1 + O 3 + O4) or an illustration of process flows to uncover optimization potential in interdepartmental operating processes (O1 + O2).

Layer 2 (Technology) contemplates technologies in use to show innovation potential. In addition, software (including interfaces) as well as hardware and infrastructure aspects have to be considered, as they can have a significant impact on the competitiveness of a company. Views on the interconnection between used software and technologies such as augmented reality (T1 + T3), or lists of implemented or conceivable software on premise vs. the cloud (T1 + T2) may be displayed at this point and connected with findings from the analysis of emerging technologies and IT innovations.

Layer 3 (Business Ecosystem) comprises the investigated company and its business ecosystem. It supports a comprehensive view of external market participants, which can be used, for example, as a benchmark or to show dependencies (e.g., software interfaces) in the supply chain or in product innovation. Here, details of the market may also be included. This layer reflects combined views such as the market share

of the company in relation to competitors (B1 + B2 + B6) or an ABC analysis of the most relevant suppliers (B3).

Layer 4 (Aggregation) represents the combination of data and views of the first three layers. In particular, this can help in decision-making as part of the to-be analysis and serve as a basis for argumentation when communicating necessary changes in the organization.

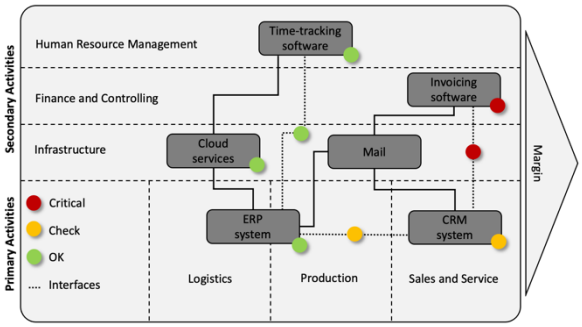

Figure 4. Example of layer 4 (B6 + O1 + T1)

Figure 4 shows a simplified example of the link between organizational aspects (O1) and software used (T1) in the company investigated (B6), combined with a status display in the form of traffic lights, which we used in the course of the as-is and to-be analyses.

4.3. Design principles

As "prescriptive statements that indicate how to do something to achieve a goal" [11, p. 1622], design principles serve as an "abstract blueprint that describe an information systems artifact" [12, p. 322]. By reflecting the results of the ADR project and by considering research from the areas of EA (e.g., [13, 17]) and DT (e.g., [3]), we developed four design principles fostering the development of a lightweight, architecture-based digitalization strategy in SMEs:

An **interest integration across departments and hierarchies (1)** helps to sensitize for upcoming changes in the organization and software landscape, reveal personal and political interests, and make relevant technological and process know-how available in the process of developing a digitalization strategy. Referring to Winter's architectural thinking [46], it also helps to understand why the transformation makes sense not only from a management perspective, but also for the individual employee and the team.

The **visualization of cross-layer dependencies (2)** in the sense of EA, in contrast to non-architecture-based methods, emphasizes drawing a comprehensive picture for the underlying transformation. This supports creating awareness for the necessity of changes among stakeholders. Taking into account different architectural layers, this also facilitates the prioritization of actions to be taken in the departments affected by change when developing the digitalization strategy and its associated roadmap based on the actual state (as-is) as well as the target state (to-be).

An **orientation on usefulness (3)** requires that the effort as well as the costs for the creation of the architectural views underlying the digitalization strategy are always considered in relation to their benefits. In companies with a low number of employees, it is important to question whether the use of complex EA software is worthwhile and leads to business value [36]. It may seem useful to build on lightweight presentation slides, sketches or simple handwritten notes to visualize EA layers and its dependencies.

With a **continuous review and adjustment (4)** of the digitalization strategy, the transformation roadmap and its underlying architectural visualizations, we emphasize the need to react flexibly to internal and external changes – understanding a digitalization strategy and transformation roadmap not as a static or unchanging artifact but as one that is dynamic, as its stability is only conditional [29] and it incorporates dimensions beyond the technological aspect as an ensemble [38].

5. Discussion

By proposing a lightweight, architecture-based method, we aimed to provide support and guidance for SMEs in the development of a digitalization strategy. In contrast to existing frameworks with little practical relevance for SMEs and potentially resource-intensive implementations of EA software, we developed a more lightweight, visualization-oriented and pragmatic solution. Although (external) experience in the use of tools can be an advantage, we offer a development process that does not require much previous knowledge in EA modeling. However, we also observed some frictions in this method between theoretical modeling and practical applicability. Despite the lack of an elaborated business strategy (case A and B) and without an existing IT department (case A), it was nevertheless possible to build on the knowledge of the responsible IT person(s). In smaller companies, such a person with knowledge about the technical properties of IT systems might not be available. While the business strategy is usually anchored in the heads of the management, it might not be written down in detail (case A) or communicated to all stakeholders in the company, even though it may contain important insights (e.g., of the business ecosystem and technology trends) at an early stage of developing the digitalization strategy. In most companies, a classic organizational chart only partially reflects the internal structure of the company. A flexible

view of the organization layer thus enables a representation of highly agile, cross-functionally scaled organizations. As we attempted to keep the LEA model as generic as possible, its entities must be adapted depending on the size, structure and branch of the company. This illustrates that not all of the steps in developing the digitalization strategy are mandatory for every company. Furthermore, the status quo must be constantly scrutinized to avoid decoupling between the mere formulation of a strategy and its implementation. Beyond this, the underlying transformation process does not necessarily imply the use of new technologies such as virtual or augmented reality (case B), but often requires basic work like redesigning the software and hardware landscape (case A). Finally, using the ADR method, the underlying involvement may also be seen as a validity threat due to the natural subjectivity that accompanies this process of working closely together. This is addressed through triangulation and the inclusion of other external researchers when collecting, coding and analyzing the data. Thus, knowledge gained from companies A and B needs to be developed further by investigating companies of different sizes and industries in a second research wave to increase the data validity and generalizability of the results.

6. Conclusion and future work

In this paper, we present our research approach and findings of creating a lightweight, architecture-based method for developing and implementing digitalization strategies in SMEs. The method and the underlying LEA model create coordinated, comprehensive visualizations of relevant views, including internal processes and external influences. A structured collection of data and the uncovering of dependencies between IT and business through the enterprise architecture lens helps to establish priorities when developing a digitalization strategy while supporting transparency and documentation [48]. In contrast to more complex, resource-intensive and highly abstract frameworks, we developed a visualization-oriented and pragmatic solution, tailored to the requirements of SMEs. The steps we provided for developing the digitalization strategy may serve as a guideline for practitioners, helping them to rethink their strategy, organization and technology use within the context of digital entrepreneurship. Finally, the four presented design principles contribute to the theoretical body of knowledge on developing digitalization strategies in SMEs. As the investigation of developing digitalization strategies in SMEs from an EA perspective is still in its infancy, we hope to engage other researchers to build upon our knowledge in this promising field of research.

7. References

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