Transfer projects in the context of digitization from the university for SMEs and the skilled trades

Paths to digital transformation in small and medium-sized enterprises from the construction site folder to retrofit

Vías para la transformación digital en las pequeñas y medianas empresas desde la carpeta de obra hasta la readaptacón

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Abstract

Although digitization is now an important technology of the future, many small and medium-sized enterprises (SMEs) do not manage to fully exploit the potential of digital transformation. Merseburg University of Applied Sciences is committed to the forward-looking digital challenges of SMEs in Saxony-Anhalt as part of the Regional Future Center for Digital Work.

The project is funded by the BMAS and the EU (ESF Plus) and by the responsible ministry of the state of Saxony-Anhalt. Studies show that the use of digital technologies can increase the productivity and efficiency of SMEs. Despite the potential of new business opportunities, SMEs face challenges in terms of financial resources when implementing digital solutions. There is a lack of funds for the necessary infrastructure and training of employees. The lack of qualified specialists who have the necessary digital know-how and a positive attitude toward digitization is another challenge.

In cooperation with regional SMEs from various industries, transfer projects with consulting and qualification elements are implemented within the framework of the Future Center to support SMEs in digitization. Two examples will be presented in the lecture: the implementation of digitalized order processing using agile methods in a construction company and the support of data acquisition with retrofit in a steel construction company.

Based on the experiences, it will be shown how SMEs can exploit the potential of digital transformation. In particular, the focus is placed on the human factor and participative work in order to successfully manage the transition to digitalization and ensure employee satisfaction.

Abstract

La digitalización es ya una importante tecnología de futuro, muchas pequeñas y medianas empresas (PYME) no consiguen aprovechar plenamente el potencial de la transformación digital. La Universidad de Ciencias Aplicadas de Merseburg está comprometida con los retos digitales de futuro de las PYME de Sajonia-Anhalt como parte del Centro Regional del Futuro para el Trabajo Digital.

Los estudios demuestran que el uso de tecnologías digitales puede aumentar la productividad y la eficiencia de las PYME. A pesar del potencial de nuevas oportunidades de negocio, las PYME se enfrentan a retos en términos de recursos financieros a la hora de implanter soluciones digitales. Faltan fondos para la infraestructura necesaria y la formación de los empleados. Otro reto es la falta de especialistas cualificados con los conocimientos digitales necesarios y una actitud positiva hacia la digitalización.

En cooperación con PYME regionales, se llevan a cabo proyectos de transferencia con elementos de consultoría y cualificación en el marco del Centro del Futuro para apoyar a las PYME en la digitalización. En la ponencia se presentarán dos ejemplos: la implantación de la tramitación digitalizada de pedidos mediante métodos ágiles en una empresa de construcción y el apoyo a la adquisición de datos con retroadaptación en una empresa de construcciones metálicas.

Basándose en las experiencias, se mostrará cómo las PYME pueden explotar el potencial de la transformación digital. En particular, se hace hincapié en el factor humano y el

trabajo participativo para gestionar con éxito la transición a la digitalización y garantizar la satisfacción de los empleados.

Keyswords: digital transformation; digital work; digital solutions; modern work; retrofit; agile methods

Palabras Claves: *Transformación digital; Trabajo digital; Soluciones digitales; Trabajo moderno; Readaptación; Métodos ágiles*

1 Introduction

The ongoing digitization has fundamentally transformed the business world, including in Saxony-Anhalt and offers companies a variety of new opportunities and business fields. Especially for small and medium-sized enterprises (SMEs), this presents a variety of opportunities but many of these potentials often remain untapped. To support SMEs in their digital transformation, the ESF (European Social Fund) program "Future Centers" of the Federal Government of Germany plays a crucial role. As part of this program, a Future Center has been established in several federal states including Saxony-Anhalt (Zukunftszentrum, 2023).

With the guiding principle of "advising - networking - qualifying," the Future Center Saxony-Anhalt serves as a service and consulting platform for companies looking to realign and position themselves in the era of digital transformation. The Research Institute for Vocational Education and Training (f-bb) is the operator of the Future Center Digital Work Saxony-Anhalt. In collaboration with University of applied sciences Merseburg, the Chamber of Crafts Halle/Saale, the Advanced Training Academy for Business and Work, and Work and Life, joint and independent offerings are developed and established for SMEs. The work of the Future Center is based on a participatory, social partnership approach and involves close cooperation with the existing advisory services in the region (Zukunftszentrum, 2023).

This article demonstrates how Merseburg University, in collaboration with regional medium-sized enterprises from various industries, has implemented transfer projects with advisory and qualification elements as part of the Future Center to support SMEs in their digitalization efforts. Two exemplary transfer projects are presented. The first example focuses on training employees for the implementation of a digital construction site

portfolio for order processing in a construction company. In the second project, the data collection and investment decision regarding a large-scale processing machine in a steel construction company were supported through the retrofitting of sensor technology accompanied by a qualification concept. These projects aim not only to showcase the experiences gained but also to illustrate how SMEs can harness the potentials of digital transformation with the assistance of tailored qualification concepts. Within a qualification concept, participants are provided with the necessary skills to successfully implement IT projects for digital transformation within their companies.

Special emphasis is placed on the human factor and participatory work to ensure a successful transition to digitalization and to guarantee employee satisfaction.

2 Theoretical foundations

2.1 Explanation of terms

In the following chapter, the terms digital transformation, small and medium-sized enterprises (SMEs), the digital construction site folder and the term retrofit are explained in more detail for a better understanding.

In the field of digital transformation, there is no uniform definition in literature and academia. For example, digitalization is defined by the Federal Ministry for Economic Affairs and Climate Protection (Bundesministerium für Wirtschaft und Klimaschutz, 2023) as follows: Digitalization means the use of data and algorithmic systems for new or improved processes, products and business models. Furthermore, four dimensions of digitalization are broken down into digital products, digital processes, digital networking and digital business processes. When it comes to digital networking, internal and external processes along the value chain are seen in an economic context (Bundesministerium für Wirtschaft und Klimaschutz, 2023).

Digital transformation is generally described as a fundamental change. This change can occur consciously or unconsciously and is not limited in time. Transformation processes can also be influenced in a targeted manner and different change processes can support or inhibit each other (Grießhammer & Brohmann, 2015). The Encyclopedia of Information Systems defines digital transformation as follows: The term digital transformation refers to significant changes in everyday life, the economy and society

with the use of digital technologies and techniques and their effects (Pousttchi, 2019). In the economic context, the process-oriented redesign within the company as part of digital transformation is carried out to achieve efficiency and effectiveness advantages (Pousttchi, 2019).

The companies supported by the Future Center in their digital transformation efforts are small and medium-sized enterprises (SMEs). These are categorized into micro-enterprises with up to 9 employees and a turnover of 2 million euros, small enterprises with up to 49 employees and 10 million euros in turnover and medium-sized enterprises with up to 249 employees and a turnover of 50 million euros. Companies with more than 249 employees and a turnover exceeding 50 million euros are considered large enterprises. (Statistisches Bundesamt, 2023).

As part of the Future Center, companies up to medium sizecan be supported. Around 99 % of the companies in Germany are small and medium-sized companies and employ around 55 % of the workforce in Germany (Lindner, 2019).

In SMEs there are a variety of approaches to increasing efficiency and effectiveness. A concrete example of this is the introduction of the digital construction site folder with the working title: Participation-oriented work process design using digital tools. The digital construction site folder describes digital order processing from the preparation of offers to invoicing. At the client's site, the notebook should be replaced by a mobile device. The flow of information is realized in real time through a cloud-based solution and every team member can track the progress of the individual sub-projects.

Behind the construction site folder is an adaptable kanban board as an agile method. It is a form of visual project management that allows teams to better visualize their workload and workflows. A Kanban board is a project board organized by columns on which work is represented; Usually each column represents a work phase (Martins, 2023). The Future Center's projects teach methods and knowledge, for example to create a kanban board in the company and adapt it to individual processes and needs.

The second project to be presented was carried out with a larger manufacturing company. The exact project presentation will be presented later in the article. To understand this, the term retrofit must first be defined. It refers to the retrofitting and modernization of existing systems. Digital retrofitting is the digital upgrading of machines to make them

compatible with Industry 4.0-technologies and Internet of Things (IoT) applications (Luber & Litzel, 2018). The term is continued to be used in further publications and the modernization of a machine is described. This can also involve replacing entire assemblies (Königl, 2023).

2.2 Challenges in Digital Transformation:

According to the Bertelsmann Foundation and a study conducted in 2020, five key roles for successful digital transformation can be defined. It requires a management level with a great willingness to change, a high level of personal responsibility on the part of employees with corresponding flat hierarchies, continuous digitalization of external structures (customer interface) but also internal processes, a high degree of willingness to try things out and an open culture of innovation (Hofmann et al, 2020).

It is very important to discuss the advantages of the transformation process in open and equal communication and at the same time to establish an open error culture, as not every project goes without setbacks. Scarce human and financial resources also cause problems for companies. Innovation projects often compete with day-to-day business and the benefits are not always immediately foreseeable (Hofmann et al, 2020).

Further obstacles in digitalization projects are often a high complexity coupled with security concerns in the company's IT. In addition, high investment costs are expected (Leyh & Bley, 2016).

The Göttingen contributions to craft research no. 46 provide a research overview of German medium-sized businesses over a period from 2013 to 2020. The following conclusions are drawn: Companies are aware of digitalization and attach great importance to it, but companies in the construction industry and companies with generally low sales are not strongly committed to this area of digitalization. Companies in the financial services sector and retail tend to have a higher level of digitalization than the manufacturing and construction industries. Benefits are perceived most highly in the corporate areas accounting and procurement. The areas of production and human resources with digitalization issues are given less consideration. Inhibiting factors are IT-security and the provision and recruitment of human resources. It is also stated that external experts are also difficult to hire. There are also financial uncertainties regarding

the economic viability of digitalization projects. It is difficult to calculate the cost benefits. Opportunities are seen in the areas of increasing efficiency, associated cost savings and increased competitiveness (Brockhaus et al, 2020).

3 Case study one: digital construction site folder

3.1 Company presentation and project framework

The transfer project to implement the digital construction site folder with the working title: Participation-oriented work process design using digital tools was carried out in a company in the construction industry. The company can be classified as a small company with around 35 employees and is located in central Germany. Hierarchically, the company can be divided into three levels: The management level, team leaders and the individual construction teams serve as the operational level of the company, with the secretariat functioning as the administrative and interface level between team leaders and the management level. The secretariat holds a special significance in this project due to its responsibility for invoice generation and thus received separate training as part of the qualification concept. The goal of the project is to quickly gain greater transparency about the order situation and progress in day-to-day operations within the company and to make the work organization in order processing more efficient.

The company has an open communication culture and a change-friendly atmosphere influenced by an ongoing generational shift in the upcoming leadership level. The project was driven forward by the junior CEO as the project leader. The Future Center was engaged as a supportive external consultancy with training responsibilities to accompany the change process. A corresponding qualification concept was developed and tested.

3.2 Implementation with a focus on: Human Factor

In SMEs, the initial challenges for digitalization projects include precise goal identification, the search for implementation approaches, a rough classification of the digitalization solution, the selection of the appropriate hardware/software level and the development of a suitable specification sheet. As part of the Future Center's qualification concept, during the project's initiation phase, which is the first of four phases, there is

always a comprehensive communication with the company's management or project responsible and assistance with the current state analysis.

In the current project, the goal was defined: to achieve a better overview of the order situation and a more efficient work organization through the introduction of a Kanban board. In the second phase, all stakeholders were familiarized with the idea and agile project methodology was applied for efficient progress. Regular project meetings helped in achieving the project objectives. Employees were addressed directly and the Future Center moderated and accompanied the process to ensure project acceptance.

In the third phase, the kanban board was developed, new work processes were integrated into daily operations and initial challenges such as slow broadband connectivity were overcome through a provider switch.

The Future Center developed a qualification concept in which the tasks within the kanban board were presented and the use of the board was taught in a target group-specific manner. The implementation phase spanned over a period of 12 weeks and started with a training day for the involved employees including the management, team leaders, secretariat, and accounting. Individual needs were taken into account, the benefits of the new processes and software were explained, software usage was taught, installation on end devices was clarified and risks were addressed.

The qualification highlighted advantages such as transparency, timeliness, availability, task clarity and comprehensive documentation. As a result of the staff's qualification and the implementation of the IT solution, construction sites operate more smoothly and transparently. This, in turn, reduces the number of errors and the effort required for rework.

During the training, fears of making mistakes were also addressed. For example, deliberate attempts were made to delete cards and even the entire board. Additional obstacles such as IT security were minimized through certification by the software manufacturer. A backup function within the software, as well as the option for CSV exports, ensure data integrity even in the event of a system failure. Smartphones were chosen as the mobile devices because they are easier to use, eliminating the need for training on a different device.

During the training, a Lego house was used as a (learning) construction project to teach how the kanban board works. This was done through a role play in which each column of the board was explained. In the Lego (learning) construction project, damages to the fence, entrance door and a tree had to be documented in writing and visually. After successful documentation by the team leaders, the secretariat took over the accounting and invoicing.

At the beginning of the project, the project leader relieved the staff of administrative tasks to ensure a smooth start. After the successful establishment of the processes, a gradual transfer of responsibility over to the staff took place. This strategy was communicated transparently and individual additional efforts were highlighted as well as the improvements for the entire process, to promote positive project acceptance. The fourth phase involves an accompanying evaluation of the project which will be discussed in the next chapter.

3.3 Project evaluation

The Future Center was scheduled to provide project support for a period of 12 weeks during which consultation was available. After 12 weeks, there was a final meeting where it was decided to continue with the tested IT solution within the company. Approximately 12 months after the introduction of the kanban board, a quantitative survey was conducted among the individuals involved in the process. The survey was divided into 3 sections. The first section pertains to the process before the introduction, the second section to the process after the introduction and the third section is intended to inquire about overall satisfaction with the implementation of the transfer project and change management.

Based on the results, it can be deduced that the new process represents an overall improvement compared to the old process. The most significant improvement is seen in the clarity of order processing, with the rating increasing from 2.4 to 4.1 out of a possible 5 points. The time required for documentation decreased in favor of the new process. There was also an improvement in the perception of the simplicity of organizational quality in order processing. Overall, the evaluation shows a positive outcome. After project implementation, there was a significant improvement in clarity, simplicity and

satisfaction in order processing. Regarding the time and documentation work, there were neutral responses. Overall, the new process can be considered advantageous.

Success factors during implementation included the project leader's willingness to change, an open-minded workforce, open communication, low financial costs in the double-digit euro range per month and the simplicity of digital processes.

4 Case study two: Production data acquisition using retrofit

4.1 Company presentation and project framework

This transfer project is about supporting the design and establishment of a production data acquisition solution in a company active in steel construction. With around 175 employees, it is one of the medium-sized companies. The project was carried out in an agile manner in bi-weekly sprints from February to July 2021.

The project team within the company included the management, the production manager, the deputy production manager, a project engineer, the controller and an external consultant. The stakeholders to be considered included the foremen, machine operators, the electrical maintenance team, the IT department and external contractors.

The company planned to invest in a large machine because the existing drilling and sawing machine was 13 years old and had been completely written off. The successor model offered technological improvements such as a multi-drilling and longitudinal milling function, allowing orders to be processed approximately 10% faster. In order to evaluate the profitability of the investment, it was necessary to collect precise information on the utilization and downtimes of the existing machine. This would establish comparability between the new and old machines and assess the need for the investment. The project's goal was to provide the management with a well-founded recommendation for the investment decision. The Future Center supported the project with an appropriate qualification concept. During the project, the possibility of analyzing and collecting operational data from other machines was also considered.

4.2 Implementation with a focus on: Human Factor

In the first phase of the transfer project, it became evident that the qualification concept needed to focus intensively on topics such as goal definition and specification development. The company's initial focus was on technical aspects and cost minimization without giving sufficient consideration to personnel-related and economic aspects. Consequently, questions related to the collection of productivity data from operated machines were initially not considered in connection with labor law issues concerning performance evaluation.

There was also an increased need for the second phase: The preparation of the project with intensive analysis of the current situation. Here, the development of the data concept for the operational data acquisition solution was supported in order to achieve the appropriate level of accuracy and detail. In order to determine the desired utilization of the drilling and sawing machine, the current options for technical evaluation on the existing machine were examined. It turned out that the existing machine only had an hour counter in the human machine interface without digital interfaces. The times when the machine saw was active could be recorded using the human machine interface. However, it was not possible to distinguish between value-adding productive time and non-value-adding active time of the machine, to record the drilling time, to determine the utilization directly from the measurement results and to export data digitally via an interface. There were no other forms of operational data collection in the company.

Therefore, it was necessary to decide in the project which data should be captured in each project phase using which operational data acquisition devices to achieve the required quality and data evaluability, considering economic goals related to cost and time. In the initial data capture stage, a decision was made also considering data capture acceptance, for manual data capture in a logbook by the machine operator. The disadvantages of this data capture method quickly became evident during the agile project's progression. Recording precise information about the processed orders, the duration of order processing, maintenance and downtime as well as the planned data transfer to a spreadsheet program, proved to be too labor-intensive and error-prone.

In this third phase of agile project implementation, the willingness to further develop the operational data capture was increased both by the management and the workforce

through the application of a participatory approach in the qualification concept. The valuable experience of the employees working directly on site was used. A test solution in the retrofit method was chosen.

In the advanced second development stage, a sensor retrofit was carried out using technology from an external provider without making any technical changes to the existing machine (retrofit). The times to be captured by which actuators (electric motors) were decided by the project team. In terms of software, the evaluation was carried out on the provider's server. The machine status could be viewed continuously, whether active or passive, using an internet-enabled device. However, an evaluation of the overall utilization of the drilling and sawing machine could still only be carried out manually. The data for the drilling time and sawing time still had to be merged in a spreadsheet program. Since the evaluation effort involved in combining the two data sets involved a lot of manual work, the external provider was not convincing..

However, the preliminary data was enough for the management to confirm the need for data collection and to therefore find another provider who could simultaneously analyze both machine time components.

In the third development stage, a technical solution from another external provider was installed on the drilling and sawing machine as well as on six other machine stations. Each machine station was equipped with a tablet with internet access. With this, the company took a significant step towards digitization.

The condition of the equipment can now be displayed in real-time, whether it's active, idle or in standby. Additionally, all operators have access to historical data for each machine, which provides insights into productivity. If there was a downtime of more than five minutes, a pop-up field had to be used to select why the system was down. The selection options are maintenance, logistics, preparation/secondary activity, disruption, other. Employees received approximately one hour of training for this purpose. After another six weeks, a positive assessment of the project was made. The utilization of the drilling-saw machine could be measured in a high level of detail and was suitable for making further decisions. The retrofit project was very successful in its implementation.

4.3 Project evaluation

In the fourth phase, qualified interviews were conducted with the project participants, especially with the machine operators, to assess project satisfaction. As a result, it can be summarized that the implementation of a retrofit solution for capturing operational data on production machines is an effective, cost-effective and time-saving approach for the implementation of digitalization projects in small and medium-sized enterprises. The implementation was so successful that more machines were upgraded during the project than originally planned.

The project goal was achieved and the company was able to avoid an uneconomical investment. Personal barriers related to operational data capture projects were overcome, and in particular the trust and acceptance of machine operators were gained by actively involving them in the project process, sharing the project results with them first and valuing their opinions.

5 Methodological criticism and conclusion

The Future Center Saxony-Anhalt has successfully committed itself to the goal of supporting small and medium-sized enterprises (SMEs) in harnessing the potential of digitization. They have developed qualification concepts for the implementation of IT solutions in order processing and operational data capture which are divided into four phases: 1) goal definition and specification development, 2) project preparation and current state analysis, 3) project execution using agile project management methods and 4) project evaluation, including the identification of future development tasks. The article highlighted the successful application of these qualification concepts using two projects as examples. Key insights and areas for improvement include:

In the first phase, careful moderation of the goal-setting process is necessary without pushing in a specific direction. SMEs should be open to the principles of systematics, precision, attention to detail and receive appropriate training. On the other hand, they must have the freedom to determine their own pace of development.

In the second phase, direct communication proved to be crucial for a smooth flow of information. Building a trust relationship regarding the change process is essential for all

parties involved. Communication is more important in SMEs than detailed preliminary planning.

Agile project management methods therefore work well in the implementation phase if they are appropriately prepared through employee training.

In this phase, the personality of the project leader plays a crucial role, as they need to continuously drive the project's progress,function as a moderator, individually engage all employees even when distracted by daily tasks and re-motivate them in case of setbacks.

The value of the evaluation phase is often underestimated in SMEs. The barriers to survey methods must be taken into account. Special caution is required since close collaboration and the small group of individuals involved demand anonymity. Surveys should not collect personal information such as gender, age and department to ensure confidentiality. However, in the case of a larger group that can be used for evaluation, differentiation by age and department groups may be of interest.

Some challenges in implementing the qualification concepts were limited financial resources and the initially difficult benefits to estimate. Despite these challenges, the successful projects have demonstrated that supporting SMEs in digitalization is of crucial importance and clear methods and moderation during the process are necessary.

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