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RPA in the post-implementation phase of ERP systems

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Abstract: Robotic Process Automation (RPA) can automate processes of various systems using their user interfaces. Back-office processes are particularly suitable for automation with the help of digital workers. Many back-office processes are carried out in Enterprise Resource Planning (ERP) systems. Companies worldwide use ERP systems, meaning they are in the post-implementation phase and interact with these systems daily. Changes to the system are expected during the post-implementation phase. In this paper, recommendations for action that help introduce this technology in the post-implementation phase of ERP systems are made, and decision factors that speak for using this technology are elaborated. For this purpose, twelve interviews are conducted with experts who have already gained experience with Robotic Process Automation in the context of ERP systems, and the results of the interviews will be compared and supplemented with the existing literature. A central result of the work is that the involvement of employees working in the processes to be automated in their daily work is an essential component in all phases of the implementation process. Decision-making factors contributing significantly to companies or organizations deciding to implement RPA can generally be divided into technical and organizational. In general, it can be said that Robotic Process Automation can be used to add value to ERP systems.

Keywords: Robotic Process Automation, ERP Implementation, Post-Implementation Phase

1 Introduction

Developments in the global economy mean that companies have to adapt quickly to new circumstances. Under financial pressure, they optimize processes to work more efficiently and minimize costs[ISB19]. For several years, Robotic Process Automation (RPA) technology has been used to realize the benefits of physical robots in IT systems [Al16]. RPA is a collective term for various software solutions that enable processes in different systems to be automated, with the software robots interacting with a system in a very similar way to how human employees would [ABH18]. Back-office processes, in particular, meet the requirements for automation by these digital workers. Many business processes that fall into the category of back-office processes are handled in enterprise resource planning

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systems (ERP systems) [AR17]. ERP systems, whose development began in the 1990s, can combine a wide variety of areas of a company into one system and store the data in a shared database [MT00]. Companies using an ERP system are in the phase after the implementation, the so-called post-implementation phase. In this phase, errors must be corrected, optimizations must be realized, and new requirements must be implemented. However, as few changes as possible should be implemented that interfere with programming or change the system's source code to avoid future problems during upgrades [EP99; RS09]. Since RPA is particularly suited for back-office processes and interacts with the system through the user interface, a relatively simple integration of RPA helps to overcome the challenges of change requests and additional budgets in the post-implementation phase. Therefore RPA is especially suitable for use with already productive ERP systems. The paper aims to answer the following research questions: "What are important factors to take into account via RPA introduced in the ERP post-implementation phase?"Based on that, some recommendations for action that help introduce the technology into ERP systems that are already working will be given. In the following section 2, the paper gives an overview of the Robotic Process Automation technology and ERP systems. Questions about crucial steps and measures during the implementation of RPA are derived from the elaborated literature. Section 3 presents the methodology used for the empirical study, followed by the results in section 4. The Discussion and answering of the research question are given in section 5. Last but not least, section 6 shows the limitations of this work with an outlook to future research to close still open gaps.

2 Theoretical Background

The main topics of RPA and ERP are described in short in the following paragraphs to get a common understanding of the basics.

2.1 Robotic Process Automation

Robotic Process Automation means process automation by robots - it is not about machine robots, but about software robots [LW16]. It is essential to mention that no single definition can be applied to RPA in the literature. Following are three definitions from the literature: According to van der Aalst et al, Robotic Process Automation is a collective term for various software solutions that enable processes in different systems to be automated, whereby the software robots used to interact with a system in a very similar way to how human employees would [ABH18]. Allweyer describes Robotic Process Automation as a technology that allows rule-based routine tasks that previously had to be performed manually by employees to be automated without traditional programming or modification of the underlying system [All16]. In summary, RPA is a technology that makes it possible to automate frequently occurring and rule-based tasks that previously had to be performed manually. That involves using the user interface of the system in question and not making any changes to the

underlying application structure [CA18]. In the context of RPA, the term bot is used in the literature. When speaking of a bot, this refers to a single RPA license [AR17; SEK19]. As Allweyer describes, the term training is also used in this context. However, this involves the definition of those work steps that are to be subsequently processed by the robot [Al16]. In this regard, however, it is essential to mention that RPA solutions can recognize elements on the interface and are thus much less error-prone than a simple screen capture or macros. Screen capture macros heavily depend on factors such as the coordinates, screen resolutions, and other factors due to the lack of element recognition capability. That allows RPA to interact with a system's user interface in a more intelligent way [AH19]. In the literature discussed, different types of RPA bots are differentiated, and this distinction concerns the degree of automation. If the robots require human intervention, they are referred to as Attended Bots, which involve a local installation. If this manual intervention is not needed, they fall into the class of Unattended Bots [HSU20]. The Attended Bot must be manually started to work on the computer first. During the process, the user may still have to provide additional data to the bot. Meanwhile the bot script is executed step by step. As mentioned before, there is a possibility to intervene in the process [Al16; Le21]. Therefore, this type of robot is also called a "digital assistant"[Us19]. The use of a central installation or the use of an RPA platform offers more potential in terms of optimization of processes and savings. This relies on the second type of this technology, namely Unattended Bots. These do not have to be started manually but by a predefined schedule. During the execution of various processes, the robot interaction is done via a server [Al16; Ui20] or a virtual machine [Kö20]. A combination of both types can also be viable in dedicated cases. In this case, attended bots are started by a human and trigger an unattended bot at a certain point to finish the process [Ui20].

2.2 Enterprise Resource Planning Systems

Davenport describes ERP systems as information systems composed of multiple sub-systems, enabling planning and control over all resources and processes that exist in an organization [Da98]. Thus, an ERP system allows an organization to map and manage all major business processes in a single system [AH11]. As a result, a single transaction, such as creating a purchase order, changing financials, changing inventory quantities in logistics, and triggering other operations in other parts of the system without the need to enter additional information in different systems [MT00]. That is possible because all the data needed for this purpose is stored in a common database. There are a wide variety of factors that prompt companies to implement an ERP system. In addition to globalization, competition or the ever-increasing amount of data to be managed can also be a reason for implementation. But also, the fact that data and information have to be exchanged with partners can be a motivation [HE11]. Implementing an ERP system is a very time-consuming and cost-intensive process since the implementation affects the entire company and not just particular areas. Also, not every module the chosen vendor offers needs to be integrated, and a company decides on those modules required based on how their processes are set up. Nevertheless, it can be

said that the inclusion of several modules is highly recommended, as this allows for better integration and thus a faster return on investment [Le11]. Implementing an ERP system can be divided into three phases: the pre-implementation phase, the implementation phase, and the post-implementation phase [CR09]. The following empirical research focuses on the third phase: the post-implementation phase.

3 Empirical Study Design

To answer the research question, qualitative research is conducted using expert interviews as a stand-alone procedure [MN09]. Interviews are conducted with individuals the authors assume have specialized knowledge of the research topic. Since there are no general criteria as to which individuals are experts, the researchers must decide which individuals will be classified as possible interviewees in the work context. That ensures that there is no extension of expert status and that the research result is not distorted [MN09]. For that reason, criteria were defined in advance, which an expert has to fulfill: (1) Experience in the field of ERP systems and (2) Experience with the implementation of RPA technology in ERP systems. After the definition of the criteria, suitable experts were searched. The search took place, on the one hand, based on convenience sampling and, on the other hand, via an online search. All potential interview partners were contacted via e-mail. Austria, Germany, and Switzerland were chosen as the geographical region for the search based on language restrictions. Overall, twelve interviews were conducted with experts between June and July 2022. Nine interviews were conducted online due to geographical barriers. However, three interviews could be performed on-site at the respective companies or organizations. The interview length was initially calculated to be approximately 20-25 minutes per interview. In preparation, an interview guideline was created based on the reviewed literature. It is essential to mention that the questions asked focus on the introduction of RPA and do not include questions about the respective ERP systems, as these systems only serve as a platform for opening RPA in this paper's context. MAXQDA software was used to analyze the interviews. After the interviews were conducted, they were transcribed according to the rules of Dresing, and Pehl [DP18]. For the analysis of the interviews, the method of Kuckartz is used because this method allows for an honest evaluation close to the material. Kuckartz distinguishes between three primary forms - for our research, the content-structuring qualitative content analysis was chosen. This analysis is suitable when content-related aspects are filtered out of the collected material and what was said about specific topics in conducted interviews is to be described [KM14; Sc14]. After transcription and an initial review of the transcripts, a first-category system was developed based on the interview guide and literature, i.e., deductively, to proceed with the basic coding. In addition to the first categories, general categories such as Miscellaneous were formed as recommended by Kuckartz and Rädiker [KR20]. After the basic coding was completed, some categories were expanded with additional sub-categories, and a suitable coding of the available texts was carried out. These sub-categories were inductively derived from the text material and the previous first coding.

4 Results and Discussion

Based on the empirical study, the results are presented in this section with important verbatim quotes (referenced by Expert Number, position in the transcript) translated as close as possible to the German original. The authors present the most interesting findings and then elaborate on the Best Practices found during the research.

4.1 Results of the Interviews

Types of Bots Regarding the types of bots used, it can be said that Unattended Bots are mostly in use in productive environments (I3, pos. 6). "Whenever possible, then we would run such a bot unattended in the background. A, the licenses are cheaper and B, the user doesn't have to do anything in the dialog either"(I8, pos. 40). Attended bots are used to gain initial experience with RPA and to familiarize themselves with the technology. For this reason, they are used in the initial phase of an RPA project (I2, pos. 41-46; I5, pos. 6). Also, this type of bot "(...) can be used in customer service, where it is more about cooperating with the customer and communicating with the customer"(I3, pos. 8) and can be started by the customer service representative if needed (I7, pos. 6).

Application Area The areas of application in which RPA is used are diverse. They range from areas such as purchasing or accounting to software development (I8, pos. 8; I2, pos. 6; I6, pos. 4). The technology is also frequently used "(...) between ERP systems and upstream and downstream systems because there are no interfaces, (...)"(I5, pos. 4) and thus used as an interface alternative. Another area of use is customer service, supported by this quote: "We then implemented several customer service jobs."(I4, pos. 10)

Process Factors "You could now say, what are the tasks that involve people for a long time, but where there is no real value creation process behind it"(I9, pos. 14). This is how the characteristics of suitable processes can be summarized. On closer inspection, processes are named above all that involve manual tasks with a definable set of rules, and thus no cognitive decisions have to be made (I8, pos. 10; I9, pos. 14). Complexity must also be taken into account since with increasing difficulty, "(...) the set of rules would become too complex, or I don't even manage to define that (...)"(I7, pos. 36). In addition, the process should have an appropriate volume and be repetitive. SSo for a process that happens once a year, I don't need to automate"(I5, pos. 8). The standardization level of the process has to be taken into consideration as well (I3, pos. 12). The "(...) process ideally always has a standardized input that does not change, and the output, that should ideally also always be the same"(I4, pos. 20). In addition, the stability of the process is essential, as any change to the process will most likely lead to a necessary change to the robot. SSo processes that are constantly changing or where flexibility is required certainly cause problems"(I4, pos. 20). But not only the stability of the process but also the stability of the systems to interact is essential. According to the experts from interview four, it is imperative with these processes

to check before automation whether an improvement can be made to the process in some way to make the following RPA automation even more efficient (I4, pos. 20).

Implementation Approach With regard to the implementation approach, the experts surveyed tended to choose an agile process. "But it's not like we say, okay, we'll start with the first process step, and then when it's finished, we'll see how we do the next one. So it is already planned from A to Z and will definitely be. (...) And that's why, I say, the analysis is a bit waterfall-like at the beginning."(I11, pos. 40). This means that the process or process part to be automated is planned through once in concrete terms before the actual development begins to know the requirements for implementation. The actual development then usually runs in an agile manner. "That's where we have test loops implemented on an ongoing basis. That means we always programmed a part, started the test and saw if it worked (I1, pos. 26). If it is a very manageable process. The requirements are clear, and a classic approach such as the waterfall model can also be used (I2, pos. 38). Än agile approach is probably better suited than a huge detailed concept and then implementing it in a sweep or so with deliverable products, but I would take it to step by step"(I7, pos. 22).

RPA Responsibility Of course, unforeseen problems or hurdles also arise during the rollout of RPA. According to the interviewees, these can occur due to organizational inconsistencies. Responsibilities need to be defined, especially when many people are involved in implementing and supporting RPA. Änd the more complex it is, and the more people are involved here, the more difficult it is to bring this down to a common denominator"(I11, pos. 24). The different areas of know-how also cause problems. "(...) I would say that if you look at a process from an IT perspective, you explain it in a completely different way and describe it completely different than if someone from the specialist area describes it"(I9, pos. 18). To avoid talking past each other during development and ending up with a solution that does not meet the needs and wishes of the end user, the experts ensure that "(...) the specialist translates it to the technician in the way he wants it"(I4, pos. 30). Especially during the introduction of the first robot, one is confronted with technical problems. These can be incorrect settings in the ERP system or the employee's work device. Missing authorizations of the robot also result in processes not being executed correctly. According to the expert from interview five, specific standards should be used during development. Otherwise, quality and performance problems can quickly arise (I5, pos. 30).

Technical Factors Technical limitations in existing ERP systems and the potential to work across systems are one reason for RPA implementation. Ï can't cover all my processes with one software as a group or as a company. Now the manufacturers don't want to provide interfaces, in some cases, there are no longer any"(I5, pos. 40) because outdated systems are still used for specific areas. However, since data and information must be transferred to or from these systems, the only option is to develop one's interface. "Because even if I now use the latest ERP system like S4/HANA from SAP, I still have the problem of system breaks and missing interfaces"(I5, pos. 40). If these problems were to be solved with a specially developed interface, "(...) that would be many times more expensive and more complex than what is possible with an RPA"(I2, pos. 50). Also, with technically implemented interfaces,

only data is transferred and no documents, as may have been the case in the manual process. Due to the omission of these documents, it is no longer possible to fall back on the manual process in the event of an error. However, with RPA, this is possible at any time, since the process remains in the background (I8, pos. 44). Also, with a program written in the ERP system, it is not so easy to integrate different systems into one process. With an RPA solution, this is easier to realize (I8, pos. 8 pos. 14; I3, pos. 38). Also, specific processes run slowly and not efficiently, but rebuilding the system would be far too expensive and would "(...) fundamentally interfere with the company's operations"(I11, pos. 54). Here, the use of software robots can ensure that systems and processes can be maintained, but still achieve an improvement. Also, the possibility of combining RPA "(...) with smaller AI tools looks promising. For example, that the bot can use an OCR tool to logically read something out of a PDF"(I8, pos. 14) is mentioned as an additional decision factor.

The shown aspects of the results are only a selection of interesting ones but can give a good overview of what the expert told about the given topics. In the following part, the authors provide some best practice aspects for using RPA after the Go-Live of an ERP system.

Regarding recommendations for implementing RPA in the post-implementation phase of ERP systems, the experts' statements overlap with the literature in some parts. Nevertheless, the interviews made it possible to develop additional aspects that supplement the literature. The experts distinguish between two types of bots. While Unattended Bots are primarily used in productive cases due to the better optimization possibilities, Attended Bots can be used to familiarize oneself with the technology, especially at the beginning of the introduction. Attended bots are also suitable for use in the area of customer service. In addition to literature, taking over software testing is also mentioned. The possible areas of application for the technology range from various modules in the ERP system, using RAP as an interface alternative, to software and customer service testing. The fact that the interviewees come from different industries also supports Pramod's statement that processes for RPA automation exist in a wide variety of industries [Pr22]. Regarding the characteristics of the processes suitable for RPA, the statements of the interviewees overlap entirely with the traits found in the literature. Processes should fulfill the following criteria: (1) a clear set of rules (no cognitive decision), (2) manual task, (3) low complexity, (4) high volume, (5) standardized, (6) digital and consistent input/output and (7) stability. Standard evaluations can be made in the ERP system to identify such processes, or process heat maps can be used to supplement the literature. The possibility of BPMS was also mentioned. However, the value-driven approach of Kirchmer and Franz is not used in this context [KF12]. According to the experts, identification takes place primarily through the involvement of those professionals who work with these processes daily, similar to what was implemented by Schmitz et al. [SDC19].

5 Conclusion

Here the answer to the research question is given where many aspects regarding post-ERP-implementation RPA support the experts' statements overlap with the literature. Nevertheless, the interviews made it possible to develop some additional aspects. The experts distinguish between two types of bots. While Unattended Bots are primarily used in productive cases due to the better optimization possibilities, Attended Bots can familiarize oneself with the technology, especially at the beginning of the introduction. Attended bots are also suitable for use in the area of customer service, and these digital workers should be used primarily for data maintenance, preparation, or shifting tasks. In addition to the literature, the experts mention taking over software testing. The fact that the interviewees come from different industries also supports Pramod's statement that processes for RPA automation exist in a wide variety of sectors [Pr22]. Regarding the characteristics of the processes suitable for RPA, the statements of the interviewees overlap entirely with the literature. According to this, the processes under consideration should fulfill the following criteria:(1) a clear set of rules (no cognitive decisions), (2) manual task, (3) low complexity, (4) high volume, (5) standardized, (5) digital and consistent input/output, (6) stability and (7) existing system breaks Standard evaluations in the ERP system can be made, or process heat maps can be used to identify such processes. The need for Business Process Management was also mentioned. According to the experts, identification takes place primarily through the involvement of those professionals who work with these processes daily, similar to what was implemented by Schmitz et al. [SDC19]. Process mining should only be used in a supportive manner. Again, consultation should be made with staff who know the process before making the final decision. An economic consideration should also be used as Schmitz et al. [SDC19] for the prioritization of the identified processes. In the implementation phase, the experts recommend an agile approach, as also recommended by Ma et al. [Ma19]. In summary, it can be said that the literature and the experts' statements are mainly consistent. Nevertheless, the expert interviews conducted some additional aspects to be elaborated. A central result of this work is the importance of involving employees in the individual phases of the implementation. They can help identify the processes, provide detailed documentation of the processes for the development of the robots, and help identify errors during monitoring by giving feedback to those responsible. So despite the automation, people still play an essential role in the process.

6 Limitations and Future Research

The interviews for this paper, conducted with the 12 experts, focused strongly on introducing RPA and dealt little with the ERP systems used. The present work also covers the complete lifecycle of RPA, which is why the authors couldn't check all the phases of this cycle and analyze the individual steps in detail. Future work could therefore focus in detail on individual phases of the RPA lifecycle to make even more detailed statements regarding recommendations for action. The influence of different types of ERP systems on the

integration of RPA could also be investigated. It became clear from the experts' statements that RPA is currently little combined with other automation or cognitive methods. In this respect, research is certainly needed in the future in which the different possibilities of combination are analyzed. In turn, recommendations for action are developed for the introduction of Intelligent RPA.

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