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Understanding the Organizational Impact of Robotic Process Automation: A Socio-Technical Perspective

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Abstract. Interest in AI-driven automation software is growing constantly across all industries, as these technologies enable companies to almost automate administrative processes completely and significantly increase operational efficiency. However, many implementation attempts fail due to a lack of understanding of how these technologies affect the various socio-technical aspects that are intertwined in an organisation. This leads to a widening gap between value propositions of automation software and the ability of companies to exploit them. For long-term success, collaboration between humans and software robots in the organization must be optimised. Therefore, the social, technical, and organizational impact of Robotic Process Automation was investigated. Following a socio-technical systems approach, a model was developed and validated in a use case of a company in the mechanical engineering sector. Knowing the influencing factors before launching large-scale automation initiatives will help practitioners to better exploit efficiency potentials and increase the long-term success.

Keywords: Socio-Technical Systems, Human-Machine Collaboration, Robotic Process Automation, Administration

1 Introduction

The future of interaction within organizations is characterized by a tightly interwoven collaboration network of humans and machines. Technological progress is constantly creating new opportunities to achieve operational excellence. One area of application that has gained increasing interest in the last years is administrative processes. Today, organizations optimize their informational processes by using advanced automation technologies [1, 2]. One of these technologies has triggered a real hype recently: Robotic Process Automation (RPA). RPA is used as a collective term for tools that interact on the user interface of computer systems, analogous to the way human actors do [3–5]. Deployment is often seen as a quick win because the conveniently designed interfaces and drag-and-drop functions mean that basically no programming skills are required, making implementation seem trivial from a technological point of view [3, 6]. Nevertheless, many implementation projects fail in practice. It becomes clear that it

is not technical functionality that is the biggest obstacle, but organizational adaptation [1, 6]. Change management issues must therefore be taken seriously to reach efficiency targets and leverage cost potentials. However, we currently experience a lack of understanding on how RPA affects the overall organizational system.

According to the socio-technical systems design, integrating technologies which automate administrative processes into the working world is a major challenge [1]. There is a growing gap between the value proposition of RPA and the ability of companies to exploit it. Many companies lack the necessary adaptability, which is essential to tap the full potential of RPA [6]. In this context, orchestrating the interplay of human employees, technology, and organizational structures is pivotal, according to Strohm and Ulich [7, 8].

With this paper we aim to understand the organizational impact of RPA from a socio-technical perspective. It is dedicated to validating the applicability of a previously developed socio-technical system architecture using a real case study in the field of mechanical engineering. In this way, we transfer our research into operational practice to solve the practitioners' dilemma outlined above.

2 Theoretical Background

2.1 Robotic Process Automation

Lacity and Willcocks characterize RPA as the configuration of software to perform administrative tasks previously executed by human employees [2]. Picking up on this idea, Aguirre and Rodriguez emphasize that despite the often-misunderstood term "robotic", RPA is in no way related to electromechanical machines, but is a software-based system [9]. Van der Aalst et al. additionally refer to RPA as a collective term for tools that interact on the user interface of computer systems, analogous to the way a human actor does [4]. Allweyer adds that software robots can support human employees as personal assistants or replace them completely in the execution of various tasks [5].

To use RPA, software robots are installed and operated on a company's server [10]. These software robots are integrated front-end and operate via the user interface [9, 10]. This means that software robots imitate humans when interacting with the user interfaces, but do not require deep intervention in existing IT applications [4, 11].

Due to the high relevance of AI for the development of automation technologies, future RPA applications will increasingly rely on a combination of "conventional RPA" and embedded AI [12]. This leads to an evolution towards intelligent systems. Technologies such as natural language processing, image and pattern recognition, or context analysis will be increasingly used to enable more intuitive perceptions and judgments in daily office and information activities.

2.2 Socio-technical Systems

The term *socio-technical system* was first used in 1951, when British researchers Trist and Bamforth at London's Tavistock Institute used studies in coal mining to find that the use of the same technologies in different work groups varied greatly in terms of efficiency and effectiveness [13, 14]. They figured that the use of new technologies under conventional conditions brought about enormous changes in the social quality of the work environment [14]. Following their observations, they addressed the interaction of social and technological factors in industrial production systems in their studies. The resulting socio-technical systems approach postulates that each production unit must be viewed as a combined system of social and technical subsystems [8, 13].

The first to transfer socio-technical thinking to the field of computer science was Enid Mumford. She investigated how socio-technical design can be used for successful information systems in the working world [15]. Since then, the socio-technical systems approach for information technology is gaining increasing importance in the literature. With the beginning of the 21st century, the number of publications increased rapidly, especially in the areas of 'computer science' and 'information and communication technologies' [16].

3 Related Research and Innovation Contribution

Since the focus of this paper is to understand the organizational impact of RPA from a socio-technical perspective to promote collaborative work between humans and software robots, an overview of existing socio-technical approaches in this context must first be provided. Following a systematic literature review, Götzen et al. found that socio-technical approaches in the context of RPA are massively underrepresented in the research community [16]. For this reason, we developed a socio-technical framework [16] using the findings from the literature review as well as applying Eisenhardt's case study research [17, 18].

The framework comprises thirteen relevant socio-technical elements that need to be considered when implementing RPA. These elements are assigned to three socio-technical dimensions: Organization, Technical System, and Social System. Collaborative human-machine interaction necessary for task completion is at the center of the socio-technical framework and acts as a link between the three subsystems. In addition, we derived relationships between the individual dimensions to specify these interactions. While the organizational dimension focuses on the orchestration of employees in a company, i.e., the creation of general conditions for collaboration and the design of tasks and processes, the social subsystem considers the individual characteristics and interpersonal relationships that influence action. In addition, RPA implementation requires a technological component to provide functionality which is represented by the technical subsystem. Figure 1 shows how the individual elements relate to each other within the complex socio-technical system architecture.

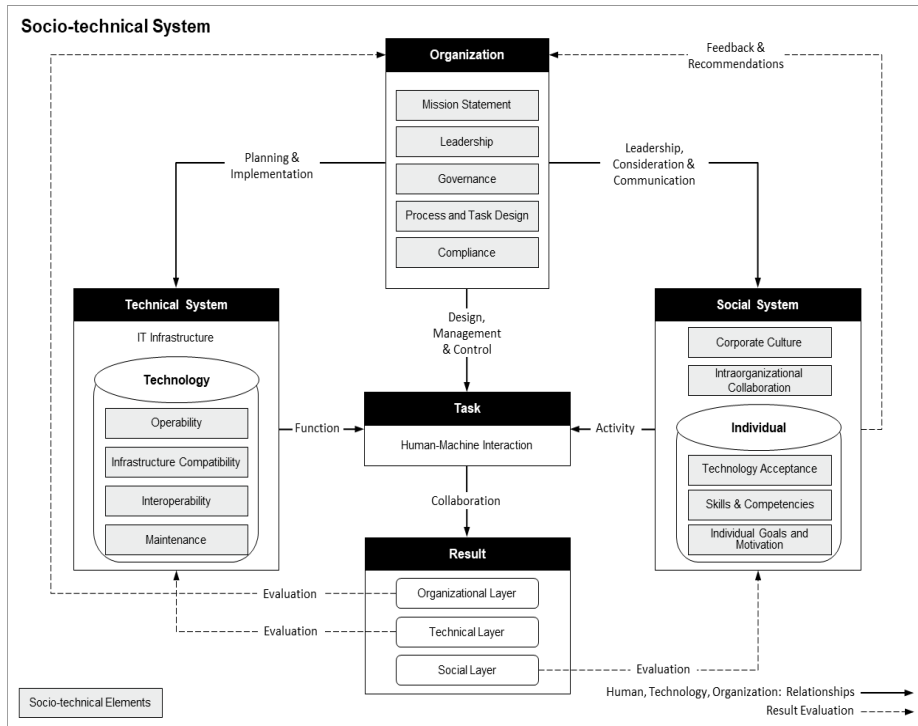


Figure 1: Socio-technical system architecture for RPA implementation [16]

To address the practitioners' dilemma of not sufficiently considering socio-technical aspects before implementing RPA, our framework will be applied in a real use case. We aim at making a significant innovation contribution by transferring scientific endeavor into practice validating the applicability of research findings. To this end, we address the following central research question:

To what extent can socio-technical research approaches be applied to a real-world RPA implementation scenario?

4 Research Design

The research process follows Ulrich's strategy of applied research. He states that the problems of applied science result from practical challenges. Research findings therefore aim at testing developed design models in an application context [19]. Figure 2 illustrates the research process, including the previous development of the socio-technical system architecture by Götzen et al.

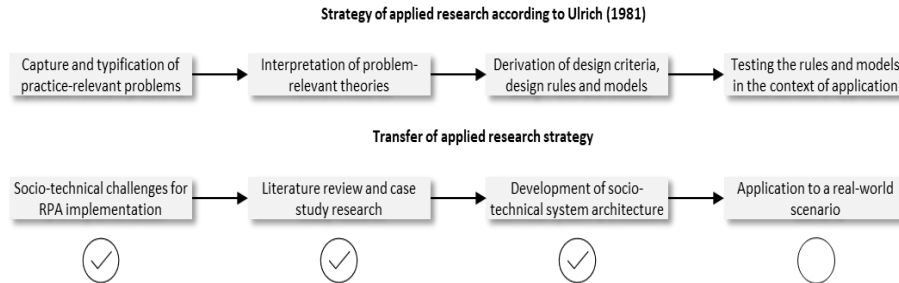


Figure 2: Research process - strategy of applied research [18]

Götzen et al. postulated that socio-technical challenges encountered in RPA implementation should be a key aspect of future research activities [16]. By using systematic literature review and case study research according to Eisenhardt, problem-relevant theories and approaches were identified. We transferred our findings into a socio-technical system architecture for the use of RPA. According to the strategy of applied research, the last step is to test the developed model in a real-world scenario. The paper will focus on exactly this step.

We selected a German medium-sized company from the mechanical engineering sector, for the RPA use case. This industry was deliberately chosen, as it was not considered in the model development of Götzen et al. The model development focused on large enterprises from the telecommunications, finance, and insurance industries, as these have taken a pioneering role in the implementation of RPA. A successful application of the framework to a medium-sized mechanical engineering business would therefore show that the framework can be used as a supporting management instrument regardless of industry sector and company size.

We have accompanied the implementation process over one year from beginning to end and will present the findings, based on own observations and expert interviews with the Managing Director, who functioned as the project sponsor. Simultaneously, the relationship between the practical experiences and the socio-technical system elements presented earlier (see Fig. 1) will be illustrated. The goal is to verify that all elements are valid in practice and sufficiently represent the complexity of RPA implementations.

4 Case Study Results

4.1. Introduction of the Company and Motivation for RPA

The company, which we accompanied is a medium-sized German company for conveyor, elastomer, and plastics technology. The company currently employs 80 people. The decisive factor for starting the RPA journey was a desire to relieve employees of repetitive and monotonous tasks that can be processed by a software

robot. According to the Managing Director, the mere execution of rule-based processes is not viable under today's labor market conditions and the prevalent lack of skilled personnel. Therefore, staff must be deployed in areas of activity that create added value for the company. He stated that in the past, the company employed a certain number of full-time equivalents (FTE) to perform invoice checks. The administrative employee was responsible for checking invoices and matching them with purchase order data. If the information was identical, manual approval was given or in case of discrepancy a ticket was forwarded to the responsible product manager. However, the case study partner preferred to use staff capacity for customer service rather than for administrative tasks. These activities require human competencies, which cannot be covered by software robots. The motivation to introduce RPA arose to free up human resources and use them for cognitively demanding tasks. The motivation is clearly not to rationalize jobs.

The automation team responsible for the implementation process comprised three employees from different departments. The first employee was a process owner with extensive operational knowledge. The second team member has been responsible for the introduction of a Management Execution System (MES) and was therefore assigned as the project manager. In addition, a third employee was released from daily business for six months to exclusively work on the RPA implementation. Moreover, the project received support from an IT employee who took responsibility for the management of hardware and software, e. g. the server installation. The Managing Director emphasized that the small task force was very effective due to efficient communication and result-oriented actions.

4.2 Case Application of the Socio-Technical System Architecture

In the following, we describe all elements of the socio-technical system architecture according to Götzen et al. based on experiences of the case study partner as well as own observations made throughout the implementation process.

Organization

The Managing Director did not envision a **mission statement** for the initial pilot, as it was only an initial proof-of-concept. However, it was emphasized that successful implementation would lead to the creation of an automation strategy for the entire company. During the case study, the need for **leadership** to drive the RPA implementation was rated as high by all participating employees. It is emphasized that a top-down sponsorship is required, which provides the employees with time and budget needed. In the present use case, this role was taken on by the Managing Director. As documented in numerous literature articles and confirmed by various experts, **governance** is a supporting pillar of RPA implementation. Also, the case study partner defined responsibilities within the team constellation. After the pilot phase, the central IT department will keep the automation solutions permanently in operation. The establishment of a Centre of Excellence (CoE) was not pursued, as there are insufficient personnel capacities due to the company size. When introducing RPA, we recommend

that the company carries out an analysis for **process and task design** before the automation goes into effect. In the use case, the process analysis was conducted in the form of interviews with the responsible staff. This helped the company to eliminate inconsistencies and design efficient and robust processes before automating. Taking **compliance** requirements into account, the company first examined which data is processed where and by which accounts. The bots used were then stored as digital resources or as external employees in the human resource system to provide access authorizations for the target applications.

Technical System

As part of the rollout, an application partner was brought in to provide the software and ensure **operability**. This partner was also responsible for error and exception handling and guaranteed that each bot went live with a defined status. In this context, the company's own IT department was also trained, as operational performance is closely interrelated with IT skills and competencies. The RPA application acts on the user interface of the in-house systems. Therefore, no complications regarding **infrastructure compatibility** are expected. To prevent the scenario of automating in systems for which the employee has no authorization, the case study company had to develop a technical access and rights concept. Together with the automation team, it was ensured that the RPA application had clear boundaries in form of reading and writing rights for each system served. This ensured **interoperability**. **Maintenance** becomes necessary whenever changes occur in the target system. However, since the company's applications are in-house, changes are predictable and not dependent on external releases. The maintenance effort is thus calculable and controlled by the process management.

Social System

All team members confirmed the need for a digital-savvy and open **corporate culture** for integrating extensive automation. Concerns were mainly expressed due to trust issues. Transparent communication is crucial to reduce uncertainty, as automation is often associated with job loss. However, the company was able to prevent conflicts by effectively redeploying human resources from administrative to cognitive tasks and transparently communicating the results from the start. Despite a dedicated automation team, implementation required a great deal of coordination and, above all, explanation. **Intraorganizational collaboration** is necessary but required extensive coordination to be successful due to the large number of stakeholders involved. This was ensured through regular coordination meetings. At first, the possibilities of RPA were incredibly overestimated by the employees. As the pilot did not produce the desired results from the start, initial **technology acceptance** dropped sharply as expectations could not be met from the get-go. With the help of further system tests, deficiencies were corrected, and acceptance ensured in the further course. There were no social fears of job loss due to transparent communication. While IT staff received extensive training on necessary **skills and competencies** also the IT affinity of employees in administration had to increase. The training was provided by the software provider and contributed

immensely to an effective intraorganizational collaboration. For the successful RPA deployment, **individual goals and motivation** of employees were addressed and included in the process. The relief from repetitive tasks contributed significantly to the individual goals of each actor, as they saw a greater sense of purpose in their new field of activity.

The case study makes clear that all the socio-technical system elements shown are relevant for the implementation process. However, due to the individuality of each use case, the relevance varies greatly. Individual elements must therefore be addressed with varying intensity.

5 Managerial Implications and Conclusion

During our research activities, we applied the socio-technical system architecture of Götzen et al. in a real case study. Our investigation contributes to a deeper understanding of the organizational impact of RPA. The case application made it possible to confirm the relevance of the research contribution in the operational context and thus validate the presented framework.

Due to the size of the company, the relatively low software penetration within the respective industry, and limited financial and human resources, the use case company took a different approach to RPA implementation than the highly digitalized companies used for the model development. For this use case three critical success factors stood out:

1. **Project Sponsorship:** For small and medium sized companies it proved to be successful to have the Managing Director sponsor the RPA project. Besides ensuring resource availability, having the direct support of the Managing Director increased the project credibility and the commitment of the employees.
2. **Dedicated Task Force:** In contrast to enterprises with large IT-departments and an extensive range of administrative processes, establishing a discrete automation department is not feasible for smaller companies. Instead of creating a CoE, a small interdisciplinary taskforce for the automation project has shown to be very effective.
3. **Communication:** Addressing potential fears and uncertainties of employees from the beginning was crucial. To maintain trust, project results were communicated openly. In retrospect, the expectations of the employees could have been assessed earlier to minimize deviation between the expected and the actual scope of the software during the pilot phase.

The case study confirmed the high importance of all socio-technical elements and the industry-independence of the system architecture. Nevertheless, we identified a need for further research. To obtain more robust results, firstly, the framework needs to be applied in more cross-industry use cases. Secondly, this paper focused only on testing the relevance of the socio-technical system elements during an RPA implementation. Conversely, we think it would be interesting to investigate to which extent applying

this framework before implementation can help to make RPA introductions even more efficient. At last, we consider testing the applicability of the model for the implementation of intelligent systems that consider the use of RPA and AI highly relevant for future research. This would show the extent to which the sociotechnical model hold validity in the context of higher levels of automation development.

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