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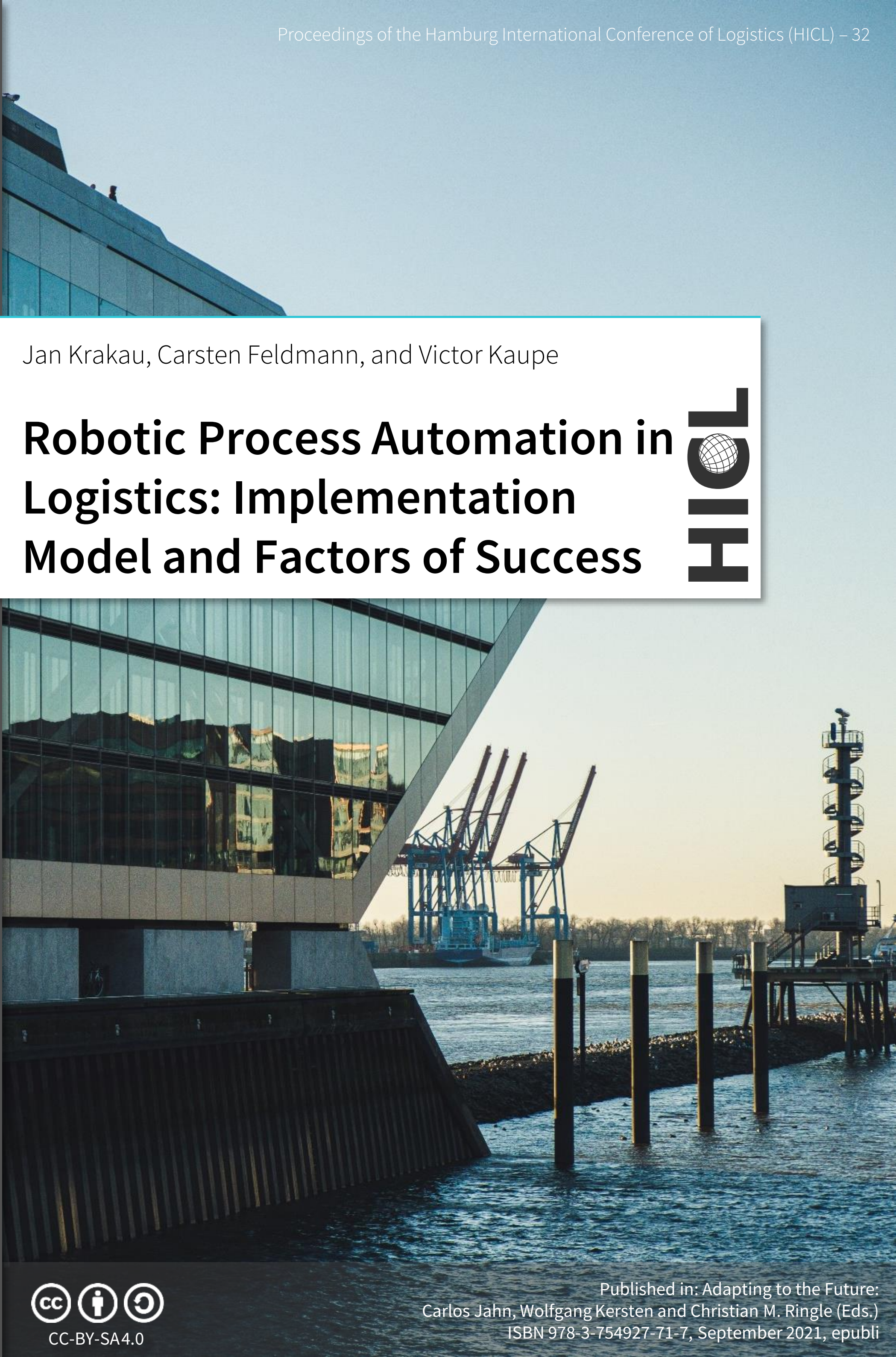

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Robotic Process Automation in Logistics: Implementation Model and Factors of Success

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Purpose: *Robotic process automation (RPA) refers to software robots (bots) that automate repetitive, rule-based tasks in a business process. In this study, the research questions regarding logistics applications are as follows: (1) What are suitable use cases for RPA in logistics? (2) Which criteria support the selection of appropriate processes? (3) How should a procedure model for implementation be designed to systematically support the introduction while considering critical success factors?*

Methodology: *This study follows the design science research process by Peffers et al. (2006). The research gap was identified through an extensive literature analysis, reflecting the state of research. Insights gained were compared with empirical data from the use of RPA at a case company.*

Findings: *A procedure model was designed to systematically consider success factors for an implementation, comprising (1) initiation; (2) piloting; (3) deployment; and (4) ongoing governance, maintenance, and continuous improvement.*

Originality: *RPA can contribute to solving challenges such as increased service demands from customers, combined with cost pressures and a shortage of skilled labor. The procedure model closes a research gap, both from a scientific perspective and from the practitioners' viewpoint, supporting an efficient and effective implementation. The consideration of knowledge from both theory and practice ensures practical relevance and significantly expands the state of research.*

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1 Introduction

Robotic process automation (RPA) refers to software robots (bots) that emulate humans in executing repetitive, rule-based tasks in a business process (Cernat et al., 2020; Willcocks et al., 2015a). In comparison to other modes of automation, RPA bots act at the front-end level of applications (Lacity et al., 2016a). Logistics is one of the many domains of interest for RPA implementation. Logistics is characterized not only by physical processes but also by digital processes such as interactions between application systems that can potentially be automated with RPA. The benefits of RPA in logistics are manifold. First, the automation of routine tasks enables employees to conduct more value-adding work and coincides with cost reductions achieved by workforce salary savings (Mullakara and Asokan, 2020; Murdoch, 2018). Second, organizations profit from a fast and reliably predictable return on investment (ROI; Alberth and Mattern, 2017). Further benefits are the increasing process execution speed and 24/7 availability of bots as well as higher process execution accuracy and improved compliance due to log data transparency (Murdoch, 2018). In addition, the implementation effort is relatively low compared to invasive automation solutions. This is because neither complex adjustments to application systems nor extensive coding knowledge are required, as programmed modules can be reused (Czarnecki and Auth, 2018; Lacity et al., 2016a; Langmann and Turi, 2020).

The main challenge in exploiting these benefits is the development of a holistic framework for RPA implementation. The ensuing research questions are as follows: RQ1: What are suitable use cases for RPA implementation in logistics? RQ2: What criteria support the selection of processes suitable for the implementation of RPA? RQ3: How should a procedure model for implementation be designed to systematically support the introduction while taking critical success factors into account? Chapter 2 provides an overview of the state of research to deduce the research agenda, and the research methodology is outlined in Chapter 3. Following the phases of the design science research process, the procedure model is developed and validated in Chapters 4 to 6. In the concluding chapter, the main findings are summarized, and implications for further research and practice are derived.

2 State of the Field and Research Gap

To obtain an overview of the state of research, a comprehensive literature review was conducted utilizing the approach by Vom Brocke et al. (2009). Relevance was gained by refraining from investigating what is known already (Baker, 2000). Rigor results from effectively applying the existing body of knowledge base (Hevner et al., 2004). As part of the keyword-based literature research, 1,120 publications were initially identified in eight databases. Based on an analysis of article titles and abstracts as well as forward and backward searches, this number was decreased to a sample of 57 publications by applying the criteria of relevance, timeliness, and validity (see Figure 1). To provide high quality sources, the focus was on articles in scientific journals and conference proceedings. For the literature review presented next, the authors used the concept matrix presented in Appendix A, which breaks down topic-related concepts into different units of analysis.

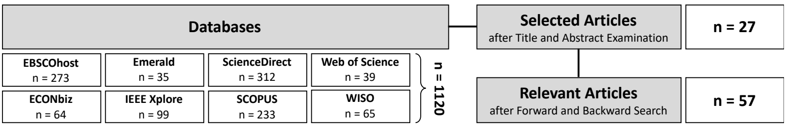

Figure 1: Databases and statistics from the literature search process

Many of the examined articles focus on general success factors for subsections of RPA implementation, often lacking a holistic and coherent view. However, in 17 papers, a structured phase model for implementation is presented (Alberth and Mattern, 2017; Hallikainen et al., 2018; Herm et al., 2020; Ilo, 2018; Jimenez-Ramirez et al., 2019; Kanakov and Prokhorov, 2020; Koch and Fedtke, 2020; Kyheröinen, 2018; Langmann and Turi, 2020; Masó, 2018; Myllymäki, 2019; Rutschi and Dibbern, 2020a; Sig-urðardóttir, 2018; Smeets et al., 2019; Willcocks et al., 2015a; Willcocks et al., 2019; Zaharia-Radulesu et al., 2017). Nonetheless, an in-depth analysis of these papers revealed substantial differences regarding the implementation approach and the focus of consideration. Furthermore, only four articles provide a profound practical validation of the theoretically derived procedure model (Ilo, 2018; Kyheröinen, 2018; Masó, 2018; Rutschi and Dibbern, 2020a).

Apart from these limitations, a major portion of the examined articles are confined to a general-level analysis. Of the few domain-specific papers that exist, a large proportion focuses on finance and accounting, followed by auditing, human resources, controlling, and manufacturing. However, none of those articles related to RPA implementation addresses logistics-specific aspects. Therefore, the literature research was extended to identify logistics use cases for RPA, resulting in an analysis of seven further articles (Agaton and Swedberg, 2018; Czarnecki and Auth, 2018; Feld et al., 2017; Kaya et al., 2019; Madakam et al., 2019; NTT DATA, 2018; Scheer, 2018), although these articles do not derive any logistics-specific characteristics and success factors for implementation.

Hence, the state of the field can be summarized as follows: Procedure models for RPA implementation are rarely domain-specific, but are often limited to general-level analysis. No logistics-specific procedure model exists. Moreover, most procedure models lack practical validation. It is therefore difficult for practitioners to understand how the outlined benefits of RPA can be achieved in logistics.

3 Research Methodology

For the design and evaluation of the procedure model, design science was chosen, as it offers a proven methodological context for construction-oriented research projects. Specifically, the research logic is based on Peffers et al. (2006), incorporating the guidelines by Hevner et al. (2004). The design science research process outlined by Peffers et al. (2006) essentially consists of six steps: problem identification and motivation, objectives for a solution, design and development, demonstration, evaluation, and communication. Following this approach, Hevner et al.'s (2004) guidelines ensure the scientific relevance and rigor of research as well as sufficient validation and effective communication of the outcome to both researchers and practitioners (see Figure 2).

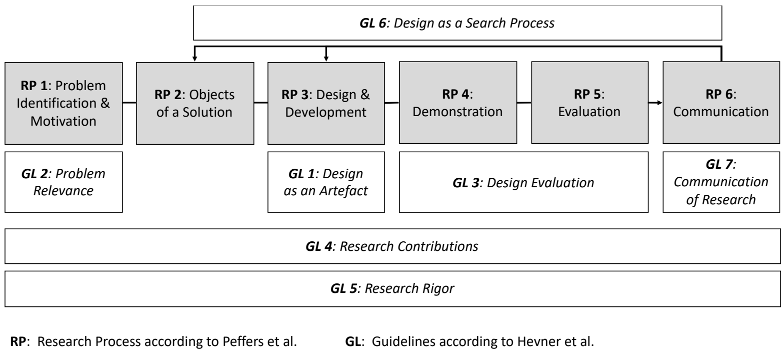

Figure 2: Design science research process and guidelines, cf. Zellner (2015)

Problem identification, objective formulation, and design and development were carried out based on a systematic and comprehensive literature review, following Vom Brocke et al. (2009); see Chapter 2. With regard to the design phase, the aforementioned 17 existing phase models for RPA implementation were mapped to identify commonalities and deviations. Building upon this mapping, insights from a case study at a leading German coating manufacturer were obtained, validating the theoretical findings and enhancing the quality of the artefact.

4 Problem Identification and Objectives for a Solution

Based on the literature review outcomes, the research gap identified is the lack of a holistic procedure model for systematically guiding practitioners in implementing RPA in logistics processes. To illustrate the complexity, the research problem can be further atomized. First, substantial knowledge about logistics use cases and suitable logistics processes is lacking. Moreover, practitioners risk making poor decisions when implementing RPA, leading to an unnecessarily long implementation duration. As a result, the costs incurred may increase, especially if external consultants are hired for implementation assistance.

The problem specification indicates that practitioners require a structured approach for implementing RPA in logistics, comprising transparent information about the objectives, input, procedure, output, methods, and success factors at every stage. A procedure model is a mapping of the activities to be performed within the context of an overall task (Schütte, 1998; Feldmann et al, 2020): A standardized process structures the fulfillment of the implementation task so that progress can be tracked and documented during the RPA project. A procedure model encourages a common understanding of the process and cooperation between the parties involved.

With regard to the research questions outlined in the introductory chapter and the problem specification delineated in the previous chapter, three main objectives for a solution are pursued. First, suitable logistics use cases for RPA implementation are to be identified. Second, criteria supporting the selection of suitable logistics processes are to be depicted in a structured way. Third, a procedure model for systematic implementation is to be designed, consisting of critical success factors derived from a literature analysis and practical implementation.

5 Design and Development

5.1 Overview

The artifactual solution to be designed is a procedure model for the implementation of

RPA in logistics processes. In Section 5.2, the fundamental design principles are outlined. Then, in the subsequent sections, an overview of the procedure model is provided, and its individual phases are described in detail.

5.2 Design Principles

According to Vom Brocke (2007), modeling is a design process intended to create a model that meets users' requirements. In terms of RPA implementation, the procedure model should provide a useful reference guideline for practitioners such as project managers and team members of RPA implementation projects as well as logistics process owners. To ensure high model quality and practicability, various design principles are applied. Following Becker et al. (1995), these design principles are accuracy, relevance, cost-effectiveness, clarity, comparability, and systematics.

5.3 Procedure Model

5.3.1 Overview

Seventeen phase models for RPA implementation were identified during the literature research. These phase models were mapped to detect commonalities as well as deviations and to derive an appropriate procedure model framework (see Appendix B). The resulting model encompasses four main phases (see Figure 3):

3. Initiation, which entails (1.1) project setup, (1.2) logistics use cases and processes identification, (1.3) business case calculation, and (1.4) software provider selection;
4. Piloting, comprising (2.1) process documentation and optimization, (2.2) pilot bot development, and (2.3) pilot validation;
5. Deployment, which involves (3.1) operating model setup, (3.2) center of excellence creation, and (3.3) deployment at a large scale;
6. Ongoing governance, maintenance, and continuous improvement.

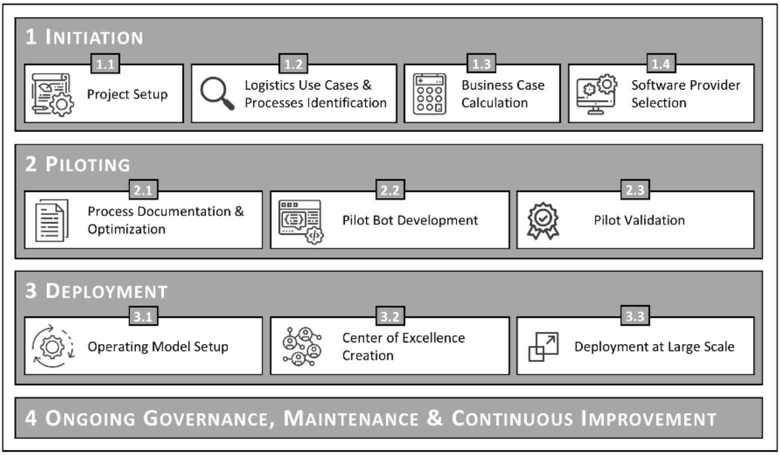

Figure 3: RPA implementation phases

To ensure consistency and practicability, each sub-phase is structured into objectives, required input, procedure, generated output, supporting methods and tools, and success factors. The following sections focus on particularly relevant aspects of the procedure model, and a comprehensive description can be found in Appendix C.

5.3.2 Phase 1: Initiation

The first step of the procedure model is to plan the project and assemble the team (1.1 Project Setup). Project planning should be based on proven project management standards, such as those of the Project Management Institute (PMI), to plan the scope, time, cost, quality, risk, resources, communication, and change management, among other topics. Apart from an early involvement of the IT department, it is important to ensure stakeholder support, especially management's tolerance for making mistakes and experimenting with RPA (Koch and Fedtke, 2020; Lacity and Willcocks, 2016; PMI, 2017).

The next step is to identify generally suitable logistics use cases and concrete processes for the pilot implementation of RPA (1.2 Logistics Use Cases & Processes Identification).

Proven use cases found in literature can be used as stimuli for a transfer to the own company, such as the entry, processing, and adjustment of master and transaction data, or the execution of functions in ERP systems (Kaya et al., 2019; Madakam et al., 2019). Appendix D provides a detailed compilation of logistics use cases.

The underlying processes must be evaluated based on qualitative and quantitative criteria. Qualitative process characteristics that should apply are a high degree of rule-based, standardization, repetitiveness and digitalization, low complexity and cognitive requirements, high process maturity, high error-proneness during manual execution, high stability of the system environment, and high re-deployability of personnel (Herm et al., 2020; Murdoch, 2018). To obtain a more comprehensive overview, the meta-analyses conducted by Agaton and Swedberg (2018) and Eggert and Moulen (2020) can be utilized. In terms of quantitative process characteristics, the monthly cost savings can be calculated by multiplying the number of process runs per month by the usual duration of a process run in hours and the involved employee costs per hour (Smeets et al., 2019). For the combined evaluation of qualitative and quantitative process characteristics, a two-dimensional heatmap can be used. Regarding the success factors within this sub-phase, it is important to analyze whether there are better-suited automation technologies than RPA for specific processes such as ERP automation or artificial intelligence (Ilo, 2018).

Next, a business case calculation for the previously selected processes must be conducted and evaluated (1.3 Business Case Calculation). Here, the quantitative and qualitative benefits as well as the costs for RPA implementation must be taken into account (Agaton and Swedberg, 2018; Alberth and Mattern, 2017; Murdoch, 2018). Based on an ROI calculation, a decision must then be made regarding whether to proceed with the implementation project or stop it. In the case of a positive decision, a suitable RPA software provider is to be selected (1.4 Software Provider Selection). The selection can be facilitated by using a scoring model with the following criteria: software costs; skill requirements; vendor reputation and support; software maturity and security; scope of functions; user friendliness; and next-generation capabilities (Herm et al., 2020; Murdoch, 2018; Taulli, 2020; Willcocks et al., 2019). Apart from using trial versions of different providers, it is recommended not to invest too much effort in the provider selection, because the major providers are on a similar capability level at the current time of technology development. Moreover, adjustments to the solution can be made after a successful pilot implementation (Koch and Fedtke, 2020; Taulli, 2020).

5.3.3 Phase 2: Piloting

In the second phase, the processes selected for RPA piloting must be comprehensively documented, standardized, and optimized (2.1 Process Documentation & Optimization). Regarding documentation, a process definition document (PDD) must be composed, providing a detailed process description as well as information on in- and out-of-scope activities, involved systems, required access rights, and responsibilities (Koch and Fedtke, 2020). The PDD draft creation can be supported by using proven process mapping methods such as BPMN 2.0, and it may be enriched by step-wise desktop screenshots and videos with voice-over (Murdoch, 2020). Regarding standardization, the process-related data must be available in a structured format (Moffitt et al., 2018). Furthermore, a re-sequencing of process steps can be useful to better separate human and robot work (Asatiani et al., 2019). Before moving to bot development, a solution design document (SDD) is to be created, consisting of technical details that are necessary for the development and maintenance of the RPA solution (Koch and Fedtke 2020). Moreover, it is recommended to document best practices and lessons learned during the entire piloting stage to facilitate future deployment activities.

The next step is to develop the robot script for the automation of the selected processes based on the PDD and SDD (2.2 Pilot Bot Development). Following an agile approach, a minimum viable product (MVP) must be built and iteratively refined by continuously conducting tests (Smeets et al., 2019). Aside from close collaboration with the respective process experts and frequent consultation with the IT department, a pragmatic approach should be adopted, allowing workarounds if necessary (Koch and Fedtke, 2020; Langmann and Turi, 2020; Wibbenmeyer, 2018).

The piloting stage concludes with the technical and economic validation and approval of the developed bots (2.3 Pilot Validation). During the technical validation, functional tests, integration tests, and finally user acceptance tests are designed and executed (Cernat et al., 2020; Ilo, 2018; Smeets et al., 2019). As soon as the bots are technically approved, the business case calculated in Phase 1.3 must be validated. Prior to final pilot approval and migration to production, the following are vital: ensuring staff acceptance and providing training to process experts in case their attendance is required.

5.3.4 Phase 3: Deployment

The deployment phase starts with defining a standardized framework for the effective, cost-efficient, and secure implementation and operation of new RPA solutions (3.1 Operating Model Setup). The operating model should include RPA demand pipeline creation; implementation project approval; implementation; go-live in production environment; and ongoing governance, maintenance, and continuous improvement. Furthermore, guidelines regarding, for example, bot access rights, the architectural anchoring of bots, and automation restrictions must be defined, and compliance with data privacy and security regulations must be ensured (Alberth and Mattern, 2017; Langmann and Turi, 2020; Smeets et al., 2019). Moreover, a change management plan must be created, following, for example, Kotter's eight-stage change model (Kotter, 2013).

The next step is to build a center of excellence (CoE) that is responsible for RPA governance, design, development, operation, and maintenance during the RPA rollout (3.2 Center of Excellence Creation). The number of personnel resources within the CoE team depends on the intended scope of deployment as well as the company size. Recommended roles are a CoE lead, a business analyst, a developer, and a tester for process selection and RPA solution development; an IT architect, support, and a controller for continuous monitoring and support; a trainer for knowledge transfer; and a distributor for communication of RPA benefits. Following Hallikainen et al. (2018), the creation of new RPA solutions and the maintenance of existing RPA solutions should be distinctly separated within the CoE from an organizational point of view.

Having set up an operating model and assembled a CoE team, the deployment of RPA at a large scale can be ensued (3.3 Deployment at a Large Scale). With regard to the demand pipeline creation, it must be ensured that process specialists comprehensively understand the capabilities of RPA (Cooper et al., 2019). The ideation process can be enhanced by incentivization and by showcasing successful RPA implementations

(Balasundaram and Venkatagiri, 2020; Murdoch, 2018). In terms of bot development, it is recommended to create and utilize a centralized component library with common RPA modules to decrease the solution design effort (Hallikainen et al., 2018).

5.3.5 Phase 4: Ongoing Governance, Maintenance, and Continuous Improvement

In addition to RPA piloting and deployment, RPA governance, maintenance, and improvement must be continuously ensured for long-term functionality and error prevention. Aside from the provision of a service desk for RPA issues, change requests and application system releases should be analyzed and managed (Anagnoste, 2018; Koch and Fedtke, 2020). Moreover, the bots' performance must be monitored, the standardized implementation procedure must be reviewed, and business continuity plans for cases of bot unavailability must be delineated (Ilo, 2018; Smeets et al., 2019; Taulli, 2020). Along with log data storage for transparency, it is further recommended to continuously examine whether an extension of RPA with next-generation technologies, such as natural language processing or optical character recognition, is beneficial (Anagnoste, 2018; Langmann and Turi, 2020).

6 Demonstration and Evaluation

Two examples of RPA implementations in the logistics processes of a German coating manufacturer were used to validate the applicability of the procedure model. The first example is a bot that replaces repetitive human input to IT systems in the context of transport processes. The second use case is the application of an RPA bot instead of developing a conventional interface between two IT systems.

6.1 Use Case One: Transportation Management

The first RPA project began as a trial-and-error approach (Phase 1), as RPA was a new phenomenon to the team involved. The first objective was to get to know the technology and collect first experiences to evaluate the benefits and constraints of utilizing RPA in logistics. In contrast to the model presented, the case company has a CoE for RPA processing, which offered services to the logistics operations team. As described by Herm et al. (2020) and Murdoch (2018), the team started with identifying simple, digital, administrative processes as potential use cases. Therefore, here, the business case calculation was done after the roll-out. The first use case chosen was the input of shipping documents into the ERP system. Transport lists, checklists, loading pictures, and other transport-related documents are collected and manually attached to the transport documentation in the ERP system.

To understand the manual process, a process analysis was conducted and documented (Phase 2). In this case, the information collected included all relevant data as described by Koch and Fedtke (2020): procedure description, involved systems, access rights, handled documents, and transactions of the process. To support the programmers in the CoE, live videos were recorded in addition to the process documentation, showing all relevant process steps performed by the employee in a repeatable manner. Following the video, the scripting was done by the CoE, and after functional and integrational testing by the CoE, the local project team tested user acceptance, taking all eventualities into account.

After successful testing, the migration to production commenced. The bot's email address required for the process was created, its access rights were requested, the bot was activated, and the process went “live.” Change management was then documented, the teams were onboarded, and management was informed. After implementation, Phase 4 was launched. The process was maintained regularly, performance was checked, statistics were compiled, and the process itself has been optimized continuously according to the LEAN principles of plan, do, check, act (PDCA).

6.2 Use Case Two: Digital Outbound Checklist

The second use case is the application of an RPA bot instead of developing a conventional interface between two IT systems. Interfaces for automated data exchange with other IT systems are not available with every IT system. For process automation, they must often be programmed and implemented in a time-consuming and cost-intensive manner. For simple standard processes, the use of bots is an alternative to data transfer between IT systems as a so-called non-invasive solution without major programming effort or deeper intervention in the respective IT systems. Standardized workflows, the comparison of use cases, and the adaptation of existing bots for further implementations are part of the deployment phase (Phase 3). The second use case demonstrates the applicability of this approach.

The physical logistics department handles the dispatch of outgoing trucks. Here, the picked and packed pallets are loaded onto the trailers. Loading security is ensured by warehouse workers using a paper-based checklist to document the correct condition of the truck and loaded cargo leaving the coating manufacturer's yard. Since this process was digitized using a digital checklist, a transfer method was needed to digitally store the checklist data, picklists, loading image, personal data of the trucker, and other shipping documents for further processing. Time-consuming and costly custom-programmed interfaces were traditionally used to transfer the data to the system, which would hinder rapid process implementation. Instead, the above-mentioned existing transportation management bot was modified to fill the gap of a missing data transfer interface between the plug-and-play checklist and the company's ERP system. The process was designed as visualized in Figure 4.

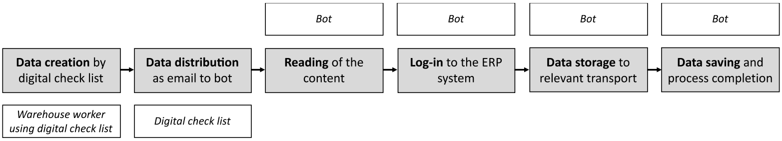

Figure 4: Process for robotic process automation (RPA) implementation in case company

The bot receives the aforementioned data as an e-mail attachment, reads the content, logs on to the transport management system with its personalized access rights, files the document under the corresponding shipment number, saves the status, and completes the process at the end. A detailed overview of success factors derived from the delineated RPA implementation approaches at the coating manufacturer can be found in Appendix C.

6.3 Evaluation

From the company's point of view, the bots offer flexibility because they can work independently 24/7, thereby enabling improved productivity. The bots also work in a standardized and error-free manner, meaning that the high process performance remains constant and measurable. Both the productivity boost and the consistent high performance increase compliance and safety, especially in companies that are strongly quality driven, such as the automotive industry. Employees can focus on more value-added work rather than dealing with strenuous or low-value work, thus increasing employee satisfaction. In addition, RPA can be implemented quickly and cost-effectively, and the benefits could be measured both qualitatively and quantitatively. In summary, RPA has the potential to increase quality and efficiency, and the lessons learned that have been incorporated into the procedure model are transferable to other use cases. RPA is suitable not only for taking over human activities on IT systems, but also for data transfer between two systems as an alternative to a complex programmed interface.

7 Communication

The objective of this paper was to provide support to logistics practitioners in implementing RPA efficiently and sustainably. To achieve this objective, three research questions were answered. RQ1: What are suitable use cases for RPA implementation in logistics? Based on a comprehensive literature review, numerous use cases were identified. RQ2: What criteria support the selection of processes suitable for the implementation of RPA? Qualitative and quantitative criteria were provided for the selection of suitable processes. In particular, a high degree of rule-based tasks, standardization, repeatability and digitization, low complexity and cognitive requirements, high process maturity, high error-proneness in manual execution, and a high stability of the system environment indicate suitability for RPA. RQ3: How should a procedure model for implementation be designed to systematically support the introduction while taking critical success factors into account? Previously available process models were not specifically geared to the requirements of logistics or were not sufficiently validated. This gap was closed by the domain-specific process model. The logistics-specific procedure model presented in this paper significantly expands the state of research. On the one hand, a comprehensive literature review and a phase model synopsis were conducted to derive an appropriate framework based on commonalities and deviations. On the other hand, the results of a case study validation comprising two logistics use cases were considered.

Nonetheless, limitations remain. First, apart from the necessity of further validation, a distinction between small and large companies would be useful regarding, for example, the number of employees in the CoE. Moreover, further research could focus on a more holistic approach to process automation, including a criteria-based selection between different tools and technologies such as artificial intelligence (AI) or intelligent business process management suites (iBPMS).

RPA has various benefits for practitioners. Aside from cost reductions, 24/7 bot availability, and a higher process execution accuracy, the automation of routine tasks enables employees to conduct more value-adding work. Moreover, neither complex adjustment to application systems nor extensive programming knowledge are required for RPA implementation. The presented procedure model supports practitioners with the implementation process, providing step-by-step guidance including objectives, input, procedure, output, methods and tools, and success factors for each phase. It must be emphasized that continuous change management is essential to run RPA successfully.

Appendix A: Concept Matrix for Literature Analysis

Source	Implementation			Procedure Model					Domains						
	Success Factors	Methods	Project Management Focus	Structured Phase Model	Project Initiation Phase	Process Selection Phase	Pilot Phase	Roll-out Phase	Audit	Controlling	Finance/ Accounting	Human Resources	Logistics/ SCM	Manufacturing	Peer-reviewed
Alberth and Mattern 2017				x		x	x								x
Anagnoste 2017							x	x			x	x			x
Anagnoste 2018	x	x													x
Asatiani and Penttinen 2016						x									x
Asatiani et al. 2019	x														x
Asatiani et al. 2020	x				x						x				
Balasundaram and Venkatagiri 2020					x	x	x	x				x			x
Bourgouin et al. 2018						x									x
Camin 2018	x					x	x	x							
Carden et al. 2019	x		x		x		x				x				x
Cernat et al. 2020	x	x													x
Cooper et al. 2019	x										x				x
Eggert and Moulen 2020						x									
Fernandez and Aman 2018	x										x				x
Fung 2014	x					x									x
Gotthardt et al. 2020	x								x		x				x
Hallikainen et al. 2018	x			x	x		x	x							x
Heponiemi 2019	x					x									x
Herm et al. 2020	x		x	x	x	x	x	x							
Ilo 2018	x			x	x	x	x				x				x
Jalonen 2017						x									x
Jimenez-Ramirez et al. 2019				x		x	x								
Kanakov and Prokhorov 2020				x		x	x	x							x
Knauer et al. 2020	x									x					
Koch and Fedtke 2020	x	x	x	x	x	x	x	x							
Kokina and Blanchette 2019	x				x	x					x				x
Kyheröinen 2018	x		x	x	x		x								x
Lacity and Willcocks 2016	x														x
Lacity et al. 2016a	x					x	x	x							
Lacity et al. 2016b	x						x	x							
Lacurezeanu et al. 2020	x					x			x		x				x
Langmann and Turi 2020	x	x		x	x	x	x	x		x	x				
Leopold et al. 2018						x									
Masó 2018	x			x		x	x								x
Moffitt et al. 2018						x	x		x						x
Murdoch 2018	x		x			x					x				
Myllymäki 2019	x			x		x	x								x
Penttinen et al. 2018						x									x
Plattfaut et al. 2020						x									x
Radke et al. 2020						x		x						x	x
Rutschi and Dibbern 2020a				x			x								x
Rutschi and Dibbern 2020b								x							
Santos et al. 2020	x				x	x									x
Schmitz et al. 2019	x					x									
Seasongood 2016	x					x					x				
Sigurðardóttir 2018	x			x		x	x	x							x
Šimek and Šperka 2019						x	x					x			x
Smeets et al. 2019	x	x	x	x	x	x	x	x							
Syed et al. 2020	x														x
Taulli 2020	x	x	x		x	x	x								
Wanner et al. 2019		x				x									x
Wewerka et al. 2020	x														x
Wibbenmeyer 2018	x				x		x								
Willcocks et al. 2015a	x			x		x	x	x							
Willcocks et al. 2015b	x														
Willcocks et al. 2019	x		x	x	x										
Zaharia-Radulesu et al. 2017				x		x	x	x							x

Appendix B: Synopsis of Phase Models

<table>
<tr><th>Source</th><th>Project Setup</th><th>Process Selection</th><th>Business Case Calculation</th><th>Software Provider Selection</th><th>Process Documentation/ Optimization</th><th>Pilot Bot Development</th><th>Pilot Validation</th><th>Rollout/Deployment</th><th>Ongoing Governance & Support</th></tr>
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Appendix C: Procedure Model for RPA Implementation

	1 Initiation	
	1.1 Project Setup	**1.2 Logistics Use Cases & Processes Identification**
Objectives	– Definition of basic project guidelines (Koch and Fedtke 2020) – Project planning – Project team assembly and division of responsibility	– Use case identification and process selection for RPA pilot implementation based on combination of qualitative and quantitative criteria
Input	– Support by management (Willcocks et al. 2019) – Statement of Work (SOW) – Personnel resources – Budget approval	– Assembled project team – Project plan – Purpose of RPA implementation
Procedure	– Determine the purpose/objectives of RPA implementation (Alberth and Mattern 2017, Kyheröinen 2018) – Ensure alignment with business strategy (Herm et al. 2020) – Define project scope (Carden et al. 2019) – Prepare timeline (Koch and Fedtke 2020) – Assess risks, calculate project effort, define quality requirements, develop communication and change management plan – Assemble a cross-functional team for RPA implementation (Balasundaram and Venkatagiri 2020, Koch and Fedtke 2020, Smeets et al. 2019): RPA facilitator (experienced project manager), RPA expert (IT-savvy employee with RPA development expertise) and IT infrastructure expert (employee with a broad network within the IT departments) – Define guidelines for cooperation in the project (Koch and Fedtke 2020) – Develop basic RPA capabilities (Willcocks et al. 2019) – Prepare project charter (Carden et al. 2019)	<u>Identify general logistics use cases and get overview of process landscape</u> (cf. appendix for detailed overview of proven logistics use cases found in literature) (Alberth and Mattern 2017) <u>Evaluate use cases based on qualitative process characteristics in scoring model</u> (Herm et al. 2020, Murdoch 2018) – Degree of rule-based (high --> easy decomposition into clear sub-processes) – Process complexity (low) / cognitive requirements (low) – Process maturity (high) – Degree of digitalization (high) – Number of involved systems (high) – Excerption rate (low) / standardization degree (high) – Degree of repetitiveness (high) – Stability of environment (high --> no/few changes in underlying systems) – Re-deployability of personnel (high) <u>Evaluate use cases based on quantitative process characteristics</u> (Smeets et al. 2019) – Calculation of monthly cost savings by multiplication of: – Number of process runs per month – Usual duration of process run in hours – Involved employee costs per hour <u>Combine qualitative and quantative characteristics evaluation in matrix/heatmap</u> to select use cases / processes for RPA pilot implementation

	1 Initiation	
	1.1 Project Setup	**1.2 Logistics Use Cases & Processes Identification**
Output	– Purpose/objectives of RPA implementation (Alberth and Mattern 2017) – Project plan, scope, timeline, risks, effort, quality requirements, communication, change management – Assembled project team with clear roles and capabilities – Guidelines for cooperation (Koch and Fedtke 2020) – Project charter (Carden et al. 2019)	– Use cases / processes for RPA pilot implementation (Hallikainen et al. 2018)
Methods	– Proven methods for project planning (e. g. stakeholder analysis matrix, work breakdown structure analysis, responsibility assignment matrix, risk probability and impact matrix)	– Workshops, surveys, discussions for basic process identification (Herm et al. 2020) – Scoring model for qualitative process characteristics evaluation (Langmann and Turi 2020) – Matrix/heatmap for combination of qualitative and quantitative process characteristics
Success Factors	– Develop stakeholder support and organizational commitment (management, employees) by communicating vision and benefits, ensuring clarity about what is going to happen and ensuring active stakeholder participation (Willcocks et al. 2019) – Consider hiring an external resource specialized in RPA implementation to acquire RPA skill-set (Taulli 2020) – Approach RPA project with a lean team (Murdoch 2018) – Management tolerance for making mistakes and experimenting with RPA (Koch and Fedtke 2020) – RPA has to be regarded as a strategic innovation (not only operational) by management (Willcocks et al. 2019) – Early IT involvement to ensure compliance with IT security and configure infrastructure (Lacity and Willcocks 2016) – Use a central expert unit for internal development (Case Study) – Ensure an open mindset to try and test a new technology (Case Study)	<u>Highly relevant process characteristics for RPA pilot implementation:</u> – Simplicity of process (rule-based) to ensure successful implementation (Hallikainen et al. 2018) – High motivation of process expert/owner and willingness to communicate experiences to other departments (Koch and Fedtke 2020) – Clear visibility of improved process efficiency after RPA implementation (high volume) to ensure management support (Hallikainen et al. 2018) – High degree of repetitiveness and error-proneness during manual execution to ensure employee support and strengthen interest in RPA technology (Willcocks et al. 2019) – Scan logistics process landscape systematically (Alberth and Mattern 2017) – Analyze if there are better-suited automation technologies for specific processes than RPA (Ilo 2018) – Organize general RPA training for personnel at pilot site (process specialists) (Hallikainen et al. 2018) – Consider use cases in administrative logistics (e. g. transport management) or the bridging between two application systems as starting points for RPA implementation (Case Study)

	1 Initiation	
	1.3 Business Case Calculation	**1.4 Software Provider Selection**
Objectives	– Calculation and evaluation of business case for selected use cases / processes (Langmann and Turi 2020) – Decision whether RPA implementation project should be proceeded or stopped	– Selection of a suitable RPA software provider (Alberth and Mattern 2017)
Input	– Selected processes for pilot implementation – Current business strategy	– Decision that RPA implementation project should be proceeded based on business case calculation – Knowledge of basic RPA software requirements (Murdoch 2018) – Selected processes for pilot implementation
Procedure	<u>Calculate / estimate quantitative and qualitative benefits</u> (Agaton and Swedberg 2018, Alberth and Mattern 2017, Murdoch 2018) – Reduced processing workforce (in euros per year) – Reduced office space (in euros per year) – Reduced costs due to defective processing (in euros per year) – Reduced FTE overhang costs (in euros per year) – New revenue sources because of new products (near real-time; in euros per year) --> e.g. offer better service level agreements due to 24/7 availability – Improved employee satisfaction / engagement – Improved compliance due to log data transparency <u>Calculate costs / expenses</u> (Alberth and Mattern 2017, Murdoch 2018) – Investment costs upfront for framework (in euros) – Investment costs upfront per use case (in euros) – License costs (in euros per year) – New workforce costs to implement, control, govern, maintain RPA (in euros per year) – Office space costs for those people (in euros per year) <u>Compare benefits and costs</u> (Alberth and Mattern 2017)	– Define requirements and selection criteria (Murdoch 2018) – Get market overview (Smeets et al. 2019) – Pre-select generally suitable providers (Czarnecki and Auth 2018) – Decide on one provider based on selection criteria (Masó 2018) <u>Selection criteria:</u> (Herm et al. 2020, Murdoch 2018, Taulli 2020, Willcocks et al. 2019) – Software costs – Skill requirements – Vendor support – Vendor reputation – Software maturity and security – Scope of functions (e.g. functions for exception handling or testing, process discovery tool) – Ease of use / user-friendliness – Next-generation capabilities (e.g. artificial intelligence)

	1 Initiation	
	1.3 Business Case Calculation	**1.4 Software Provider Selection**
Output	– Calculated and evaluated business case for selected processes (Balasundaram and Venkatagiri 2020) – Decision whether RPA implementation project should be proceeded or stopped	– Offers of various RPA software providers – Selected RPA software provider (Alberth and Mattern 2017)
Methods	– Return on investment calculation (Herm et al. 2020)	– Scoring model
Success Factors	– Broad perspective on quantitative and qualitative dimensions of benefits – Robust data as input or valid assumptions in case of predicted data – Be aware that RPA is not a "universal remedy" (one bot can provide time savings, but there are many bots necessary to provide FTE savings) – Consider all kinds of process steps (e. g. walking distances) (Case Study) – Take "soft" factors like compliance or user satisfaction into account (Case Study)	– Fast selection of a suitable provider (do not invest too much effort in provider evaluation for pilot implementation) because all major providers are on a similar level and more comprehensive evaluation can be conducted after successful RPA pilot implementation (Koch and Fedtke 2020) – Use trial versions of providers to get a feeling for the capabilities of the software (Taulli 2020)

	2 Piloting	
	2.1 Process Documentation & Optimization	**2.2 Pilot Bot Development**
Objectives	– Documentation, standardization and optimization of selected processes (Alberth and Mattern 2017)	– Iterative development of robot script for automation of selected processes (Koch and Fedtke 2020)
Input	– Selected processes for pilot implementation	– Process Definition Document (Koch and Fedtke 2020) – Solution Design Document (Koch and Fedtke 2020)
Procedure	<u>Process documentation</u> – Comprehensively understand the activities in the selected processes (interview key users, record manual tasks including all variations, capture the "unwritten rules" of processes) (Hallikainen et al. 2018, Murdoch 2018) – Depict entire process as well as individual pages per sub-process with screenshots (Smeets et al. 2019) – Create desktop screenshots/video of each step (+ voiceover) (Murdoch 2018) – Provide a list of typical bugs and errors to enable a quick error detection and elimination – Compose draft of Process Definition Document (PDD) with detailed process description, in-scope, out-of-scope, involved systems, required access rights, responsibilities (Koch and Fedtke 2020) <u>Process standardization</u> – Data cleansing/standardization (Alberth and Mattern 2017) – Data should be in a structured format so that software program can successfully interpret inputs (Moffitt et al. 2018) <u>Process optimization</u> (Alberth and Mattern 2017, Smeets et al. 2019) – Alignment of process with process requirements – Transform paper into electronic data – Create flawless dataflows – Implement electronic process trigger to initiate RPA transaction – Adjust PDD <u>Draw up Solution Design Document</u> (SDD) with description of all technical details that are necessary for development and maintenance of RPA solution (Koch and Fedtke 2020)	– Iteratively develop robot script based on PDD and SDD (Koch and Fedtke 2020) – Successively increase functional scope (starting with a minimum viable product) (Smeets et al. 2019) – Conduct tests and tune/debug robot script according to test results (Kanakov and Prokhorov 2020) – Update PDD and SDD if necessary (Koch and Fedtke 2020)

	2 Piloting	
	2.1 Process Documentation & Optimization	**2.2 Pilot Bot Development**
Output	– Process Definition Document (Koch and Fedtke 2020) – Solution Design Document (Koch and Fedtke 2020) – Documented lessons learned	– Robot script (Koch and Fedtke 2020) – Documented lessons learned
Methods	– Flowchart (Murdoch 2018) – Process map (Murdoch 2018) – Lean, Kanban, Six Sigma (for process optimization) (Taulli 2020) – Process mining	– Scrum for agile development of automation solutions (Anagnoste 2018)
Success Factors	– Detailed and high-quality process documentation essential to ensure seamless and thorough development of RPA solution and because nature of supply chain operations is complex with high data volumes, tending to cause many process variations (Carden et al. 2019, Willcocks et al. 2019) – Re-sequence processes to better separate processes into human work (mindful components) and robot work (mindless components) and clearly define the interfaces (Lacity et al. 2016b, Asatiani et al. 2019, Hallikainen et al. 2018) – Utilize proven mapping method such as BPMN 2.0 for process map for easing collaboration with involved (external) parties – Utilize process mining to support documentation – Check whether automation of individual process steps is possible through existing system applications (e.g. SAP workflow) (Langmann and Turi 2020) – Document lessons learned for future rollout/scaling (Case Study) – Standardize/stabilize/simplify processes before automation (Case Study)	– Comprehensively document/comment all development steps (Ilo 2018, Taulli 2020) – Use support services of RPA providers (Koch and Fedtke 2020) – Take a pragmatic approach, allow workarounds, but always in consultation with the IT department (Koch and Fedtke 2020) – Use development/sandbox environment, not directly develop in production environment to prevent disruption of operations (Smeets et al. 2019, Carden et al. 2019) – Close collaboration with process experts/owners (Langmann and Turi 2020, Cooper et al. 2019) – Ensure IT involvement to comply with regulatory and cybersecurity requirements (Wibbenmeyer 2018) – Document lessons learned for future rollout/scaling (Case Study) – Document testing steps and results (Case Study) – Conduct testing together with key users (Case Study)

<table>
<tr><th></th><th>2 Piloting</th><th>3 Deployment</th></tr>
<tr><th></th><th>2.3 Pilot Validation</th><th>3.1 Operating Model Setup</th></tr>
<tr><td>Objectives</td><td>– Technical and economic pilot validation
– Approval of developed bots (Masó 2018)</td><td>– Definition of guidelines and standardized framework for effective, cost-efficient and secure implementation and operation of new RPA solutions without stakeholder resistance (Langmann and Turi 2020)</td></tr>
<tr><td>Input</td><td>– Robot script
– Business case calculation</td><td>– Documented lessons learned of pilot implementation</td></tr>
<tr><td>Procedure</td><td><u>Technical validation</u>
– Test design: define testing scope / responsibility and create scenarios / test cases (e.g. in Excel file, comprising pre-conditions, post-conditions, the expected result, and the actual result) (Cernat et al. 2020, Smeets et al. 2019)
– Test execution: functional tests, integration test, user acceptance test (real data test, precondition for migration to production environment) (Ilo 2018, Koch and Fedtke 2020, Masó 2018)
– Further development or technical approval

<u>Economic validation</u>
– Validate the business case respectively the profitability
– Compile KPI list (e.g. cycle time, error frequency) to visualize the improvements achieved by RPA implementation

<u>Survey staff acceptance and provide training in case of attended RPA</u>

<u>Pilot approval and migration to production</u> (Masó 2018)</td><td><u>Define standardized operating model comprising:</u> (Anagnoste 2018, Willcocks et al. 2019)
– Demand pipeline creation
– RPA implementation project approval
– RPA implementation
– Go-live in production environment
– Ongoing governance, maintenance and continuous improvement

<u>Decide on basic RPA governance/guidelines:</u> (Alberth and Mattern 2017, Langmann and Turi 2020)
– Access rights for bots and application process
– Restrictions which processes must not be automated by RPA
– Architectural anchoring/locating of bots

<u>Create change management plan based on Kotter's 8-step change model:</u> (Kotter 2013)
– Create sense of urgency around need for change
– Form powerful coalition by ensuring relevant stakeholder support
– Create clear vision and strategy for change
– Communicate vision and address employees' concerns and fears early and honestly
– Remove obstacles by reviewing organizational structure and incentivizing change-oriented behaviour
– Create short-term wins by starting with "sure-fire" projects
– Continuous improvement during change process
– Anchor changes in corporate culture by continuously communicating success stories</td></tr>
</table>

	2 Piloting	3 Deployment
	2.3 Pilot Validation	**3.1 Operating Model Setup**
Output	– Test protocols (Ilo 2018) – Approved robot script (functioning bot) – Validated business case – KPI list (before and after automation) – Documented lessons learned	– Standardized operating model for ongoing implementation of RPA solutions (Langmann and Turi 2020) – Guidelines for cooperation and governance (Koch and Fedtke 2020) – Change management plan (Taulli 2020)
Methods	– Prototypical testing in representative process activities: functional test, integration test, and user acceptance test	– Management of Change (MOC)
Success Factors	– Check if RPA provider offers test case templates to allow testing in different scenarios (automated test execution, test design still manual) (Cernat et al. 2020) – Involve users (Kyheröinen 2018) – Document lessons learned for future rollout/scaling (Case Study) – Ensure robust business case data (Case Study) – Ensure acceptance by staff prior to final approval (Case Study) – Prepare set of KPIs according to business targets/strategy to visualize the success of RPA implementation (Case Study)	– Design RPA governance early (Willcocks et al. 2019, Smeets et al. 2019) – Ensure compliance with data privacy and security regulations (Smeets et al. 2019, Gotthardt et al. 2020) – Communicate the operating model (Koch and Fedtke 2020)

	3 Deployment		4 Ongoing Governance, Maintenance & Continuous Improvement
	3.2 CoE Creation	**3.3 Deployment at Large Scale**	
Objectives	– Creation of Center of Excellence (CoE) with responsibility for RPA governance, design, development, operating and maintaining to ensure effective RPA deployment (Willcocks et al. 2019)	– Standardized deployment of RPA at large scale based on defined guidelines and operating model	– Ongoing governance, maintenance, support and continuous improvement of implemented RPA solutions to ensure long-term functionality (Koch and Fedtke 2020) – Failure and error prevention (Smeets et al. 2019)
Input	– Standardized operating model and guidelines for cooperation and governance (Willcocks et al. 2019) – Documented lessons learned of pilot implementation – Pilot implementation team – Personnel resources (Herm et al. 2020)	– Standardized operating model for ongoing implementation of RPA solutions (Willcocks et al. 2019) – Change management plan (Taulli 2020) – Documented lessons learned of pilot implementation – CoE team roles	– Developed and validated bots in operation – CoE team roles
Procedure	<u>Assemble CoE team:</u> (Willcocks et al. 2019, Anagnoste 2018, Langmann and Turi 2020, Koch and Fedtke 2020) – RPA facilitator (CoE lead) – RPA business analyst (process selection, documentation and optimization) – RPA developer (design and development of RPA solutions) – RPA tester (development of test cases, execution of tests) – RPA scrum master (agile development) – RPA architect (holistic support of the RPA solutions and platform, coordination with IT department, IT governance compliance) – RPA support/service (first line support for RPA production process, regular testing of the functionality of RPA solutions) – RPA controller/operator (performance measurement, continuous improvement) – RPA trainer (RPA knowledge transfer) – RPA distributor (communication of RPA opportunities and benefits to employees)	<u>Implement new RPA solutions according to operating model:</u> (Anagnoste 2018, Willcocks et al. 2019) – Review requests for RPA implementation from business units based on process selection criteria and create demand pipeline (cf. phase 1.2) – Conduct business case calculation and approve RPA implementation project (cf. phase 1.3) – Implement RPA by conducting process documentation and optimization, solution development and testing, as well as technical and economic validation) (cf. phases 2.1, 2.2, 2.3) – Go-live of RPA solution in production environment – Ongoing governance, maintenance and continuous improvement (cf. phase 4) – Manage change according to change management plan (Taulli 2020)	– Manage change requests (Koch and Fedtke 2020) – Manage application system releases by analyzing impacts on production after 3rd party software updates (e.g. SAP update) (Anagnoste 2018) – Provide service desk for RPA issues and errors – Create business continuity plans for cases of bot unavailability (especially for critical processes) (Ilo 2018, Smeets et al. 2019) – Measure and monitor bot performance (Taulli 2020) – Identify and execute improvement measures (Koch and Fedtke 2020) – Continuously develop and review standards/templates – Check extension of RPA with next-generation technologies (e.g. natural language processing, optical character recognition) (Langmann and Turi 2020)

	3 Deployment		4 Ongoing Governance, Maintenance & Continuous Improvement
	3.2 CoE Creation	**3.3 Deployment at Large Scale**	
Output	– CoE team – Accounting processes for internal cost allocation	– Demand pipeline with potential RPA use cases (Balasundaram and Venkatagiri 2020) – Developed and validated bots in operation – Success stories regarding RPA implementation (Balasundaram and Venkatagiri 2020)	– Service desk for RPA issues and errors – Business continuity plans (Ilo 2018) – New/updated standards/templates for RPA implementation (Lacity et al. 2016b)
Methods	– Work breakdown structure analysis – Responsibility assignment matrix		– PDCA cycle for continuous improvement
Success Factors	– Ensure organizational separation between creating new RPA solutions and maintaining existing RPA solutions (Hallikainen et al. 2018) – Organizationally, anchor CoE on business side, not on IT side (Herm et al. 2020) – Use pilot implementation team to train new team members (Balasundaram and Venkatagiri 2020) – Ensure connections to IT department for exchange of information about future application system releases (Koch and Fedtke 2020) – Management support (Lacity and Willcocks 2016) – Based on scope of rollout and company size, roles in CoE team can be filled with various resources or one resource can fill various roles (Case Study)	– Ensure that process specialists/owners understand RPA capabilities because they have the required domain expertise (Cooper et al. 2019) – Motivate process specialists/owners to identify new opportunities for RPA implementation by showcasing successful RPA implementations and incentivizing the ideation process (Balasundaram and Venkatagiri 2020, Murdoch 2018) – Successively increase complexity of selected processes (Herm et al. 2020) – Document and communicate success stories regarding RPA implementation to strengthen interest in RPA within company (Balasundaram and Venkatagiri 2020) – Create and use a centralized component library with common RPA modules to reduce solution design effort in development phase (Case Study) – Insource RPA knowledge (Case Study)	– Constant monitoring of bot performance by process specialists/owners in the first time after implementation (Knauer et al. 2020, Murdoch 2018) – Make an agreement that process owners commit to performing automated processes manually in case of bot unavailability (Kokina and Blanchette 2019) – Save log data of bots for transparency (Anagnoste 2018) – Define process owners and maintenance cycles (Case Study) – Ensure early communication of change requests and application system releases (Case Study) – Continuously document changes/adjustments (Case Study)

Appendix D: Logistics Use Cases for RPA Implementation

Operations in application systems

- Acquisition, processing and adjustment of master data and transaction data, e. g. creation of new material masters, adjustment/ generation of bills of materials (Agaton and Swedberg 2018, Feld et al. 2017, Madakam et al. 2019)
- Logging into application systems, filling out input masks, extracting data, executing functions in ERP systems (Czarnecki and Auth 2018, Kaya et al. 2019)
- Transfer of data between administrative and operational systems that are not already interconnected, e. g. transfer of shipping data to warehouse management system (Madakam et al. 2019, NTT DATA 2018)
- Creation and updating of customer profiles (Koch and Fedtke 2020)

Order processing

- Identification of anomalies in order processing, e. g. employee forgets to issue invoice (Feld et al. 2017, NTT DATA 2018)

Procurement

- Support in supplier evaluation and selection through preliminary analysis of supplier documents (Feld et al. 2017)
- Generation of forecasting reports in procurement (Heponiemi 2019)
- Initiation of complaint processes by opening and processing e-mails (Czarnecki and Auth 2018, NTT DATA 2018)
- Acceptance of delivery quantity deviations (Feld et al. 2017)

Inventory management

- Comparison of stock levels with customer orders, automatic notification when stock levels fall below a certain limit, adjustment of safety stock levels in ERP system based on data from other systems or emails (Madakam et al 2019)
- Automated demand recognition, availability check of suppliers and order triggering in purchasing system (Scheer 2018)
- Projections creation for demand planning (Koch and Fedtke 2020, Taulli 2020)

Distribution and transport logistics

- Creation of loading lists (NTT DATA 2018)
- Updating and communicating the shipping status to customers (Heponiemi 2019)
- Identification of anomalies in the transport processing, e. g. temperature fluctuations (NTT DATA 2018)

Returns processing

- Identification of customer via customer number and order via order number, display of order history, checking of individual items of the return order for completeness, creation of return order and linking with the items of the original order, completion of standard entries in the return order, completion of return order and accounting initiation (Czarnecki and Auth 2018)

Logistics controlling

- Creation of reports and key figures for decision-making (Koch and Fedkte 2020, Madakam et al. 2019)

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