A Generic Process Model for the Introduction of Robotic Process Automation in Financial Accounting

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ABSTRACT

Increasing pressure on costs requires companies to streamline and enhance the efficiency of main and support processes. The digital transformation with its various automation options offers great potential for this. In the area of process automation, Robotic Process Automation (RPA) can be used to automate individual process steps as well as entire business processes using software robots without a change of existing systems across applications. In the support process finance, the focus of RPA is on accounting and controlling processes, whereby especially the repetitive processes of external accounting are suitable for the use of RPA. In this paper, the relevance of RPA for the main processes of external accounting will be analyzed. Based on an analysis of case studies on the use of RPA in external accounting, premises for a successful Robotic Process Automation are derived and combined in a generic process model for the introduction of RPA. Subsequently, the proposed generic model is verified in a company.

CCS CONCEPTS

• **Social and professional topics**; • **Computing and business**; • **Information Systems**;

KEYWORDS

Financial accounting, main processes, Robotic Process Automation, generic process model

1 INTRODUCTION

Increasing cost and efficiency pressures require companies to constantly streamline their business processes. This affects both main and support processes along the value chain. Focusing on the support process finance which is essential for corporate management [1], controlling and accounting activities can be optimized through standardization and automation [2].

In addition to traditional business process automation (BPA), for example via enterprise resource planning (ERP), robotic process automation (RPA) has become increasingly important around process automation. This technology imitates human actions in manual or predominantly administrative processes with the help of software robots. Individual process steps or entire business processes can be automated across applications [3]. Compared to traditional automation technologies, RPA can be implemented much faster and more cost-effectively because it is a non-invasive technology. This means that no or only minor changes to the existing IT landscape or backend system are required to integrate RPA [4]. In a study conducted by KPMG [5] regarding the use of RPA, only one percent of the companies surveyed stated that they use RPA across the board. In the area of finance, the focus of RPA is on accounting and controlling [6]. Following Langmann/Kokina [7], Maček et al. [8] and Chukwuani et al. [9] especially the repetitive processes of external accounting are suitable for the use of RPA. Langmann/Turi [10] points out the benefits of RPA: These are cost savings (especially personnel), process quality improvements (e.g., fewer errors), and time savings (especially shorter cycle times, faster response/result times). A study by KPMG Group and the Fraunhofer Institute [11] shows that financial managers expect a degree of automation of up to 96 % for external accounting and bookkeeping in the next five to ten years.

This paper will analyze and answer two questions: (1) Which external accounting processes are particularly suitable for automation by RPA? (2) Which critical success factors are relevant for a successful Robotic Process Automation? To answer these questions, a semantic analysis of case studies describing an application of RPA in the main processes of external accounting is performed. In the context of a text analysis, premises for a successful automation with RPA in accounting are derived and mapped in a generic process model. Subsequently, the developed model is validated by application in a company.

The paper is organized as follows. Chapter two derives the main processes of external accounting from the literature and a case study analysis is conducted. Chapter three evaluates the proposed Model. Therefore, existing models for the introduction of RPA in companies are analyzed and combined with the derived premises of a comparative case study analysis in a generic process model. Chapter four discusses the results and the proposed generic process model is verified by applying the model in a company. Conclusions and the list of references finalize the paper.

Exclusion Criteria: Process with collaboration between human and IT system/application is present	Wanner et al. 2020, S. p. 9-11	Wellmann et al. 2020, p. 6.	Langmann/Turi 2020, p. 16-18	Bourgouin et al. 2019, p. 46f.	Smeets et al. 2019, p. 67.	UiPath Business Analyst Coun	Baranauskas 2018, p. 258-26	Alexander et al. 2018, p. 15.	Hermann et al. 2018, p. 28-30	Asatiani/Penttinen 2016, p. 7-	Willcocks et al. 2015, p. 9.	Sum
1 Process frequency/frequency	X	X	X	X	X	X	X	X	X	X	X	#
2 Rule-based process		X	X	X	X			X	X	X	X	8
3 Standardization	X	X	X	X	X			X	X		X	8
4 Process stability	X	X	X		X	X		X	X	X		8
5 Low complexity		X	X	X	X	X		X	X	X		8
6 error rate	X	X			X	X		X		X		6
7 Number of software applications		X	X		X	X		X		X		6
8 Process execution time	X	X			X	X		X		X		6
9 Digital standard data types		X	X		X	X		X		X		6
10 Process maturity		X		X			X	X			X	5
11 Number of exceptions		X	X					X	X	X		5
12 Process execution volume		X				X			X			3
13 Application stability						X		X	X			3
14 Manual interventions (interaction between robot and	X	X						X				3
15 Number of users/users involved	X	X						X				3
16 At least one interaction with a software application		X	X	X								3
17 Cost understanding of the process/process costs						X				X		2
18 Automation rate	X											1
19 Multilingualism			X									1
20 Security risk			X									1
21 Number of process steps						X						1
22 Applications retrieved via VDI						X						1
23 Impact on the customer in case of failure								X				1
	6	12	14	6	11	11	3	14	9	10	4	

Figure 1: Criteria for the selection of suitable RPA processes in the literature. (Tschandl/Möstl [21])

2 LITERATURE REVIEW

2.1 Main processes of accounting and RPA

Managerial accounting is an information system that records and monitors financial and performance flows within a company in terms of quantity and value. This includes procedures for preparing and evaluating the necessary information for internal and external addressees. This information serves on the one hand as a basis for future-oriented decisions within the company, and on the other hand for reporting and accountability to external addressees of the balance sheet [12]. Key components of internal management accounting are cost and revenue accounting and various planning calculations. The external or financial accounting includes the legally bound bookkeeping and the preparation of the annual financial statements [13]. The focus of this paper will be on this area. External accounting often involves repetitive activities and standardized processes. Following Jedrzejka [14] a particular focus could be on the automation of work steps. Janke/Burkhardt [15] work out the importance of disruptive technologies such as Artificial Intelligence, Machine Learning, Blockchain or RPA for management accounting. I.e. Mullakara/Asokan [16], Devarajan [17], Brettschneider [18], point out that with RPA, higher accuracy, quality, stability and reliability of the processes can be achieved. Due to the low technical barriers, it is easy for companies without programming knowledge to implement simple automations independently. The relief achieved by RPA can contribute to a better employee satisfaction as well as to an increased productivity. RPA leads to more transparency, which has a positive effect on compliance and reporting processes.

Horvat and Partners Management Consulting [19], summarize the main tasks of external accounting and their main and subprocesses, shown in Table 1

To assess the suitability of a process for automation by RPA, evaluation tools with weightings and calculation models can be used, i.e., Langmann/Turi [10] with 13 minimum, additional, and special criteria or Smeets et al. [6] with seven criteria for technical and managerial attractiveness. Tschandl/Möstl [21] conducted a systematic, quantitative literature review of eleven sources to identify indications of priorities in the potential criteria for assessing RPA maturity of processes. (see Fig. 1).

The first five points of Figure 1 are the most important and are explained below:

Process frequency and frequency: Processes with a high frequency, such as a data query performed every minute or reports generated daily, have a particularly high RPA maturity.

Table 1: Main and Sub-Processes of financial accounting

Tasks of financial accounting	Main Processes	Sub-Processes
Systematic voucher-based posting of all business transactions to balance sheet and profit and loss accounts, as well as chronological recording of all business transactions	Main accounting	Maintain master data General ledger postings Balancing accounts Analyze accounts Perform closing activities Create period-end closing
Detailed recording and breakdown of customer accounts	Accounts receivable-accounting	Maintain customer master data Record and evaluate services Create and send invoices Manage incoming payments Dun open items Value adjustments, corrections and closing entries
Detailed recording and breakdown of supplier accounts	Accounts Payable accounting	Maintain supplier master data Receive, check, assign and archive invoices Manage open items and arrange payment Adjustment and closing entries
Accurate list and information of all fixed assets	Asset-accounting	Maintain asset master data Post asset acquisition and retirement Valuate and depreciate assets Support inventory
Settlement of liabilities to employees and reimbursement of expenses incurred for travel activities	Payroll and travel expense accounting	Maintain employee master data Carry out, check and post travel expense reports Post payroll accounting Trigger and archive payment run and account reconciliation
Determination of the overall tax result and preparation of the tax balance sheet	Taxes	Create and maintain tax master data Identify recognition and measurement differences Calculate and post taxes Prepare required notes Prepare and perform tax declarations Record and track tax risks and take effects into account Prepare e-balance sheet according to specified taxonomy
Group Accounting	Group financial statements	Maintain master data Collect, validate and release data Validate intercompany issues Perform consolidation steps Validate consolidated financial statements Create consolidated financial statements

Rule-based process: The process to be automated must have a rule-based character, as well as fixed sequences. Every if-then decision that occurs in the process must be clearly covered by predefined rules in the RPA artifact.

Standardization: Particularly repetitive processes are suitable for automation, i.e. those processes whose sequences are defined by unambiguous standards and whose execution is also as consistent as possible. Processes that vary greatly with each run are less suitable for RPA.

Process stability: Processes must remain largely unchanged - i.e., stable - over a certain period of time and little or no changes should be expected in the future, since process changes would otherwise require an adaptation of the RPA robot.

(Low) complexity: The complexity of processes is determined by the number, type and relationship structure of the necessary work steps. Complex processes often have their own dynamics and are therefore not as suitable for RPA as processes with a high frequency and a low number of differences in the processes [16].

Once a suitable process for automation has been found based on minimum criteria, it must be evaluated and documented. Tschandl/Möstl [21] i.e., have used a utility analysis to rank the processes for RPA suitability. For this purpose, criteria for RPA suitability must be defined and multiplied by a weighting factor that reflects the relevance of the criteria. Regarding the suitability for RPA for the main external accounting processes Langmann/Turi [10] and Deloitte [20] have developed heatmap models. They found out that postings are generally highly suitable for RPA automation
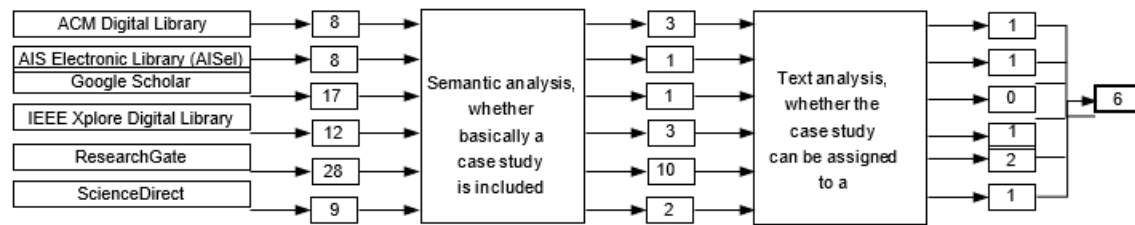
Figure 2: Results of the database search

Table 2: Results of the database search: Use Cases concerning accounting processes

Main process	Autor and use caseTitelJournal /FachbuchSeiteJahr
Main accounting	Jędrzejka, Dariusz: Robotic process automation and its impact on accounting, Theoretical Journal of Accounting,137-166, 2019
Accounts receivable accounting	Aguirre, Santiago/ Rodriguez, Alejandro: Automation of a Business Process Using Robotic Process Automation (RPA): A Case Study, Communications in Computer and Information Science, 1-7,2017
Accounts Payable accounting	Viale, Laurence/ Zouari, Dorsaf: Impact of digitalization on procurement: the case of robotic process automation, Supply Chain Forum: An International Journal,185-195,2020
Asset-accounting	Hallikainen, Petri/Bekkhus, Ritta/ Pan, Shan: How OpusCapita Used Internal RPA Capabilities to Offer Services to Clients, MIS Quarterly Executive,40-52,2018
Payroll and travel expense accounting	Qiu, Yu Lian/ Xiao, Guo Fang: Research on Cost Management Optimization of Financial Sharing Center Based on RPA, Procedia Computer Science,115-119,2020
Taxes	Sethi, Vikram/ Jeyaraj, Anand/ Duffy, Kevin/ Farmer, Berkwoord:Embedding Robotic Process Automation into Process Management: Case Study of using tasks, AIS Transactions on Enterprise Systems,1-18,2020

and master data maintenance is moderately suitable. Considering Langmann/Kokina [7], Jedrzejka [14] and Chukwuani/Egiydi [9] the sub-processes of accounts receivable and accounts payable, as well as payroll and travel expense accounting are moderately or strongly suitable for RPA automation. Tax processes are only weakly suitable for RPA.

2.2 Methodology: Case Study Analysis

To find out what are the critical success factors when introducing RPA in the main processes of external accounting, case studies - published in economic journals in the period from 2015 to 2021 - were analyzed. The following databases were used for the research:

- ACM Digital Library
- AIS Electronic Library (AISel)
- Google Scholar
- IEEE Xplore Digital Library
- ResearchGate
- ScienceDirect

The secondary research is divided into keyword, backward and forward search. For the keyword search, the word combination "robotic process automation AND accounting AND case study"

was initially used in the title, abstract and the keywords. No evaluable case studies were found with this word combination, so the following general word combinations were used:

- robotic process automation AND accounting
- robotic process automation AND accounts payable
- robotic process automation AND accounts receivable
- robotic process automation AND general ledger
- robotic process automation AND inventory
- robotic process automation AND payroll
- robotic process automation AND tax
- robotic process automation AND travel expenses

In addition, the keyword search was performed using the short form RPA instead of Robotic Process Automation. Figure 2 gives an overview of the databases used and the resulting results of the secondary research:

The result of this database search was 82 publications, 20 of them described a case study. The latter were examined in a further semantic analysis regarding their assignability to the main processes of external accounting. Six case studies - mainly from the automotive and business process outsourcing industries - can be clearly assigned to one main accounting process each (see Table 2) [14] [22] [23] [24] [25] [26].

Table 3: Case Studies Analysis: Goals and results of RPA implementation

Main Process	Goals	Results after introduction of RPA
Main accounting	Automation of postings to G/L accounts	Reduction of process time of the booking transactions (-90%) Reduction of error rate due to manual processing Improved result in compliance audit
Accounts receivable accounting	Automation in the creation and sending of invoices, complete takeover of back-office activities	Higher output due to increased number of cases processed (+21%) Hardly any savings in average (-2%) processing time
Accounts Payable accounting	Automation of data transfer between different sources	Reduction of the processing time of the incoming invoice, if it is transmitted electronically and on time by the supplier (- 95%) Need for a change management program
Asset-accounting	Automation of employee master data maintenance	Complete automation from transfer of employee master data to transmission to payroll IT department must be involved during the development, testing and production phases
Payroll and travel expense accounting	Reduction of inefficiencies due to different IT systems	Automation of asset retirement postings Time savings through reduction of manual activities
Taxes	Prevent penalties due to compliance deficiencies and missed deadlines. - Reduction of the error rate, 100% compliance rate, - no penalty payments to tax authorities	Reduction of error rate, 100% compliance rate, No penalty payments to tax authorities

3 DESIGN OF THE PROPOSED GENERIC PROCESS MODEL

The proposed generic process model was developed in several steps. The first step was to analyze the selected case studies and derive premises from the comparative analysis. In a second step, existing process models for the introduction of RPA were analyzed and main process steps were derived. In a third step, the premises were assigned to the process steps in a generic process model.

3.1 Step one - Premises of the case study analysis

For each case study, a semantic analysis was performed about the respective goal of the RPA introduction, the initial situation of the company described in the case study, the automation process described and the associated results (see Table 3).

In a comparative analysis of the case studies and considering the knowledge gained through literature research, five premises (E1 - E5) were deductively derived that should be taken into account when introducing RPA.

E1: Back-office processes of accounts receivable, accounts payable, fixed asset accounting, and travel expense accounting are well suited for RPA support due to their frequency, rule-based processes, standardization, and low complexity.

E2: The reduction of processing times through automation is significantly influenced by the RPA configuration, the hardware used and the reaction speed of the target application. The speed at which software robots execute processes depends significantly on the speed of the underlying IT-system.

E3: The IT department should be involved during the development, test and production phases. If RPA development is outsourced, the IT department should be involved in negotiations with the vendor.

E4: Further development of the RPA solution should be regarded as an ongoing task.

E5: In order to counter employees' fears and reservations, a change management process with a corresponding communication strategy should be introduced before starting the RPA project and it should accompany the entire project.

Table 3 summarizes the results of the case study analysis, working out the objectives of an RPA implementation in the main accounting processes and their achievement.

3.2 Step two – Phases of Implementation of RPA

Various models for the development and implementation of RPA can be found in literature. According to Langmann/Turi [10], the introduction of an RPA solution goes through a start-up, ramp-up, scale & institutionalize and mature & innovate phase. The model according to Koch/Fedtke [3], is divided into five stages, beginning with a feasibility study, followed by the analysis, development, and test phase of the RPA solution, and finally ends with the stabilization phase. The selection of the RPA vendor is not addressed in the phase model itself but is considered a prerequisite for the first phase. Smeets et al. [6] distinguishes eight stages in its model, starting with the definition of the project structure, process selection, selection of the RPA solution, proof of technique, process optimization, subsequent artifact development, and finally, after a test phase, the PRA solution can be handed over to the process owners.

E5	Change Management			
Change Management	Selection of Processes	Selection and Testing of RPA-Software	Development of RPA-solution	Go-Live
	E1 Back-Office processes of • Accounts receivable • Accounts payable • Asset accounting • Travel expenses	**E2** • used hardware • RPA configuration • Reaction speed of the target application	**E3** Inclusion of IT-department in • Developement phase • Testing phase • Production phase	**E4** • Ongoing development of the RPA solution • Upgrading of the RPA solution as needed

Figure 3: Generic Process Model for the Introduction of RPA

Although the models considered are divided into different numbers of phases, they all include the activities: process selection for RPA, RPA software testing, development of the RPA solution and go-live. There are differences in the phase of testing. While the models according to Koch/Fedtke [3] and Smeets et al. [6] include a dedicated testing phase, this is not described in the model according to Langmann/Turi [10]. In contrast, performance measurement is only dealt with in the models according to Langmann/Turi [10] and Koch/Fedtke [3], but the activity of upstream process optimization is not described.

3.3 Step three - Model Design

The five premises (E1 - E5) derived from the literature research and comparative case studies analysis, which should be considered when introducing RPA, were assigned to the identified process steps based on the existing models from Langmann/Turi [10], Koch/Fedtke [3] and Smeets [6]. The results are summarized in a generic process model shown in Figure 3.

The proposed generic model is based on necessary phases, which have to be passed through during the introduction of an RPA. The phases are as follows: identification and selection of processes suitable for RPA, followed by the selection of suitable RPA software and its testing. The next phase is the development of the RPA solution up to the handover of the solution to the daily business. The premises derived from the case study analysis (E1 - E4) can be clearly assigned to a phase in the process model, while premise E5 can be regarded as a cross-phase, that means across all phases of the RPA introduction, like a supporting process.

4 RESULTS AND DISCUSSION

4.1 Selection of Processes

The selection of processes for RPA automation can take place in the context of a workshop or - if detailed documentation of all the company's processes is available - by analyzing these processes according to technical and business criteria. Repetitive, standardized and rule-based processes that occur in the context of accounts receivable, accounts payable and asset accounting are particularly suitable. With RPA, productivity can be increased, as activities can be carried out in significantly less time. This also results in a reduction in personnel costs. The data generated with the help of RPA can subsequently be analyzed and examined for inefficiencies,

which provides the opportunity for continuous improvement of business processes.

4.2 Selection and testing of RPA Software

Selection criteria for RPA software can include implementation and licensing costs, components and usability of the software, required enrollments and prerequisites of the existing IT system. When selecting RPA software, it should be tested for compatibility with the existing IT system in terms of installability, accessibility at the intended target applications, readability and writability of content in the target applications. Transparency is an important criterion, as RPA can be used to identify faulty data integrity and enable standardization. This subsequently reduces errors that can negatively influence management decisions and performance.

4.3 Development of the RPA-solution

The RPA should be divided into several artifacts or program parts. First, the main path should be developed without any exceptions and special situations. Subsequently, exceptions and special situations can be mapped in secondary paths.

4.4 Go-Live

The RPA application should be tested not only in the development phase, but also by the employees who will execute the process. If there are changes in processes or application systems, RPA solutions must be continuously adapted. This prevents processes from being executed incorrectly and requiring expensive rework.

4.5 Verifiability of the Proposed Generic Model

The proposed generic model was tested in an industrial company by following the process phases proposed in the model and implementing them according to the premises.

One of the back-office processes mentioned in the model, travel expense reporting, was selected. After comparing different software solutions, the company chose the provider UiPath. The developed RPA solution successfully passed the technical tests and was handed over to productive operation after acceptance and training of the persons responsible for the process. The entire process was accompanied by a stakeholder-oriented communication strategy. The selected travel expense processes were recorded over a period of one week using a screen recording and observation. During the

one-week period, 54 travel expense reports were measured. On average, a time saving of 15 to 9 minutes (40%) was achieved, which can be attributed to the processes of data verification and data entry in the travel expense program. Due to the positive results, the company is discussing the automation of more complex travel expense processes as well as the use of optical character recognition for the automatic evaluation of scanned receipts. Automation of other main processes in external accounting is also being considered.

5　CONCLUSION

Robotic Process Automation (RPA) offers an interesting opportunity for digital support in management accounting. Compared to traditional automation technologies, RPA can be implemented much faster and more cost-effectively. Repetitive processes that remain unchanged as much as possible over a long period of time and have fixed processes are particularly well suited. These processes should not be too complex and should have a high frequency of use. With the help of various evaluation models, suitable processes can be selected for the use of RPA. In relation to the main processes of external accounting, these fulfill many of the requirements mentioned. In this paper, case studies describing the use of RPA in one of the main accounting processes were analyzed and premises were deductively derived and assigned to the essential process steps of RPA implementation in a generic model. It becomes apparent that change management is a cross-process phase that must accompany the entire implementation process. The model was tested in an industrial company that wanted to automate travel expense reporting with RPA, at least for simple tasks. The travel expense processes were recorded over a period of one week using a screen recording and observation. Due to the positive results, the company is discussing the automation of more complex travel expense processes as well as the use of optical character recognition for the automatic evaluation of scanned receipts. Automation of other main processes in external accounting is also being considered.

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