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Robotic Process Automation (RPA) in Accounting

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Abstract:

Finance and accounting are the leading areas for the implementation of Robotic Process Automation (RPA). Next to other technologies RPA is a core driver of the digitalization of accounting. However, academic research in this area is still limited, especially on the adoption of RPA in corporate accounting settings. Therefore, this chapter reviews existing academic research on RPA in accounting settings and provides insights into the suitability of the various processes in accounting and management accounting for RPA. Finally, we look at the future impact that RPA will likely have on the role of corporate accountants.

1 Digitalization technologies in the field of Accounting

Accounting is undergoing vast digital transformations in many organizations today, and Robotic Process Automation (RPA) is at the heart of those efforts. Along with other digitalization tools at accountants' disposal, such as tools for data extraction, transformation, and loading (ETL), and data analytics and visualization, RPA is viewed as a foundation for future use of more advanced cognitive computing. While classical RPA intends to use applications on existing interfaces in the same way as humans use the application, Intelligent Process Automation (IPA) makes additional use of digitalization technologies from the field of artificial intelligence. As a result, IPA mimics the processes carried out by humans and after some time learns to do them even better (Berruti et al. 2017; Houy et al. 2019; Taulli 2020). RPA combined with an intelligent OCR engine (backed by machine learning) to scan, read and learn to correctly interpret data from invoice documents to generate an automated booking is just one example (e.g. Anagnoste 2018).

Concerning the adoption of RPA, a survey of top 25 global RPA service providers drawing upon 5,800 customer deployments revealed that finance and accounting were the leading areas of RPA implementation constituting 36 percent of all RPA use cases (Forrester 2019). Furthermore, a recent PwC study reported that within accounting areas processes most suitable for RPA are those in accounts receivable (72%), accounts payable (51%), and monthly closing (28%) (PwC 2020).

Motivated by the widespread adoption of RPA in finance and accounting, in this chapter we focus on various important aspects of RPA implementation integrating diverse insights from literature targeting accounting practitioner and academic audiences. Our chapter is structured as follows:

- Section 2: In this section, we first analyze publications in academic journals focused on the various aspects of RPA implementation. We highlight that much of the published work on the topic has been in the area of auditing and public accounting in the U.S. context, with slight focus on RPA implementation in corporate settings.
- Section 3: Based on the identified shortcomings from the literature review, we identify broad characteristics of accounting processes that make them good candidates for RPA. Further, we discuss the differences between financial and managerial accounting and position these areas alongside two dimensions of task analyzability and exception quantities using Perrow's framework. Finally, we provide some examples of specific accounting tasks that organizations have automated with RPA.
- Section 4: In this section, we present RPA process suitability via visualizations using heatmaps that was discussed on a broad theoretical basis in section 3. We highlight a separate heatmap for processes within financial and managerial accounting. We underscore that process suitability for RPA is determined at a more granular sub–process level as opposed to automating a process in its entirety.
- Section 5: We discuss the RPA–enabled changing roles of accountants that involve a shift from being a scorekeeper mainly focusing on transaction processing and compliance to becoming a valued strategic advisor and business partner. To provide a real–world example, we describe future management accounting roles at BASF. In addition, we address the need for accountants' digital upskilling in order to successfully work with the new technologies.

– Section 6: We conclude with providing key takeaways from our chapter and future outlook on RPA in accounting. The impact of RPA on the role and skills of future accountants provides further research opportunity, especially when looking at the combination of RPA with other cognitive advanced digitalization technologies.

2 Literature Review on the use of RPA in accounting

The use of RPA in accounting has become an area of interest explored in several recent studies published in academic journals as well as working papers. While the majority of papers focus on examining RPA in public accounting (Cooper et al. 2019a, 2019b), especially auditing (Moffitt et al. 2018; Huang and Vasarhelyi 2019; Zhang 2019; Tiberius and Hirth 2019; Manita et al. 2020), other papers address topics such as RPA implementation for accounting tasks in industry (Kokina and Blanchette 2019), roles and competencies of accountants and controllers as integral RPA implementation players (Kokina et al. 2019; Oesterreich et al. 2019), and ethical implications associated with the use of artificial intelligence in auditing (Munoko et al. 2019).

Ongoing RPA work explores the use of bots in the internal audit function (Eulerich and Pawlowski 2020; Eulerich and Masli 2020), issues related to auditing an RPA–enabled accounting system (Appelbaum and Kozlowski 2020), the adoption of bots in public accounting (Bakarich and O'Brien 2020), and the role intelligent agents play in diffusing managers' responsibility for earnings management (Kipp, Curtis, and Li 2020). As RPA implementation in accounting becomes more mature and widespread, we anticipate that this area of research will grow both in the depth and breadth of RPA–related issues examined and the diversity of methodologies employed. For example, there is a notable lack of literature addressing RPA implementation in the area of taxation even though Cooper et al. (2019) highlight that the tax function in public accounting reports the greatest RPA adoption levels.

2.1 Review of literature on RPA in auditing

Audit automation has been a subject of academic inquiry for several decades. Early examples of audit automation were computer–assisted audit tools and techniques (CAAT) that were later integrated into various decision support tools which have now become embedded in the business processes themselves (Vasarhelyi 2013). The goal of automation has been the reduction of latency occurring throughout business process performance. Vasarhelyi et al. (2010) conceptualized audit automation to consist of four areas aimed at latency reduction: automation of labor–intensive tasks, automation of staged data collection and data delivery, automation of decision–making, and automation of decision implementation. Unstructured decision–making and decision implementation, however, could not be easily automated given the technology at the time. Instead, in order to automate decision–making, "…substantive formalization…" as well as "…classification structures like taxonomies and hierarchies must be expanded to harden "soft" knowledge into computable structures..." (Vasarhelyi 2013, 9). Further, to automate decision implementation, an auditor, for example, could consider "progressive automation" accomplished by increasing the sample or type of transactions selected for confirmations. Subsequent publications provide a more detailed overview and examples of the use of automation in auditing. It is worth noting that even though opportunities for automation in audit are vast, it is "…a still somewhat artisanal process dominated by anachronistic standards and *ad hoc* judgment…" (Moffitt et al. 2018, 1).

Kokina and Davenport (2017) present a set of tasks performed by cognitive technologies and their intelligence level emphasizing that repetitive task automation is ongoing in large accounting firms. They state that RPA is particularly useful for automating structured audit processes and point out that almost 40 percent of all audit tasks can be classified as structured which makes them good candidates for automation. Moffitt et al. (2018) report that repetitive audit tasks in areas such as reconciliations, testing of internal controls, and substantive testing can be automated. Furthermore, the role of the auditor would shift from mainly performing data collection, processing, and analysis to evaluating the audit procedures (Moffitt et al. 2018). As it relates to RPA implementation in audit, they emphasize the importance of the validity of both RPA tools and the data, ensuring proper validity checks and segregation of duties, the need to automate the processing of notable items generated by RPA tools, and the need for privacy and security considerations in order to manage digital audit evidence.

Huang and Vasarhelyi (2019) introduce a four–stage framework for RPA implementation in audit practice and present the outcomes of a pilot project that automates the confirmation process. The RPA–enabled confirmation process occurs by first logging into the electronic confirmation platform, sending confirmation requests, extracting account balances, and downloading the final confirmation (Huang and Vasarhelyi 2019). The results are then compared to the

same confirmation process performed manually to ensure a complete match for accuracy. This paper showcases the feasibility of RPA implementation for certain audit tasks without introducing additional detection or audit risks while decreasing the number of hours spent on the process.

By introducing artificial intelligence (AI) to RPA, Zhang (2019) presents a framework for Intelligent Process Automation (IPA) for audits. IPA encompasses a suite of technologies that can be found on the continuum between RPA and cognitive automation, technologies that can automate tasks using structured data as well as unstructured data for inference–involving processes (Lacity and Willcocks 2017). As it relates to auditing, Zhang (2019) describes potential opportunities for IPA use in the audits of pensions (by using NLP or computer vision to organize digital pension plans) and inventory (by using drones to scan RFID tags and an AI tool to analyze images). Further evidence is needed to ascertain whether IPA can or should be implemented in actual audit engagements.

Moving beyond conceptual work, Tiberius and Hirth (2019) conduct an exploratory survey of experts in a two–round Delphi study in Germany to generate the most likely scenario with regard to a broad array of technological trends in auditing for a 5–10 years into the future. In terms of RPA–related predictions, the study reports that 93 percent of respondents agreed that routine audit tasks will be automated thus relieving auditors to focus more on more challenging judgment encompassing work. Interestingly, the overall expert impression is that they do not foresee significant disruptive changes caused by the advancements in technology influencing auditing practice in the near future.

Highlighting the importance of engaging with professionals, Manita et al. (2020) report results of interviews with experienced auditors of five largest firms in France. They suggest that digitalization will make audit more relevant and improve its value proposition by removing the need to manually perform repetitive tasks thus allowing the auditors to focus on evaluation of estimates, judgments, and unusual transactions.

Munoko et al. (2019) uniquely focus on exploring the ethical implications of AI in auditing. They emphasize the importance of ethical AI governance and practical guidance related to AI use for individual auditors, audit firms, and the profession and society as a whole.

2.2 Review of literature on RPA in public accounting

In addition to exploring RPA tool implementation in auditing, there are two studies that expand to other areas of RPA implementation in public accounting. Cooper et al. (2019a) interview RPA leaders at Big–4 accounting firms in the US and find that RPA has reached the greatest levels of adoption in tax services, with slower adoptions in advisory and audit services. They also report that lower–level employees often drive RPA implementation and that it has resulted in measurable and significant cost savings and efficiency improvements (Cooper et al. 2019a). Subsequently, Cooper et al. (2019b) compare RPA–related perceptions of top and bottom–level employees in public accounting and report general agreement of the positive influence of RPA on the work of accountants.

2.3 Review of literature on RPA for accounting tasks in industry

Another stream of literature employs qualitative methods to investigate the use of RPA tools for accounting and finance tasks in companies from various industries. Kokina and Blanchette (2019) interview experienced accounting professionals who have had firsthand exposure to RPA implementation. Through the lens of Task–Technology Fit and Technology–to–Performance Chain, they document task suitability for RPA, motivation to implement the tools, challenges encountered in early RPA implementation, risk and control environment as well as organizational governance structures necessary for successful RPA deployment. They also document quantitative and qualitative performance indicators specific to RPA. They find that organizations are challenged by the need to understand a process at a keystroke level and the need to build in error–handling which requires documentation of the failures that could occur at each step of the process that is being automated.

To address the uncertainty surrounding the roles that the human accountants need to fill to successfully work alongside bots and the competencies that need to be developed, Kokina et al. (2019) conduct interviews with professionals to document and categorize the skills required in order for accountants to actively engage in RPA implementations in their organizations. Adapting the categories of AI–driven business and technology roles, they thematically organize the skills and competencies specific to RPA implementation alongside the following five roles: Identifier, Explainer, Trainer, Sustainer, and Analyzer. They find that the work of accountants is transitioning from ‘doing’ to ‘reviewing’ and that accountants are uniquely positioned to serve as subject matter experts or Explainers who can communicate to bot developers in great detail the steps and internal controls of a particular process or task. In

addition, accountants can successfully fulfil the Sustainer role in which they manage bots and monitor the environment for changes and determine whether the IT organization needs to be notified in order to make those changes in bot code.

Oesterreich et al. (2019) also look within organizations to determine how the role of a controller has changed as a result of automation. They report that controllers' roles have become more data–driven and that data science and IT skills are central to their role in addition to being able to fulfill the role of a strategic business partner.

In sum, the literature review shows that much of the published work on RPA has been in the area of auditing and public accounting in the U.S. context, but only few studies have looked at RPA in corporate accounting settings. As a result, we analyze the characteristics of (corporate) accounting processes that make them good candidates for RPA in the next section.

3 RPA and the nature of accounting processes

Generally, companies regard RPA to be well suited for the automation of processes that are mature and rules–based, have high volume and are repetitive, and operate in digital form with multiple systems (e.g. Lacity et al. 2015, Kokina and Blanchette 2019). Hence, in order to analyze the applicability of RPA for accounting processes, we must first take a look at the nature of accounting tasks.

While there are many structured frameworks to characterize tasks, Perrow's (1970) framework characterizes tasks by their degree of routineness which in return reflects the uncertainty of the task. Brownell and Dunk (1991) constitute that "[…] the underpinnings of virtually all conceptualizations of task uncertainty in the literature relate to the work of Perrow." (Brownell and Dunk, 694). Perrow's framework has been widely adopted in the academic literature (e.g. Brownell and Dunk 1991; Sicotte and Langley 2000; Fry and Slocum 1984; Williams and Seaman 2002; Ylinen and Gullkvist 2011).

According to Perrow (1970), tasks can be described as 'non–routine', when established techniques for handling tasks do not exist (low analyzability), or when substantial variety or novelty in the tasks is encountered (high number of exceptions). Conversely, when tasks are analyzable with few exceptions, they are described as 'routine'. Figure 1 shows the relationships between the two dimensions (Abernethy and Brownell, 1997).

[Insert Figure 1 here]

In order to apply Perrow's framework to accounting processes, a closer look at the accounting discipline itself is recommended. The accounting discipline is made up of various branches, not just one. The two major branches are management accounting and financial accounting, further branches are tax accounting and auditing. Management accounting and financial accounting are comprised of different processes and tasks that fulfill the information needs of different stakeholders. Financial accounting has the primary responsibility of preparing financial statements through bookkeeping processes in accordance with law, rules, standards, and regulations to communicate this information to parties outside the organization. Instead, management accounting is not governed by any statue and covers key processes such as strategic and operational planning (budgeting), forecasting and management reporting, with the primary focus on the information needs of the internal decision makers like the management (Libby et al. 2020).

As a result, the nature of management accounting tasks differs from financial accounting tasks. While the two disciplines contain both routine and non–routine tasks, research implies that financial accounting tasks are generally to a greater extent structured with fewer exceptions, and therefore tend to experience higher routineness than management accounting tasks. For example, Alix et al. (1996) note that bookkeeping as central part of financial accounting "[…] is a highly structured, repetitive part of accounting." (Alix et al. 1996, 375) and Moffitt et al. (2018) point out that "[…] tasks associated with payroll, accounts payable, and accounts receivable are often mundane and recurring […]" (Moffitt et al., 3).

Further support for this view can be drawn from the shared service center (SSC) literature. SSCs are regarded as ideal for tasks that are structured, standardized, repetitive and are in a transaction processing environment (e.g. Lacity et al. 2011). A survey in Germany, Austria and Switzerland conducted by the University of St. Gallen together with KPMG indicates that financial accounting tasks like bookkeeping are regarded as highly suitable for SSCs due to their repetitive and transactional nature, whereas management accounting tasks were seen with less prevalence (Reimann and Möller 2013). Correspondingly, other research shows that companies primarily transfer financial accounting tasks such as

accounts payable to SSCs whereas management accountings tasks such as planning and budgeting are rarely transferred out (PWC, 2013; Stewart et al. 2004).

[Insert Figure 2 here]

Based on the argumentation above on the nature of their tasks, financial accounting and management accounting processes can be depicted in Perrow's framework as illustrated in Figure 2. Hence, financial accounting processes as a whole tend to have a higher degree of routineness, whereas management accounting processes have a higher number of exceptions and a lower analyzability which leads to lower degree of routineness. Undoubtedly, this conceptual view provides opportunities for further empirical research.

To provide some examples of specific accounting tasks that organizations have automated with RPA, Kokina and Blanchette (2019) summarize early RPA implementation and find that RPA is widely used to automate processes in the following financial accounting areas:

Order–to–cash

- Customer master file: new customer record creation, customer data maintenance, customer credit limit approval, loan and bank account applications.
- Invoicing: customer order entry, invoice preparation, invoice exception handling, and re–invoicing.
- Cash receipts: identification of duplicate payments, and cash application.
- Resolution process: customer follow up, issue identification and support, and client communication.

Procure–to–pay

- Vendor master file information: vendor creation.
- Purchase order activity: purchase order creation and modification, and open purchase order management.
- Invoice processing: incomplete invoice information identification, audit and review of travel invoices, preparation of procure–to–pay reports, unpaid invoice issue resolution.
- Cash disbursements: payment processing and requesting payment date for invoices.

Record–to–report

- Journal entries: data entry and account classification, journal entry preparation and entry.
- Reconciliation and analysis: extraction of account activity from bank website, uploading and validation of bank statement activity.
- Account analysis: accruals creation, calculation of warranties, commissions, and rebates.
- Closing process: export and data consolidation, reconciliation process.

In these automations, RPA was most often used to open, read, and create emails, log in to enterprise apps, copy/paste and fill in forms, read or write to database, follow decision rules, extract data from documents, and obtain human input via emails/workflow. RPA functionality such as moving files and folders, collecting statistics, making calculations, and pulling data from the internet were used less frequently.

Transferring this line of argumentation to the applicability of RPA for accounting, financial accounting in general seems to be more suitable for RPA than management accounting processes. Indeed, empirical studies (see section 2) and publicly available reports of companies like Merck (Pelegrino and Mega 2020), Daimler (PWC 2018), KION Group or ProSieben Media (Beisswenger et al. 2020) indicate that the introduction of RPA in the accounting field is mainly driven by financial accounting processes. Reports on the introduction of RPA in the field of management accounting, instead, are far more seldom or limited to the use of RPA for automating management reports (Hermann et al. 2018).

4 RPA heatmaps for accounting processes

Financial and management accounting are dominated by a number of processes. Central processes in management accounting include, for example, management reporting, operational planning (budgeting), forecasting, or cost and performance accounting (e.g., International Group of Controlling 2012). Instead, key processes in financial accounting are, for example, payroll, accounts receivable, accounts payable, cash management or fixed asset accounting.

[Insert Figure 3 here]

For each of the described processes in accounting the question arises, how well–suited they are for the use of RPA. Of course, not all processes are equally suitable. To graphically present the suitability of accounting processes and sub–processes, process heatmaps are an established instrument in practice. Regarding the suitability of RPA for accounting processes, there are various heatmaps available, mainly driven by consulting companies (e.g. Deloitte 2018; Langmann and Turi 2020; Wenning and Przytulla 2020). Although such heatmaps are typically generated by practical project experience rather than scientific rigorous approaches, they give first indications of which processes in accounting might be more suitable for RPA and provide further opportunity for research. In other words, they show how strong the individual processes are affected by the introduction of RPA. Figure 3 shows an RPA process heatmap for management accounting processes while Figure 4 – for financial accounting processes. Conceptually, such RPA heatmaps are based on the extent to which the respective process fulfills the evaluation criteria such as being rules–based, high volume, or repetitive (e.g. Lacity et al. 2015). A look at Deloitte's (2018) RPA heatmap of financial accounting shows that sub–processes of accounts receivable, accounts payable, general accounting and reporting are particularly suitable for robotization (see Figure 3). In management accounting, the sub–processes of cost and profit accounting and management reporting stand out as good candidates for automation (see figure 4).

[Insert Figure 4 here]

Both heatmaps highlight that rather than an entire accounting process (e.g. fixed asset accounting or management reporting) being suited for RPA, sub–processes are the right level of detail for selection. For example, not the entire management reporting process is well–suited for RPA, but rather the sub–process steps of 'report generation' and 'management reporting system and data process'. These sub–process steps typically are highly repetitive, rule–based and standardized, and are mostly carried out frequently (daily, monthly). Other sub–process steps such as the 'management evaluation and initiation of measures' are highly individual, unstructured and normally require an individual discussion which makes them unsuitable for RPA.

Although the heatmaps' indications seem logical and convincing, in practice processes may vary completely from company to company. As a result, a sub–process like 'report generation' might be conceptually convincing to be supported by RPA, in reality however, the process could have such small volumes (e.g., only one small report once a month) not making it a good case for introducing RPA into that process.

5 RPA as a driver for new roles in accounting

Advances in information technologies often serve as a driver for reducing the traditional role of the accountant which has been transaction processing and financial report preparation, while supporting a shift towards the role of a business partner (El–Sayed and Youssef 2015; Byrne and Pierce, 2007; Järvenpää, 2007). By partially or completely taking over accounting processes, RPA is such a technology with direct and indirect effect on tasks and competencies – and therefore on the role – of accountants. In order to better understand the impact coming from RPA, we first take a look at the traditional role of accounting.

5.1 Traditional role of accounting

Traditionally, accounting has been fulfilling a number of different roles in a company. Typically, an accountant is responsible for a set of defined tasks for which certain competencies are required. Both management and financial accountants have traditionally played a key role of the scorekeeper and information provider for decision makers and stakeholders (e.g. Verstegen et al. 2007; Needles et al. 2013). In this role, both management and financial accountants execute standard (transactional) activities – financial accountants, for example, perform invoice processing and bookkeeping; management accountants, for example, undertake cost allocations and performance measurement – and generate the resulting information (e.g., management reports and accounting statements).

However, the performance of transactional activities and the simple provision of numbers and standard reports generate only limited added value in many companies today. Due to the ongoing adaption of ERP systems and Business Intelligence systems which began more than two decades ago, transactional activities have been continuously automated

and decision makers either automatically receive current financial performance information from a system or can create such reports via self–service at any time (e.g. Peters et al. 2016; Sánchez–Rodríguez and Spraakman, 2012). For this reason, accountants are expected to shift their focus towards enriched tasks such as those focused on being business partners, hence, acting as a proactive source of ideas and as consultants (e.g. Bhimani and Willcocks, 2014; Osterreicher et al. 2019, Schäffer and Weber 2018). As a *business partner*, financial and management accountants should, for example, actively advice on balance sheet policy and tax optimization, independently keep an eye on the achieving the objectives while monitoring and coordinating countermeasures that have been initiated.

5.2 RPA–related changes in accountants' roles

The increasing spread of digitalization technologies such as big data, analytics, and RPA change tasks, skills and competencies of financial and management accounting professionals (e.g. Bhimani and Willcocks, 2014; Osterreicher et al. 2019, Kokina et al. 2019). As an automation technology, RPA aims at efficiency gains by performing transactional activities with standardized and repetitive patterns. As a result, the traditional role of the accountant as scorekeeper and information provider performing mainly transactional tasks will probably be largely or even completely replaced in the future by robots. At the same time, the importance of the accountant's role as business partner will increase. Supporting this view, El–Sayed and Youssef (2015) conclude their literature review stating that the change of "[…] the role of accountants from a traditional bookkeeper to more of a business partner…" is likely to occur in the near future (El–Sayed and Youssef 2015, 206). Lawson (2019) similarly notes that that the new role of finance and accounting professionals will include "[…] providing business insight and serving as strategically oriented business partners." (Lawson 2019, 18). To serve as business partners, accountants will need a solid understanding of the business model, communicative and analytical strength as well as a problem–solving–oriented and critical mindset paired with coordination skills (Burns and Baldvinsdottir 2005; Siegel et al. 2003). All skills and competencies, in which an accountant, rather than an accounting robot has her strengths.

In corporate practice, however, research also shows that accountants still focus on traditional tasks today. Pietrzak and Wnuk–Pel (2015) conclude their research study on management accountants that accountants "[…] still focus on traditional areas of costing and financial analysis, like performance measurement, operational budgeting and cost control." (Pietrzak and Wnuk–Pel 2015, 285). Also, Rieg (2018) summarizes his study's results on management accounting tasks by stating: "[…] yet the emphasis of MA work still seems to lie in the operational area." (Rieg 2018, 203) Other current studies on the role of management accounting show similar results (e.g. Schäffer and Weber 2018; Osterreicher et al. 2019).

In recent years new roles for financial and management accounting have emerged in corporate practice and research next to the traditional roles discussed above (e.g. Schäffer und Brückner 2019). Two roles that are particularly interesting with respect to the impact of RPA as an automation technology can be found in Figure 5 which displays a model for future roles in management accounting at BASF. These roles are *guardian* (focused on governance) and *pathfinder* (focused on innovation) (Seufert and Kruk 2016).

[Insert Figure 5 here]

In the *guardian* role, an accountant should ensure the establishment of and compliance with company–wide guidelines and standards in the area of compliance, e.g. travel expenses, account assignment guidelines or defining key figures. With the introduction of RPA and other digitalization technologies, this is likely to become more important in the future. The use of RPA in accounting requires regulations that are not only IT–technical in nature. Questions such as 'Which accounting data can be used by robots?' or 'What are the specifics for governance in the accounting field to mitigate risks arising from the use of RPA?' must be clarified. A role such as the *pathfinder* has the task of continuously screening for new trends and digitalization technologies, processes and methods for accounting, such as analytics or RPA. The accountant filling this role screens, for example, RPA tools concerning their portability and applicability for particular accounting processes (Seufert and Kruk 2016).

While the *pathfinder* seems a rather broad role concerning digitalization technologies, some companies develop roles in the accounting organization specifically for RPA as a technology. Deutsche Post DHL as one of the world's leading logistics companies, for example, introduced two new roles in accounting each focusing on different aspects of RPA. In the role of a *process champion* an accountant is responsible for monitoring and controlling an automated end–to–end process. Accordingly, this role ensures the actual process is carried out as defined by the target process, both operationally by employees and system wise by the automated technologies. The rationale is that even if RPA is a rule–

based technology that basically works successfully with careful implementation, failures can still occur again and again such as unexpected, new pop–ups which the technology does not know how to handle. Instead, the *automation design expert* at Deutsche Post DHL is also an employee of the accounting department (e.g., accounts payable or central accounting) with a focus on technically maintaining established RPA solutions, i.e., performing first level maintenance activities. Next to maintenance, this role also technically implements desired extensions and improvements in robots (Wenzel 2020). Next to these new roles within accounting departments specifically linked to RPA, Kokina et al. (2019) identified further roles such as the *identifier* who spots opportunities for RPA and *analyzer* who uses the output of RPA tools to provide future–oriented insight.

In summary, RPA as an automation technology acts as an enabler that further shifts the emphasis of accounting away from the traditional role as information provider towards a *business partner* and roles like a *pathfinder* or *automation design expert*.

5.3 Role shifting requires new skills and competencies

The new roles connected to the introduction of RPA presented above require skills and competencies that go far beyond those of traditional accountants (e.g., Kokina et al. 2019). To assess their applicability and to support the implementation in the field of accounting, she is required to have knowledge of RPA as an automation technology. As a result, today's accountants who step into new roles handling technologies such as RPA should build corresponding skills and competencies. In Deutsche Post DHL, for example, accountants accompanying the new role of *automation design expert* build up their skills in the organization's own automation academy.

Even if not every accountant is supposed to jump into more technically oriented new roles such as the *automation design expert,* she must have a solid basic understanding of RPA, including its application possibilities and limits, in order to effectively use and work with the technology, or to serve as respected interface to technical RPA units. The IMA – Institute for Management Accountants (2019) supports this argumentation by stating in their current framework that accountants should demonstrate an understanding of the potential applications of emerging technologies such as RPA. The shift in roles accompanied by the shift in skills and competencies is also reflected in the training and education offered by leading universities and accounting associations for future accounting experts (e.g., AICPA 2020; University of Washington 2019).

However, using the example of management accountants in particular, research shows that the shift of the role of accountants as discussed above cannot be found in the broad market of job postings or skill profiles of accountants in professional social networks (Osterreicher et al. 2019). Hence, it seems like the digital transformation resulting from RPA adoption is not yet widespread in accounting departments.

6 Summary and outlook

RPA is driving the digital transformation of accounting in many organizations today. Looking at the nature of accounting processes, especially financial accounting processes with their routine nature such as accounts receivable, accounts payable or monthly closing are highly suitable for RPA. Within management accounting especially the core processes management reporting and cost accounting are highly suitable for the use of RPA. As a result, the role and competences of accountants will shift from the traditional role as information provider towards more digital and communicative roles like the *business partner* or new digitalization roles like the *pathfinder* or *automation design expert*.

In the coming years, the ongoing expansion of RPA towards IPA with other digitalization technologies from the field of artificial intelligence such as natural language processing (NLP), sentiment analysis, or machine learning algorithms will make robots more intelligent and suitable for more complex tasks. IPA has the power to grasp even more process activities in accounting and therefore speed up the shift of roles and competencies outlined above.

Although there is a body of literature, individual reports from corporates and first empirical studies on the use of RPA within accounting, further research is required in a number of fields. First, while there are a number of conceptual papers and studies on the suitability of RPA in public accounting and auditing, only very few empirical studies have looked at the implementation of RPA in financial accounting, tax or even management accounting at all. Hence, empirical research on the suitability of RPA for management accounting processes provides a research opportunity. Second, further empirical research could explore the ways in which RPA is changing the role of accountants and their skills and competencies. Finally, future research could look at the long–term effects of RPA on the accounting function itself. The shift of processes towards RPA in an organization might change the entire organizational set–up including

accounting departments. Today's responsibilities and resources of departments in the corporate landscape might fundamentally change with a broad introduction of RPA.

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Figure 1: Perrow's Framework for Task Routiness (Perrow 1970)

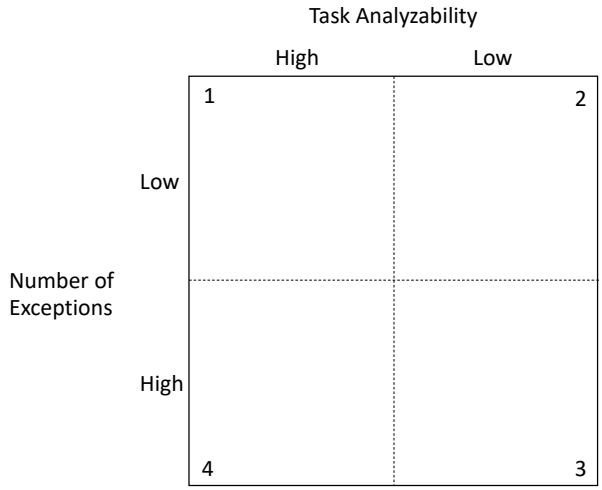


Figure 2: Nature of Financial and Management Accounting Tasks

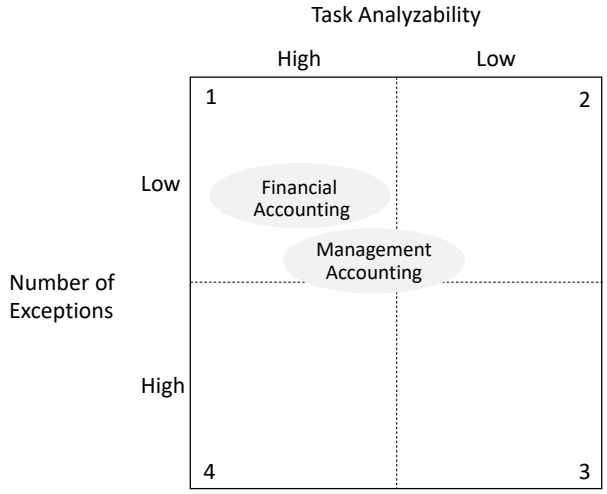


Figure 3: RPA–Heatmap financial accounting processes (Deloitte 2018)

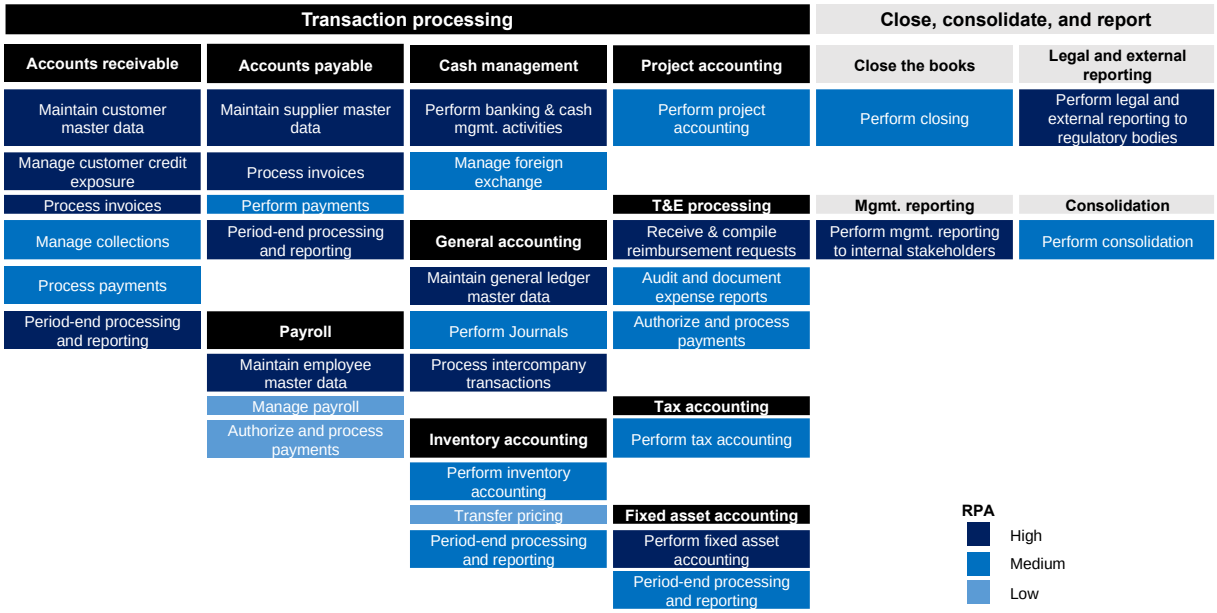


Figure 4: RPA–Heatmap management accounting processes (Wenning and Przytulla 2020)

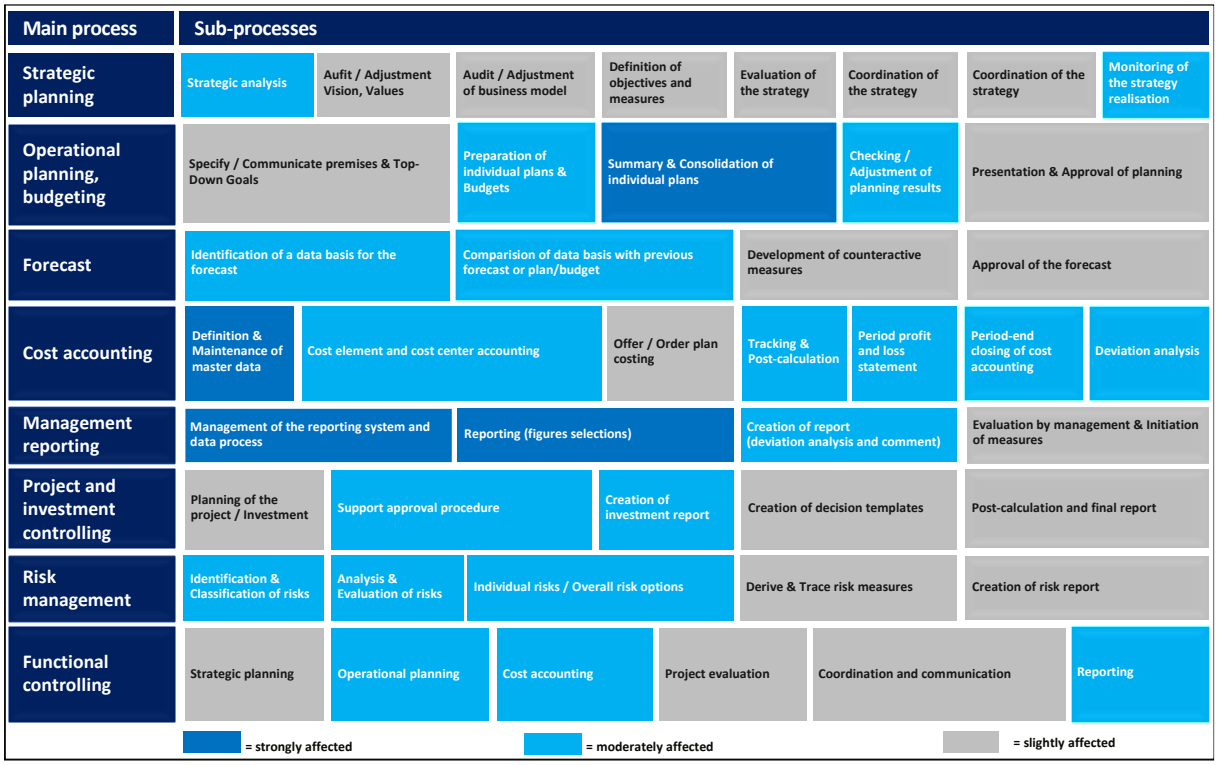
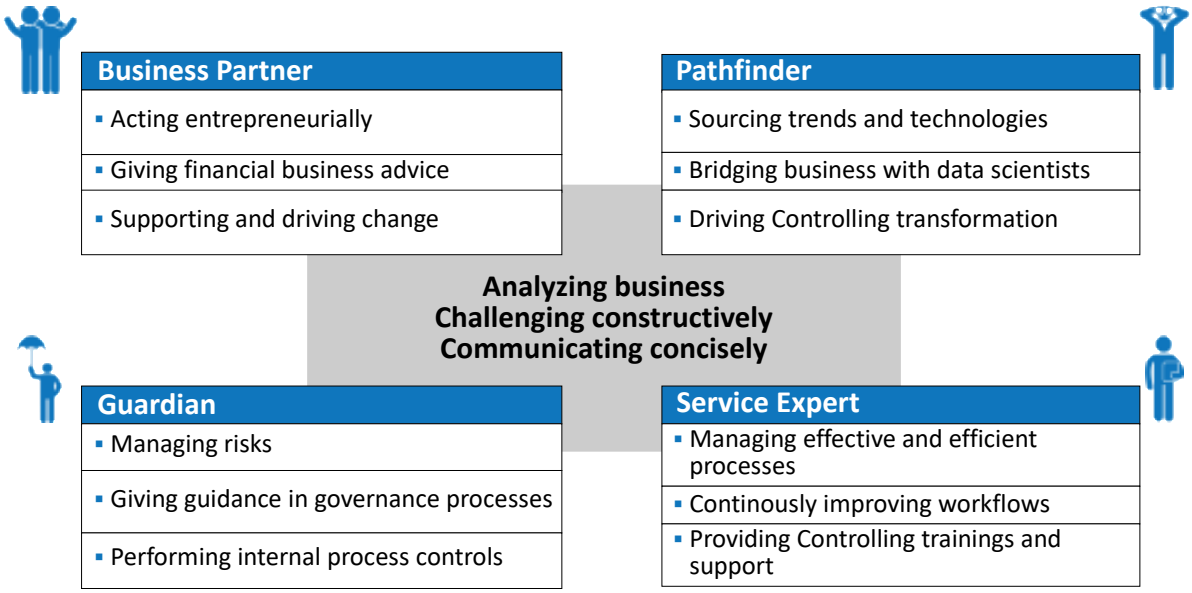


Figure 5: Management Accounting Roles at BASF (Seufert and Kruk 2016)



All Controlling roles equally important in moving towards „Controlling 2025“

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