

## **Accountant as Digital Innovator: Roles and Competencies in the Age of Automation**

**Abstract:** In this paper we explore how Robotic Process Automation (RPA) is changing the work of accountants, identify the roles that accountants will play in their organizations' digital transformations, and categorize the skills and competencies that accountants will need to develop in order to successfully work alongside their digital colleagues. We employ a multiple case study methodology and collect interview data from eight organizations undergoing RPA implementation for their accounting and finance tasks. Our analysis reveals that accountants play important roles as identifiers, explainers, trainers, sustainers, and analyzers of their organizations' automation initiatives. To prepare to undertake these five roles, accountants will need to acquire new technical skills. Therefore, the paper concludes with a mapping of the skills needed for each role that the accountant is expected to play in RPA implementations.

**Keywords:** robotic process automation; software robots, digital workforce; accounting automation; accounting innovation; accounting digitalization; robotics; digital competencies.

## INTRODUCTION

This paper is motivated by the need to understand the role accounting professionals will play and the skills and competencies they will need to support the adoption and implementation of Robotic Process Automation (RPA) in organizations. RPA technology creates software robots (bots) that emulate the actions of a human interacting with digital systems. The bot executes business processes by following a series of structured workflows, particularly for processes that involve data from multiple information systems (Kokina and Blanchette 2019). Because the bots operate 24/7, take no sick or vacation time, and make far fewer errors than humans, organizations are looking towards RPA to increase transaction speed, improve processing accuracy, and comply with industry rules and regulations (Davenport 2019). The RPA market is growing at a frenzied pace and it is estimated that by 2022, 85 percent of large organizations will have deployed some form of RPA (Gartner 2018). Given that many accounting and finance tasks have the characteristics that make them suitable for RPA (Kokina and Blanchette 2019), it is essential for accounting professionals to develop an understanding of the skills and competencies required to take part in or even lead automation efforts within their departments or organizations. Given that bots are only as effective as the humans who create, implement, maintain, and manage them (McKinsey 2018), accounting faculty could benefit from enhancing its digital literacy as they prepare graduates entering the accounting profession that increasingly demands technology-related skills.

The goal of this paper is to explore ways in which RPA is changing the work of accounting and finance professionals, to identify the roles accountants play in digital transformation, and to detail the skills and competencies that accountants need to develop in order to successfully work alongside their digital colleagues. There is a definite lack of clarity regarding the extent of those skills and their focus. On the one hand, a survey of over 700 senior finance leaders reports that only 10 percent of finance teams have sufficient technical skills to support their organization's digital journey (Oracle Cloud, AICPA, CIMA 2019; Trentmann and Shumsky 2019). On the other hand, software providers emphasize that their RPA tools are "business-led," "easy-to-control," and "no-code" (Blue Prism 2019); "drag-and-drop" and easy to design (UiPath 2019); and "work-ready" and enabling the "workforce to automate on their own, in real time" (Automation Anywhere 2019). As a result, it is important to explore whether this digital skills gap among accountants exists and what are some of its possible remedies. This paper makes an important and unique contribution to the literature documenting the evolution of accounting practice (Elliott and Jacobson 2002; Howieson 2003) and emerging research on how recent developments in automation are shaping the work of accountants as knowledge professionals (Cooper, Holderness, Sorensen, and Wood 2019; Moll and Yigitbasioglu 2019; Kokina and Blanchette 2019).

## LITERATURE REVIEW

Kokina and Davenport (2017) evaluate the broad spectrum of technologies and their intelligence levels highlighting their undisputable impact on accounting and auditing. Cooper, Holderness, Sorensen, and Wood focus on the adoption of RPA in public accounting and report that the majority of the interviewees in their sample did not foresee a reduction in new hires due to bot implementation. However, they indicated that the hiring practices were increasingly focused on attracting computer programmers and software engineers. This shift in the Big-4 hiring model due to developments in technology is supported by employment data showing that non-accounting graduates represent 31 percent of new hires in public accounting which is an 11 percentage point increase from 2016 to 2018 (BusinessWire 2019). We expect that the need for new hires with both accounting and technology skills to be similar in private practice. Therefore, it is important to develop an in-depth understanding of the new emerging roles in the changing landscape of accounting work.

Wilson, Daugherty, and Morini-Bianzino (2017) propose three new categories of AI-driven business and technology roles: *Trainers*, *Explainers*, and *Sustainers*. Through the design and implementation of software

code, Trainers teach AI systems how to perform. In order to design and later support these systems, Explainers bridge the gap between technologists and business leaders, bringing clarity to how the automation functions. Sustainers help to ensure that the automation continues to operate successfully. While Wilson, Daugherty, and Morini-Bianzino (2017) focus on broad categories of emerging human jobs based on their observations of 1,500 organizations using or testing AI systems, our paper adapts these categories to detail the roles suitable for accountants. As a result, we have added two additional roles to the taxonomy: *Identifier* and *Analyzer*. In order to take advantage of RPA, digital opportunities must first be assessed and business cases must be developed. This is the Identifier role. Once bots are created, more data are available for analysis and the generation of insights. This is the Analyzer role.

To explore how machines are transforming the landscape of accounting work, we focus on the following research questions:

**RQ1:** What roles do accounting professionals play in digital transformations with RPA?

**RQ2:** What skills and competencies should accountants develop to work alongside digital workers?

### **RESEARCH METHOD AND STUDY CONTEXT**

We employ a multiple case study methodology following Kokina and Blanchette (2019), Rikhardsson and Dull (2016), and Lillis and Mundy (2005) to collect data from semi-structured interviews with experienced professionals reflecting upon their experience with RPA implementations. Table 1 presents a detailed list of the participants of this study. We used the following selection criteria to screen participants for participation in our study: First, each interviewee had to have actual experience with an RPA implementation using at least one of the RPA software tools such as UiPath, Automation Anywhere, or Blue Prism. Second, study participants had to have implemented RPA to automate accounting and/or finance tasks. We conducted interviews between December 2017 and August 2019.

In Appendix A, we provide a list of quotes gathered from our interviews. Following Miles, Huberman, and Saldaña (2014), we use NVivo qualitative data analysis software to develop open codes and to categorize interview data into the appropriate role category. In Appendix B, we provide a sample invoice automation using UiPath software in order to illustrate how RPA works and to provide deeper context for our analysis. The use case is a business consulting firm where each week, the firm's consultants log their hours and client information into an Excel worksheet. At month-end, the company's accountant downloads this data from Excel, logs into the firm's QuickBooks Online Accounting System, and generates client invoices. Since the consulting firm would rather its accountant concentrate on analytical work, a bot was constructed to perform the routine invoice creation task.

Insert Table 1 Here

### **RESULTS**

The most important aspect about automation and the future of work is that it is less about technological innovation and more about ways in which humans will choose to use that technology (PwC 2018). The impact of automation, specifically RPA, on the work of accountants has been transformative as RPA changes the kind of work an accountant is performing. Below we provide a detailed analysis of the roles we identified above, namely, Identifier, explainer, Trainer, Sustainer, and Analyzer.

#### **Identifier Role**

Accountants are well positioned for the innovative role of identifying RPA opportunities that will allow their organizations to operate more efficiently and effectively. Companies report that when looking for potential RPA opportunities, they examine three criteria: (1) Is the process mundane, routine, and rules-

based (2) does it have few exceptions, and (3) will automating the process save a significant number of labor hours. Accountants have the knowledge to answer all three questions. Many accounting transactions meet criteria one (Kokina and Blanchette 2019). When we asked the Director of RPA at Company B if he could describe one of their RPA implementations, he replied accounts payable matching and accounts receivable cash application. Likewise, Company D mentioned the automatic creation of fixed assets and leases within its Enterprise Resource Planning (ERP) system. With their deep understanding of business processes, accountants can help quantify both the process exception rate and the number of labor hours saved. Regarding process exceptions, Company B mentioned their organization's 80/20 guideline where it is inclined to automate processes with fewer than 20% exceptions. However, this guideline does not necessarily exclude processes from consideration. Instead, the company works with its accountants who analyze the exceptions and try to standardize them. The revised processes will be reflected in the "to-be" flowcharts within the RPA design document. Company D also looks at process exception rates but the company's primary goal is to develop RPA solutions that will save the company at least 2000 labor hours per year.

Once accountants are trained on how RPA technology works, they will be able to recommend processes that meet the criteria outlined above and create the business case to support RPA including the calculation of the project's ROI. To successfully fulfill the identifier role, accountants need to focus on developing an ability to analyze and understand business processes (Company A):

*You've got to develop an ability to analyze processes, so if you want to automate something you need to understand the process so I think the process knowledge starts to become more and more relevant.*

Accountants should be able to employ their logical reasoning skills to differentiate between what can and what should be automated (Company B):

*We are moving from the traditional accounting, where people are just used to doing the manual work, to the point that we will have to really think about how accountants can become process architects. [Redacted]*

Once accountants have combined their knowledge of the business, its processes, and technology and identified RPA opportunities, they can fulfill the role of Explainer, working with IT to ensure RPA success.

### **Explainer Role**

As bots become more prevalent in organizations, accountants will routinely find themselves in the position of having to explain to software designers and bot developers in great detail the steps and internal controls involved in a process chosen for RPA. As can be seen in our sample implementation (Appendix B), the accountant can explain to the software designer and developer that the consulting hours are stored in an Excel worksheet with the following name and location, the data elements (e.g. field size, data type, and description) that are being moved from Excel to QuickBooks, and whether QuickBooks is running locally on a company server or in the cloud. Next, the accountant could describe how to navigate to the invoice creation window and how to populate the form including which fields are required, and the prerequisite master data needed to complete the invoicing process. For example, in our sample RPA implementation, the customer and product/service records must have been defined before the invoice could be created. Company A explains how the accountant works alongside the developer:

*The process owner if it was the accountant would be involved in documenting to ensure that the process was well understood. Then you would have the developer which was kind of like the way I talked about the IT specialist who was trained in UiPath coding, who could come in and do the backend or the coding. [Redacted]*

Because RPA deals with process automation, the accountant could help the software designer create a flowchart of the current or 'as-is' process and then, after thinking through the future automation including what steps can be eliminated, standardized, or revised, the 'to-be' process flowchart. With their deep understanding of the business process being automated, accountants can help identify the source and target systems, describe the precise steps a human takes when executing the business applications, and define the data elements that are being extracted from one system and transferred to another. Accountants can also be immensely helpful in identifying process exceptions and defining the actions the bot should take if it encounters an exception, in particular, who to notify and what data to forward. Company B provides the following account of this part of RPA implementation:

*Once the 'as is' flowchart is completed, the solution architect will come and review and then will go into the 'to be' process, and then what are we looking at in terms of a future, the automated solution, what steps can we cut out, what can we standardize, what are the inputs and the outputs or prerequisites around all that to kind of document that whole process and map it out.*

Company B outlines how its internal auditors helped to create this documentation:

*They wanted to make sure that as we kind of pilot these deployments, that we know what we're doing, and we have the right documentation in place, we have the right process in place, we have the right controls in place. That's where coming from internal audit, I helped define from day one, right? We had a standard template for documenting the 'as is' process. So, how does the process work currently, and then documenting the 'to be' process. How will that process look in the automated state, because there would be some modifications to how the process is done in the automated state.*

In addition to providing process-related documentation to bot designers and developers, as process owners, accountants develop lines of communication with managers, internal auditors, or external auditors to explain what the bot is doing. For example, Company D mentioned that the cash reconciliation process is a good candidate for a bot. In the course of the external audit, an accountant who manages this bot is going to have to explain to the auditor how the bot downloads and then converts the bank statement in PDF format to a Text file, how the bots logs into the company's general ledger system and obtains the cash account journal postings, and finally how the bot performs the reconciliation by comparing the data from the two systems. During this explanation, the external auditor is certain to ask about security and compliance issues and the accountant will need to explain that the bot has its own login credentials so that there is an audit trail of its activities (Company B). To follow the conversation and be able to ask relevant questions, auditors, both internal and external, will also need an understanding of RPA so they can explain their audit activities to their management and ensure appropriate procedures are performed on any bot-related transactions.

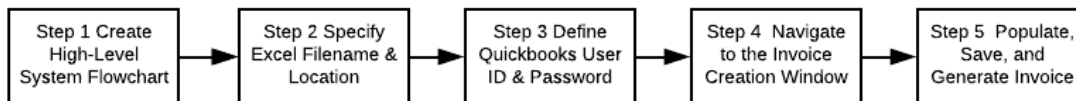
As businesses continue to adopt modern technologies such as RPA and cognitive computing, accounting and finance teams are going to have to rethink how their COSO Internal Control — Integrated Framework applies to this new digital workforce. In order to manage cyber risks, organizations should ensure that it has well-documented, formal policies and procedures, explaining who is controlling, monitoring, and communicating bot activity. Senior management must be made aware of the risks associated with employing bots and the company must be proactive in mitigating these risks. Internal auditors, like the company accountant and the external auditor in the cash application scenario above, will need to become more tech-savvy so they are able to put the proper internal controls in place to manage the digital workforce. For example, Company B changes its bot passwords every six hours to reduce the risk of a cyber-attack.

With the automation designed, it is time to train the bot or code the system. While we maintain that

enterprise-level bot software development will remain the purview of the IT organization, we have added an understanding of bot code to our competencies table (Table 3). This is because in order to fully explain a bot’s activity and provide evidence to auditors, the accountant will need to be able read the bot code.

### Trainer Role

Once the design document is reviewed and approved by the business process owner, the RPA developer signs into the RPA software and creates a systems flowchart based off of the “to-be” diagram. Next, he or she enters the code associated with each process step. To code the sample invoicing bot described in the Research Method and Study Context section of this paper and documented in Appendix B, the RPA developer logged into the RPA software and performed the following five steps:



Step 5 is the most involved as the developer must define the detailed steps a human takes when interfacing with the QuickBooks invoice creation window.

Our sample code is extremely simplistic as it consists of what many RPA developers refer to as the “happy path” or the path that deals with zero exceptions. Of course, this is entirely unrealistic. Bot software code is complex since it must cover exceptions that are normally dealt with by humans. For example, when programming the login process, the bot developer must account for the appearance of pop-ups, notifications, or password expirations messages. And what if the system is unavailable? How many times should the bot try to login before alerting someone that the system is down? As you can see, bot development has to deal with many more exceptions than when developing a system with a human interface. At Company B, the code was created by a developer who resided within the accounting area as opposed to the organization’s centralized IT department However, the Senior Manager of Intelligent Automation stressed the following:

*From a development standpoint, we decided at the very beginning to have IT as our copartner in the development work. Even though we had developers within our team, we gave IT equal kind of stage in the development cycle, so that they actually owned the IT sign-off of the development work before it was moved to production. They did their series of checks to evaluate the quality of the code that was built, and that it followed the right set of standards. That there were certain documents in place, and checks, and peer reviews prior to the code being moved to production.*

Even though today, the role of a Trainer at the companies we interviewed was fulfilled primarily by individuals with extensive IT background, many organizations offer opportunities for accountants to gain skills necessary to engage in bot building. Company G highlights the need for accountants to, at a minimum, understand the code in order to build resiliency and error-handling into the bot:

*You do have to have some good understanding of at least the logic that goes into programming. You might not need to know how to program but you should be able to think that way logically. The second challenge is for any reason whatsoever these bots can fail, so you have to think about ways or things that might affect a bot, especially things that a person would normally deal with.*

Company B outlines their approach to change management and technology-related training in the following:

*We’ve been going around and educating and doing training for our finance team; we’ve been doing a lot of change management. So, educating our accountants that here’s an opportunity for you to automate your work. The work that you do to just prepare the data for you to then do your work,*

*and then the second piece being, okay, now let's educate and elevate the level of our accountants and finance individuals with some of these additional analytical tools that we have. For example, we have different coding languages that the data scientists are actually sharing with the finance community, so that they can start learning new coding techniques.*

At Company B and Company D, RPA is centralized within the IT organization and Centers of Excellence had been created to develop best practices for bot design, development, and governance. Despite the RPA software vendors' claims of easy-to-use, no-code, and drag-and-drop, we found that at Company B, C, D, and E, the bots were programmed by software developers. Company A shared that with training, accountants can take part in bot programming:

*But I found with [RPA software] I could actually train my accountants on how to code bots.*

As libraries of reusable bots are developed to deal with a variety of rules-based tasks, accountants may find that they begin to play a greater role in training the software.

With the automation developed, it must be continually managed. In the near future, the accountant may find that he or she is managing more bots than people. As bot managers, they need to sustain the software and measure its success.

### **Sustainer Role**

The business and technical environment in which bots operate is constantly changing. To ensure that the bot continues to function properly, accountants need to work with their IT organization to develop an effective governance model and the skills required for bot management. Company D summarizes these competencies in the following:

*We do a lot of presentations regarding the future of work. In the future, and I'm talking about not even five years from now, they even are going to rename the titles that we have. Instead of just having a controller, it's going to be bot controller and bot accounting manager, because now you're going to have to be knowledgeable in all the accounting guidance and how different accounts should behave [...] but you also need to know computer programming like a basic understanding of when a bot doesn't work or it's not giving you what you need, to be able to articulate your issues with this third party provider, or to a point that you can basically own the bot and go into the coding and edit and change as needed. That's going to be expected from some accountants and some people don't see it that way because they're like, "Oh, I went to school for accounting not for computer programming. Why do I have to look at this coding?" [...] And the reason is, it's because that's the way we are heading.*

There are many variables that can affect the functioning of the bot including regulatory changes such as tax rates. Additionally, because RPA software mimics a human's interactions with an application, it is highly susceptible to changes in application screens. When a screen layout changes, the code must be updated. Therefore, anyone involved in RPA development or support must ensure that they are notified of application system upgrades whether the applications are running in-house or in the cloud by a third-party provider. For example, Company B mentioned that they are trying to get better interlocked with SAP so that they are notified when the SAP developers make screen changes. Unlike humans who recognize when something looks different, currently, bots are not intelligent enough to detect changes. They are considered to provide assisted versus autonomous intelligence. Overtime, bots will become smarter as RPA software vendors embed artificial intelligence or cognitive computing features into their software but until then, someone with a deep knowledge of the process has to closely monitor the bot and proactively identify future changes. The bot sustainer or manager must also create a business continuity or back-up plan for when the bot fails. Company B highlights the need for bot monitoring in the following:

*The only thing to learn about managing a bot is that it doesn't have intelligence, so it's not going to react to changes in the environment, whether it's a system change, or a regulatory change, or a distributor change. For example, with the Brazil tax bot that I mentioned, we noticed that the volumes that the bot was transacting suddenly started to drop, and when we went back to the process owner to understand why the bot used to process so many returns a month, and now it was just processing a fraction, they told us, 'Well, actually, we switched distributors. We went from DHL to some other one.' Well, the bot wasn't picking up the new distributor.*

In their sustainer roles, accountants need to develop metrics for the bots or their digital workers just as they would for their human employees. The metrics, or Key Performance Indicators (KPIs), also help with the continuous bot monitoring. Accounting managers, working in conjunction with the IT organization, should define both accounting and system performance metrics for its digital workforce. For example, in Table 2 we list the metrics that Company B defined for its cash application bot.

Insert Table 2 Here

Changes in technology have created opportunities for organizations to access more data to run the business than ever before. Data is no longer the obstacle to analytics adoption; instead, it is the knowledge of analytical tools and the time to devote to them. By eliminating much of their non-value added work, automation tools such as RPA, provide the opportunity for accountants to take on the valuable analyzer role.

### **Analyzer Role**

The role of analyzer consists of using data to help provide answers to the company's most pressing issues or problems. In this capacity, the accountant is assisting his or her organization in meeting its strategic objectives. Data analysis begins with developing the questions that need to be answered. This is the most important part of the process as Pablo Picasso proclaimed in 1968, "Computers are useless, they can only give you answers" (Artlyst). For many accountants, these questions are top-of-mind but until recently, they have not had the time to seek solutions. With the promise of RPA eliminating much of their routine, mundane, and time-consuming work, accountants can finally move forward seeking answers through data analysis. Company A believes accountants will have more time for analysis and will require more business acumen to increase their ability to analyze the data. Company A further shares:

*It will impact competencies, because you won't have so much reliance on those traditional competencies where you relied on somebody for accuracy [...] you're looking then for somebody that can actually do creative thinking with the output. You're going to need to be more strategic, more creative. You're going to need people who can express their ideas, can communicate very effectively. [...] it kind of pivots the dial and puts a lot more emphasis on digital fluency all the way through to high value added insight that comes with having, an analytical and strategic mindset.*

With the questions developed, the next step is to identify the data needed to answer those questions. As Company B describes, organizations want individuals that can triangulate information and have an ability to connect dots from unrelated data points. The ability to ask the right questions, utilize logical thinking and to quickly identify trends will be important factors for success. Company A also shares the importance of an accountant's ability to interpret large data sets and step back and see the big picture. In addition to using ad hoc analysis tools to examine historical data, organizations are looking for ways to transform the accounting department from a historical reporting function to a more future oriented group. This will require accountants to have the ability to use more predictive and prescriptive analytics.



In addition to generating insights and making predictions from data, another key competency that will be required is the ability to communicate that information effectively to a wide range of audience members. Once the accountants have the data they need to support the answers to the questions they raised at the start of their analysis, they can use data visualization tools to effectively tell their story. Company C outlines the importance of both of these in the following:

*You need to be focused on analyzing and pulling insights [...] and being able to communicate effectively, that which this information is telling you, so that when you're talking to your client or the leaders, you can effectively tell that story, paint the picture, and help them see the future, [...] so the predictive analysis piece would come out of that.*

Company B supports this transformation by sharing how they want the accountants to be able to understand how changing different variables will affect future company performance. Company A also shared that an accountant's ability to recognize the impact of changes in the business or regulatory environment on both technology tools and corporate performance will also be critical. As accountants share these insights with others, the use of data visualization tools will enhance their ability to communicate effectively.

Finally, in their role as analyzer, the accountant can help suggest and then implement the changes that their analysis revealed was warranted. This is analogous to the tennis swing follow-through. Too often companies collect, store, and analyze data and then stop without identifying and implementing the necessary company changes. In their analyzer role, the accountant is well suited to round out this process. After determining the questions that need answering, identifying and shifting through the data looking for insights, and then presenting the results in a compelling way, accountants can play a valuable role in helping to implement the procedural changes needed to impact the future performance of the company.

## CONCLUSIONS

The digital workforce has arrived and accountants must engage in digital upskilling to be part of this new way of work. Recent academic and practitioner literature referring to the "future of work" comments that these changes are not simply already happening but also accelerating. Accountants must adapt in order to navigate these changes (PwC 2018). RPA highlights the importance of some competencies already in line with accountants' skillsets. For example, some skills, like flowcharting, simply need to be dusted off. Yet others offer opportunities for new skill development -- skills like data management and coding need to be acquired or strengthened. Because RPA programmatically moves data in and out of data sources, accountants need to better understand data structures. Historically, they might have been oblivious as to whether the data were stored in a database or in a flat file or whether the data were located on-premise or in the cloud. With the expectation that accountants will be identifying automation opportunities and then helping to explain, train, and sustain bots, an understanding of databases and cloud computing is essential. Data quality, an important part of data management, is crucial as bots move data around on their own. Anomalies that humans might notice may go undetected when the process becomes fully automated. Data quality is fixed at the time of creation and so accountants must help to ensure that data entered into source systems is accurate (Redman 2013). While automation provides organizations with many benefits, it also presents "bad actors" with opportunities for disruption and tremendous damage can occur if a bot is hacked. Therefore, accountants will need to become familiar with security practices so the bots remain secure. As noted earlier, while not expected to fully code the bot, it will be important that accountants learn how to read and edit RPA code so they can perform their RPA roles. Finally, with several processes now automated, the accountant's time can shift to higher value-added analytics work and therefore they should acquire expertise with data analysis and data visualization tools. Recognizing this shift caused by technological developments, Company B added data science—the combination of domain expertise, programming skills, and math and statistics—to its bot training for finance professionals. At the

conclusion of the training, its employees earn a “digital player” badge.

As automation becomes embedded into the culture of organizations, the current hiring practices of accounting personnel is changing with companies looking for accountants with more STEM skills. In response to our question about his future hiring practices, the Vice President of Finance at Company B, replied, “I would definitely look for this sweet combination of accounting knowledge and technology.” Moreover, as technology continues to evolve, broader skills will be required by those who pursue a career in accounting. Higher levels of technical skills, business acumen, analytical skills and soft skills including communication, storytelling and teaming will be required. Company B emphasized that an accountant’s work is transitioning from ‘doing’ to ‘reviewing’:

*I think it’s important also that the profession understands that this is going to continue evolving, and it’s going to be moving more in a direction where accountants are going to be really process experts, rather than just doers of the processes.*

Table 3 lists the skills, mapped to the five RPA roles described above, that accountants will need to acquire. While not every accounting role will necessitate all of these skills, a wider variety of career opportunities will exist for individuals with higher level competencies in these areas.

Insert Table 3 here

Technological transformation in accounting offers many opportunities for future research. Future studies could offer a more detailed analysis of how automation is transforming each role – staff accountant, senior accountant, controller, and CFO. It would be interesting to document how each of these roles has changed over time from pre to post RPA. Future studies could also broaden the analysis and include accountants in various roles in public accounting, particularly tax and external audit. This area of research can also be adapted to offer many opportunities for curriculum development in order to supply accounting faculty with meaningful innovative content that could better prepare accounting students entering the profession.

This study’s limitation is that the sample size consisted of eight organizations. However, we interviewed multiple professionals from most organizations to corroborate our findings. Furthermore, we reviewed multiple internal documents related to RPA implementation – several process definition documents, internal presentations and summaries of RPA roles.

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**Table 1**

Case company overview.

Interview No	Company	Interviewee	Interviewee Code	Years of Professional Work Experience	Company Size (Employees)	Industry
1	Company A	Chief Financial Officer (formerly Global Controller of Company B)	1A1	18	3,000	Software
2	Company A	Vice President, Head of Internal Audit	1A2	23	3,000	Software
3	Company A	RPA Technical Pre-Sales Engineer	1A3	8	3,000	Software
4	Company B	Vice President of Finance, Head of Region Controllershship	2B1	20	55,000	Fortune 100, computers and office equipment
5	Company B	Senior Manager, Intelligent Automation	2B2	23	55,000	Fortune 100, computers and office equipment
6	Company B	Director, Finance Innovation (RPA)	2B3	22	55,000	Fortune 100, computers and office equipment
7	Company B	RPA Project Manager	2B4		55,000	Fortune 100, computers and office equipment
8	Company C	Director of Global Finance Learning and Development	3C1	27	62,600	Fortune 100, beverages
9	Company D	Assistant Controller	4D1	15	46,000	Media
10	Company E	Senior Manager of Finance Operational Excellence Senior Manager of Finance Robotic Process Automation	5E1 5E2	24 18	32,000	Fortune 500, medical products and equipment
11	Company F	Managing Director	6F1	19	< 100	RPA services provider
12	Company F	Managing Director Head of Business Development/RPA Academy Training Lead	6F1 6F2	19 14	< 100	RPA services provider
13	Company G	Director of Global Corporate Solutions Technology	7G1	15	17,643	Fortune 100, financial services
14	Company G	Lead Quality Manager of Global Corporate Solutions Technology	7G2		17,643	Fortune 100, financial services
15	Company G	Senior Director of Sourcing Operations Senior Manager of Business Metrics and Technology, Finance and Actuarial Senior Accounting Operations Reconciliation Analyst	7G3 7G4 7G5	18 8 14	17,643	Fortune 100, financial services
16	Company H	Director of Financial Systems – Robotic Process Automation, Corporate FP&A	8H1	17	9,600	Fortune 500, beverages

**Table 2**

Bot Key Performance Indicators (adapted from Company B documents).

<b>KPI Name</b>	<b>KPI Calculation</b>
RPA Success Rate	$\frac{\text{Total number of invoices processed (including fallouts)}}{\text{Total number of invoices loaded}}$
RPA First Pass Rate	$\frac{\text{Total number of invoices processed without any intervention (no touch)}}{\text{Total number of invoices processed}}$
RPA Accuracy	$\frac{\text{Total number of invoices processed without errors}}{\text{Total number of invoices processed}}$
RPA Turn Around Time	$\frac{\text{Total number of invoices processed with-in agreed TAT}}{\text{Total number of invoices processed}}$

**Table 3**

Accountants' skills and competencies.

<b>Identifier</b>	<b>Explainer</b>	<b>Trainer</b>	<b>Sustainer</b>	<b>Analyzer</b>
RPA literate	Strong communicator	Higher technical acumen	Develop and monitor bot metrics (KPI's)	Strategic mindset
Passion for automation	Process improvement mindset	Programmer (write and/or read Python, R, open source code)	Deep understanding of business and changing environment	Analytical mindset (ask the right questions, logical reasoning skills)
Higher technical acumen	Solution architect (ability to assess "as is" process and "to be" improved process)	Understand algorithmic scripts	Understand change management (Translate changes in environment to impact on risk and bot environment).	Provide high value added insights and analysis (more predictive)
Process architect	Translate business process to technical experts (IT, external and internal audit, etc.)	Data miner (consolidation/extraction)	Bot exception evaluation and resolution (update bot, manual interventions, etc.)	Creative thinker
Deep understanding of business	Strong understanding of control environment including security controls	Creative thinker (how to use bot technology to get the answers needed)		Effective communicator and storyteller (visual and spoken)
Create and communicate business case to support automation	Design thinker			Use data visualization tools
Logical reasoning	Collaborate with multi-discipline teams			

## Appendix A

Data analysis and sample quotes.

Panel A: *Identifier* role.

Example quote	Open code
“When we look at an opportunity we look at the feasibility of RPA - whether the opportunity is the right kind of fit in terms of structured or unstructured kind of data, how many systems are we talking about, what’s the volume we’re talking about, what is standard or non-standard in terms of process or touch points” (2B3).	Assess opportunities for RPA.
“We need people to have the skillset of going about identifying first those tasks and then executing it that they can actually perform it without having to involve an outside consultant to do that type of work, because it’s going to be expected of them [accountants] to do so” (4D1).	Identify tasks for RPA and automate without outside consultants.
“Maybe you don’t need a bot for that, maybe you can just create a little macro, or enhance the data, the source of the data, make it when it comes to you it is already done” (4D1).	Identify tools other than bots to improve the process.
“People need to upskill themselves and go beyond their ability to work in Excel or work in one database. [...] I think ten years ago when you were taking people through finance and accounting degrees we taught them Excel, right? They didn’t have to learn how to build Excel but they needed to know how to use Excel, right? I think that’s going to happen with RPA very soon” (1A2).	Understand what a bot can be used for; go beyond Excel.
“We also have programs across the finance organization that provide training to our people in robotics. They not only kind of participate in the program, but also they understand how the technology works, so they can find more opportunities for us” (2B1).	Understand how RPA works and identify automation opportunities.
“A little bit like social media where you can post your ideas [sandbox], and then somebody reviews the ideas and responds back to those ideas, and sometimes we even involve the people that are providing this idea to kind of find solution for robotics automation” (2B1).	Implement creative approaches to idea generation.
“I am constantly thinking about it on projects or I have a certain data point where thinking how I can automate it, how I can use technology to make this process better, faster and make my particular job ____43:46 that allows me to focus on the higher value pieces, like the analysis, the topline of it rather than the actual data collection and data reporting” (1A2).	Develop a process improvement mindset: how to use technology to make it better, faster, and make the person more effective.
“Then you answer that if I’m going to automate all 20% of these tests or 80% of these tests how much of capacity and able to ____31:32 how much money I am saving for the company. So you take those pieces and then you say, what’s the cost of me implementing it and it’s really teaching them to create a business case” (1A2).	Ability to create a business case and differentiate between what can be automated and what should be automated.
“You don’t have to be an IT person to do that, you need to just have logical reasoning of saying is this something that is mundane” (1A2)?	Logical reasoning skills.
“You’ve got to develop an ability to analyze processes, so if you want to automate something you need to understand the process so I think the process knowledge starts to become more and more relevant” (1A2).	Analyze and understand processes.
“You will be able to understand what you can automate but the part that as finance people we need to make sure we understand is what we should automate and that’s where an understanding of any businesses’ return of that investment make sense” (1A2).	Differentiate between what can and what should be automated.
“One thing we’re looking at to enable more is kind of like this translator role, right, so there’re guys who are in the business could be finance, could be a control issue who are our spokes if you like, right, our single point of contact for kind of evangelizing innovation and RPA and kind of the guys who will go into their team, respective teams to try and say okay look, what kind of projects can we look at or opportunities can we look at and then bring them, you know, to us for evaluation. I think that role is becoming more and more important because you need that type of person or profile where, you know, these guys understand innovation, understand what RPA can do and, you know, machine learning and all these other natural language processing and whatever, all these other kind of skills of the future if you like. And be able to kind of generate that type of understanding within their teams and kind of be able to correlate that into some kind of use cases, right” (2B3).	Translator role: Identify opportunities for innovation, bring them for evaluation; understand what RPA, ML, NLP, and other technologies can do.



<p>“We are moving from the traditional accounting, where people are just used to kind of do the manual work, or do the normal reconciliation to the point that we will have to really think about how accountants can become process architects. Instead of doing the manual work, they can be the architects that understand processes, understand the business, understand technology, and they basically ____06:45 translators in order to help people with technology or with expertise to really put a solution in place and continue automating and making better processes for the company” (2B1).</p>	<p>Accountants as translators who understand process, the business and the technology: work with IT to assist with automation.</p>
<p>“Other people could use this bot, how do we deploy this bot beyond just that one person’s request, because then you can become inefficient again, I’m building the same bought that 20 other people need, hey, why not leverage the same bot if we could? So, how do we like maybe have a small function of people within finance that can build bots that could be deployed across the organization and different places” (3C1).</p>	<p>Apply bot use cases to other processes/situations especially for global organizations.</p>

*Panel B: Explainer role.*

<b>Example quote</b>	<b>Open code</b>
<p>“They wanted to make sure that as we kind of pilot these deployments, that we know what we’re doing, and we have the right documentation in place, we have the right process in place, we have the right controls in place. That’s where coming from internal audit, I helped define from day one, right? We had standard template for documenting the ‘as is’ process. So, how does the process work currently, and then documenting the ‘to be’ process. How will that process look in the automated state, because there would be some modifications to how the process is done in the automated state” (2B2).</p>	<p>Understand and document the ‘as is’ process and the ‘to be’ process; capture the ‘as is’ process in key level detail.</p>
<p>“Once that is completed in terms of the ‘as is,’ then the solution architect will come and review and then will go into the ‘to be’ process, and then what are we looking at in terms of a future, the automated solution, what steps can we cut out, what can we standardize, what are the inputs and the outputs of prerequisites around all that to kind of document that whole process and map it out” (2B3).</p>	<p>Capture the ‘to be’ process—what steps can be cut out, what can be standardized, map out the process (design a flowchart).</p>
<p>“This is a typical ____01:01 that you have in companies you started with more centralized services activity, so you move the processes from the countries in the current state, and then reengineer the process in the hubs, and try to make it more effective, and then you try to standardize and then you can centralize a bit more, and then you apply more technology to make it more efficient. We have been going through that journey, I mean Company B is really advanced in terms of shared services, most of the transaction processing activities are managed out of their hubs in India, Poland, and Guadalajara” (2B1).</p>	<p>Reengineer a process and communicate with other countries.</p>
<p>“It did require some change management with the distributor because the way they were sending the invoices in was not standard” (2B2).  “A lot of times with the automation comes a bit of process change, because the robot is not like the human user who can interpret and kind of troubleshoot and figure out what invoice is this, the robot needs to know exactly how to handle the invoice and the PDF and where to find information, so that had to be standardized” (2B2).</p>	<p>Understand processes and manage change with stakeholders in order to standardize processes.</p>
<p>“The process owner if it was the accountant would be involved in documenting to ensure that the process was well understood. Then you would have the developer which was kind of like the way I talked about the IT specialist who was trained in UiPath coding, who could come in and do the backend of the coding. So, could essentially take the process, interpret it and then do the appropriate coding step, so bifurcate it. There were cases where they were one and the same and that was the matter of training the existing team to do that. The lady who did the fair value calculation, for example, she actually became trained in UiPath Academy and actually helped to build part of the bot that helped her pull the data for her model. So, is it possible to do that? Absolutely. [...] But, you know, the vision here is very much to simplify this end-to-end, so that it will be -- you imagine it’s going to be -- at some point in the future, it will be like Excel where anybody can basically fill it out” (1A1).</p>	<p>Document the process and code the bot (even though initially duties are bifurcated between subject matter expert and IT person.)</p>
<p>“In those early deployments, we didn’t have any PII. We had -- we did look at, you know, do any of these processes that we’re automating, have any bot control? If they did, they would ask for our compliance team [internal audit] to come in and evaluate the design of the robot, once we’ve gotten to that stage where we have documented the design of the robot, and we’re ready to build the robot, so that they could</p>	<p>Work with compliance teams to check for modification in the control environment due to</p>

come in and do an independent evaluation to say, “Yes, it looks good, you haven’t modified the control environment in any way.” So, we thought about those types of checks” (2B2).	automation.
“We are doing outside the control security testing is going to happen through bots. Pretty much all of IT testing before the end of the year will be done by bot and we have one person sitting in [another country] who’s going to do any analysis or any interpretation of what the bot looks at. The plan is to boost the financial and operational controls” (1A2).	Understand internal controls testing performed by a bot.

*Panel C: Trainer role.*

<b>Example quote</b>	<b>Open code</b>
“Center of excellence that would be like the hub of the technology. In that hub you would need a combination of different skills. Those skills would be somebody who obviously is an RPA developer, plus you would need a solution architect, plus, you would need a bot controller, somebody that actually monitors the bots 24/7, is following all of the rhythm and the ups and downs of bot management” (1A1).	Some RPA-related roles are developer, solution architect, and bot controller.
“But I found with [RPA software] I could actually train my accountants on how to code bots” (1A1).	Ability to code the bots.
“Now, after having been in it, for three years, I can see a robotic process automation has really been kind of your base level to just enable further data analytics. That would be one type of role, someone that can just code those automations, because the majority of the automations we are doing were extraction, data cleansing, and data reporting. I mean, preparing the data to then be used by an analyst to, you know, analyze” (2B2).	Code automations focused on data extraction, cleansing, and reporting; supply data for further analysis.
“We’ve been going around and educating and doing training for our finance team; we’ve been doing a lot of change management. So, educating our accountants that here’s an opportunity for you to automate your work. The work that you do to just prepare the data for you to then do your work, and then the second piece being, okay, now let’s educate and elevate the level of our accountants and finance individuals with some of these additional analytical tools that we have. For example, we have different coding languages that the data scientists are actually sharing with the finance community, so that they can start learning new coding techniques. There’s R, there’s Python, these are all open source technologies that we’re educating our finance individuals. Again, those that are really kind of are inclined to do it, to get better educated on how they can use these new capabilities to then further their work” (2B2).	Develop change management skills and use coding techniques in R and Python to further accounting work.
“Optimization is also another area where how do we get more optimized with the robots and the queuing of the robots and how we can manage that kind of throughput and utilization is going to be important as well” (2B3).	Manage bot optimization, queue and manage bot throughput.
“I could see where finance professionals would want to have built their own bot or leverage bots that other people have built, so that they can get to this higher level value added work that can help us with growing the business and moving the business forward” (3C1).	Build your own bots, engage in value-added work to support the business.
“From a development standpoint, then we also decided at the very beginning to have IT as our copartner in the development work. Even though we had developers within our team, we gave IT equal kind of stage in the development cycle, so that they actually owned the IT sign off of the development work before it was moved to production. They did their series of checks to evaluate the quality of the code that was built, and that it followed the right set of standards in developing. That there were certain documents in place, and checks, and peer reviews prior to the code being moved to production” (2B2).	Depending on the company—as a process owner you may now need to work with developers.
“It’s not much about programming or creating the script, one of the mega trends that we are looking at is that in the future also, it’s not about the people are going to be doing a lot of programming, this is another thing that it’s going to change, not many people talk about that, but we see that as a mega trend. They are going to be templates that are going to be created that you can reuse in multiple situations. So, instead of having to recreate the ____ 22:27 every time that you have an automation to do, you are going to have a library and in fact we do have a library of templates or a script that you can reuse in multiple situations” (2B1).	Understanding the library of code templates, where to look, and how to use it.
“Another one is Excel. A lot of people when I ask: “Are you doing Excel?” “Yes.” But now it has come to the point that it’s been good in itself, it’s not just knowing pivot tables, like the ____ 24:51 to do pivot tables or VLOOKUP. I’m talking about doing macros. [...] I will say VBA, the	Excel macro writing skills and VBA are essential.

language what is based on the macros in Excel, right now that's kind of like essential. I have not yet been in a company that they didn't need a macro in Excel and I have done wonders. I have taken hundreds of hours a week of work by implementing macros in Excel and a simple example will be manual journal entries. I put a macro in the manual journal entry submission before it gets uploaded into the system" (4D1).	
"There are a few handful of tech-savvy accountants that you will find in every organization, we picked them up, we took them to the training, we trained them, we're working with them side by side while my developers are working, even those accountants are working and making sure how the development happens. Other than getting deep into creating a virtual machine or creating a virtual data image or any of those pure technical work we're letting them work with now automating a step, creating goal of reusable steps, telling them to create a library of events or automated events so that they can be pulled in. For example, logging into an application; rather than writing a piece of code each time, we're creating that as a small event and then that event can be dragged into any of the workflow that we create, which requires logging into an application" (7G1).	Create a library of reusable events.
"Number one is the learning curve. Most of them [accountants], they have excellent Excel background. They are good at creating charts, macros and all that but when it comes to the toolset [RPA software], I believe it's important that we know some minimal programming, _____60:28. That's where I see their shortcomings. So, exception handling, they don't know how to put the code for special cases in our inner conditions (7G2)."	Programming skills necessary to handle exceptions.
"You do have to have some good understanding of at least the logic that goes into programming. You might not need to know how to program but you should be able to think that way logically. The second challenge is for any reason whatsoever these bots can fail, so you have to think about ways or things that will then affect bot that a person could normally deal with." (7G5).	Need to understand at least the logic of programming to build resiliency and error handling into the bot.
"In hindsight I think you can't be successful in this role unless you have a really strong technical aptitude. You can learn the process stuff but it's harder to come up the curve on technology, so someone who is just really strong with tools and technology is kind of a pre-requisite" (5E1).	Strong technical aptitude is required.
"What we found here is that in some cases there wasn't any documentation existing by the process owner themselves, they were just doing the work. When somebody did leave, it was basically a word of mouth or training or knowledge transfer, but when we actually automated it with a bot, we now actually have documentation as to how the process works. That was an additional benefit of just having those documentation standards in place for these mega processes in finance" (2B2).	Ability to create process documentation according to documentation standards.

*Panel D: Sustainer role.*

<b>Example quote</b>	<b>Open code</b>
"We do a lot of presentations regarding the future of work. In the future, and I'm talking about not even five years from now, they even are going to rename the titles that we have. Instead of just having a controller, it's going to be bot controller and bot accounting manager, because now you're going to be knowledgeable in all the accounting guidance and how different accounts should behave [...] but you also need to know computer programming like basic understanding of when a bot doesn't work or it's not giving you what you need to be able to articulate your issues with this third party provider, or to a point that you can basically own the bot and go into the coding and edit and change as needed. That's going to be expected from some accountants and some people don't see it that way because they're like, "Oh, I went to school for accounting not for computer programming. Why do I have to look at this coding?" [...] And the reason is, it's because that's the way we are heading to" (4D1).	As bot controllers and bot accounting managers, accountants will be expected to explain to an IT person what issues the bot is having, ultimately learning how to make changes to the code themselves.
"For my interns, I requested a person to have Google script, which is based on JavaScript coding like advanced coding, otherwise I didn't need an intern because I don't need an intern to come in and do accounting work because that's something that we can easily do. But I needed someone to automate and I know it's not bot-related, but I'm just talking about the skillset that a person needs to have is some level of coding because that will also go hand in hand with understanding when you are requesting a bot to do something" (4D1).	Ability to code is essential as skills are transferrable to any automation effort.

<p>“Software like UiPath and if there is some other ancillary covering that needs to be done whether it’s some other type of, language like R or Python or PowerShell” (2B3).</p>	<p>Work with RPA providers; acquire additional coding skills in R, Python, or PowerShell.</p>
<p>“They have a team, they have the robot performing that reconciliation, and if anything were to change in that process, they would need to understand that in order to have that robot updated” (2B2).  “I need to manage that change with the robotics team who built the bot” (2B2).</p>	<p>Understand when a bot needs to be updated and communicate with those who build bots.</p>
<p>“Think of a procure-to-pay space, or the quote-to-cash space. We have activities there that have been automated, and yet, we still have those accountants who own that power, that process power from a finance perspective, and now, they are responsible for managing that robot in their space. So, they have a team, they have the robot performing that reconciliation, and if anything were to change in that process, they would need to understand that in order to have that robot updated” (2B2).</p>	<p>Accountants are process owners and bot managers. Need to know how to update bots to reflect process changes.</p>
<p>“We have been even going beyond just having expertise in a central team, but also training some people outside the robotics team to really manage more robotics. [...] They basically review what those [the bots] are doing” (2B1).</p>	<p>To engage in bot management – review what the bots are doing.</p>
<p>“The only thing to learn about managing a bot is that it doesn’t have intelligence, so it’s not going to react to changes in the environment, whether it’s a system change, or a regulatory change, or a distributor change. For example, that Brazil tax bot that I mentioned, we noticed that the volumes that the bot was transacting suddenly started to drop, and when we went back to the process owner to understand why the bot used to process so many returns a month, and now it was just processing a fraction, well, they told us, ‘Well, actually, we switched distributors. We went from DHL to some other one.’ Well, the bot wasn’t picking up the new distributor” (2B2).</p>	<p>Bot management requires broader knowledge of the business and how the process works.</p>
<p>“At [Company B], we’re going through a significant transformation in our ERP, we’re moving to S/4 HANA. We were going off of legacy SAP systems to one platform S/4HANA. As a process owner, you need to think about, well, I have a bot running on a legacy SAP system and I need to get that bot moved on to the new platform. It’s just taking ownership for your area and the risk might arrive with that changing environment. And for a tax regulation, there may be a change in a tax code, or a tax benefit, or the tax rate, you need to go back and reprogram the bot to now calculate instead of 8.25%, you know, 8%, because the tax rate has changed” (2B2).</p>	<p>Ability to understand when the environment has changed and consider risks that arise from changes in environment.</p>
<p>“Well, then it got escalated, because, well, the bot is not working. The bot is not working because actually the underlying application that it is running off of has been down for eight hours, and it’s not backed up yet. So, it’s always dependent upon the system that it’s touching. So, that was why the initial decision to have it centralized and centrally managed as to the number of bots, what are the bots touching, what systems they’re touching, what processes is running, having it well documented, because for that that knowledge is a lot” (2B2).</p>	<p>Understand what is changing both on internal systems and processes and external systems and create detailed process documentation.</p>
<p>“The actual process owner was the one that escalated that because they noticed nothing was being processed in that eight hours” (2B2).</p>	<p>Know when you are not getting what you expect from the bot; escalate issues if needed.</p>
<p>“How is the bot running, what is it doing? That needs to be documented, so that we know how to change it [...] But I think from a process owner standpoint, yeah, if you would have to manage that change tax rate from 8.25 to 8, but you can’t forget how does your process work, because the body is built on that process. A lot of people kind of washed their hands and said, ‘Okay, my bot is doing that three-way match, now I don’t have to do that three-way match anymore’. Well, you still need to be, you know, accountable for that process” (2B2).</p>	<p>Business continuity planning— what if bot doesn’t work, how will we handle the process manually—so still need to understand the process.</p>
<p>“To the ____33:19 question around business continuity planning, we started doing that I would say in the second to third year of this program, was thinking about when the bot goes down after a period of time, that’s unacceptable to the process owner, how you implement manual processes again because a lot of this work potentially has been taken away from individuals, and they may have laid off those individuals. In some cases, they moved on to other roles, but in some cases probably we don’t have the team that we used to have to manage the process manually. So, from a business continuity planning standpoint, we spent a lot of time on that over the last year, putting those plans</p>	<p>Business continuity planning— what if bot doesn’t work, how will we handle the process manually—so still need to understand the process.</p>

in place, talking about training to ensure that if something were to go wrong, we would have people that were educated on the process and can perform it manually” (2B2).	
“That’s why part of the robots you’ve got to have a BCP plan, business continuity plan, the idea of that is that if your robots go down then you’ve got a plan, a plan B continuously where you revert to manual” (2B3).	Business continuity back-up plan if bot doesn't work.
“We have people that not necessarily are in the robotics team. They are kind of bots managers - they basically review what those are doing. We have centrally controlled towers, because one of the things about robotics that is interesting, and they also involve accountants and auditors, is really how you control the bots in terms of governance” (2B3).	Control bots in terms of governance and engage in bot monitoring.
“You cannot just put a bot and expect that that process or a script is going to be working perfectly all the time, because the variables around those processes are going to change, somebody needs to monitor. What we have is people involved in process that are kind of also providing input to people that are more expert in the program, script in order to kind of evolve or change the bots as the variables or the environment where those bots are working are changing” (2B1).	Monitor bots for changes in environment, handle exceptions, and provide input to IT experts.
“We should really have the bot controller give us that type of information so we can be proactive with any changes that need to be done. [...] they know about a new policy coming in and, you know, that may change the process flow, right from a systems standpoint, let’s say a tax rate changes that’s going to have a knock-on effect on the bot” (2B3).	Bot controller—proactively identify future changes.
“An accountant can become, we call it process controller and typically that’s the person who is checking the robot outcomes, managing the other robots, looking for exceptions, managing the exceptions” (6F1).	Accountant as process controller – managing bot exceptions.
“Next time it is not exception but it’s normally processed. This can be actually also the role of accountant that really like make sure that robot is getting more capable and can process more transactions and eliminate the robot of exceptions going forward. Typically we have this process controller role, this could be like full-time employee; if you have for instance about 20, 30 processes” (6F1).	Enable a bot to become more capable.

*Panel E: Analyzer role.*

<b>Example quote</b>	<b>Open code</b>
“People will need to have more business acumens, people will need to have the ability to analyze data more.” (1A3)	Increased business acumen and ability to analyze data.
“I was revising the whole workforce of my organization in light of this whole digital kind of development that was going on, and redefining jobs. Basically, you know, removing traditional analysts and replacing those jobs with things like data wizards, etc. because, you know, the traditional analysts job was pretty much in some cases even though they might have been in accounting background they were much more of a processor, you know, data entry as opposed to actually doing real value added analysis.” (1A1)	Value added analysis.
“Start to think creatively and differently about how you kind of get to the answers that you need to get to whether you're doing audit internal, external.” (1A1)	Creative thinking to determine most effective way to use bots.
“I try to move people into, you know, into tools that enable more predictive and real-time insight that you can actually govern.” (1A1)	Use tools to develop more predictive real time insight.
“You need to be able to do something with the output of algorithms and bots, and so I think that's where, you know it will impact competencies, because you won't have so much reliance on those traditional competencies where you relied on somebody for accuracy [...] you're looking then for somebody that can actually do creative thinking with the output. You're going to need more strategic, more creative. You're going to need people who can express their ideas, can communicate very effectively. [...] it kind of pivots the dial and puts a lot more emphasis on, digital fluency all the way through to high value added insight that comes with having, an analytical and strategic mindset” (1A1).	High value added insight from having an analytical, strategic mindset including the ability to communicate effectively.
“Data management is going to be one of the keys of the finance of the future” (2B1).	Data management
“We try to build that in so that even though they’re hardcore accountants, [...] today you guys are pulling reports and, you’re doing pivot and	Download from the source and

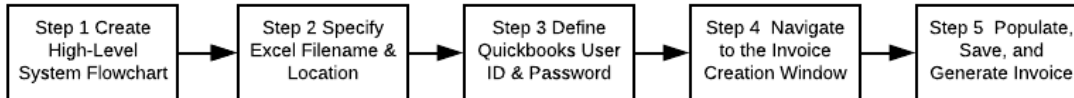
<p>all these kind of stuff in Excel and everything. And we want you to just go to the source and the source would be our enterprise data warehouse or business warehouse and essentially use the data visualization tools like Tableau and Power BI to manual report directly off the source and not having these local versions on your machine and not having to slice and dice locally and really have those skills and those types of software” (2B3).</p>	<p>use data visualization tools like Tableau and Power BI.</p>
<p>“The goal is to transform finance itself from -- I mean, majority of what we do is historical reporting, right? Every quarter, we close the book, we report out how did we close that quarter. Now, the focus is more on the predictive and prescriptive analytics.” (2B2)</p>	<p>Transform accounting function from historical reporting to more predictive analysis.</p>
<p>“you need to be focused on analyzing and pulling insights [...] and being able to communicate effectively, that which this information is telling you, so that when you’re talking to your client or the leaders, you can effectively tell that story, paint the picture, and help them see the future,[...] so the predictive analysis piece would come out of that.” (3C1)</p>	<p>Ability to provide insights and provide predicative analysis.</p>
<p>“We have another data challenge going on within finance amongst our finance associates right now that the CFO is sponsoring and it’s a data challenge where we’re again trying to get people within finance here to automate or to make a process more efficient than it is today, and they are able to leverage different tools like Alteryx and Power BI [...], and then he will decide on what the top three are, and those top three people will get to work in his office on a project.” (3C1).</p>	<p>Use Alteryx and Power BI.</p>
<p>“We’re trying to build up our digital curriculum and created a curriculum with specific learning parts around digital savviness and advanced analytics, then there is continuous improvement and design thinking and innovation” (2B3).</p>	<p>Need skills in advanced analytics, continuous improvement, design thinking, and innovation.</p>
<p>“I can see the world where there is no Excel in the future with these tools. Obviously learning how to program RPA, but then moreover, getting into, I kind of call it the algorithmic world of scripts so knowing Python, knowing R, understanding some of the BI tools as well, very important. I kind of look to it as that sort of skills the areas that I would steer my organization to invest in versus I kind of had an Excel as dead policy -- don't tell Microsoft that -- but I was trying to push my team away from Excel because it's static. It doesn't provide updates, it doesn't provide real-time insight. It is a wonderful way to pull a bunch of data together, but it's all offline. It's not in the system of record. I try to move people into tools that enable more predictive and real-time insight that you can actually govern” (1A1).</p>	<p>Program in RPA, understand the algorithmic world of scripts such as Python, R, and BI tools. Less reliance on Excel in the future. Ability to use tools to develop more predictive real time insight.</p>
<p>“I think from like a high level standpoint, the goal is to transform finance itself from -- I mean, majority of what we do is historical reporting, right? Every quarter, we close the book, we report out how did we close that quarter. Now, the focus is more on the predictive and prescriptive analytics. So, now instead of doing analysis of how we performed, it’s more analysis about, well, how can we perform in the future if we change certain variables. So, that’s the focus within HP is to change the finance individuals from historical reporters to more of that future looking analysis. And that’s where I think we’ve been driving education and training on how to move that finance function to that more of a mature state of doing more future analysis. I mean, I think that’s one of the complaints as well if you talk to like a typical FP&amp;A person -- financial planning and analysis person -- within HP is, “I spend so much time getting data, putting it together, and then reporting it out, but I don’t have enough time to analyze the data. What does it mean, what -- and making sense of it and making more value added insights back to the business about, you know, influencers to that data” (2B2).</p>	<p>Transform the work from historical reporting to more predictive and prescriptive analysis - future looking analysis.</p>
<p>“Initially people thought of RPA is something that was going to take away their job, that we wouldn’t need accountants anymore, but really basically it’s the way accountants are doing their work is changing. If you think about -- if you think back to like a traditional accountant 30 years ago, where they had a ledger, and they were doing debits and credits in your ledger and storing it. Well, we have since adopted, you know, global ERP systems that have been, you know, automated, or put in place an alternative to those old ledgers. So, really, RPA is also just kind of transforming the way an accountant does their work, and what we’ve seen is, it’s just bringing more benefit to what we do, in the sense of, there’s a lot of very mindless activity related to doing an accounting work, right? There’re lots of reconciliation activities, there’s a lot of data extraction, we need to get data. In any big corporation, you’re going to find that data is very difficult to obtain, and then when you do obtain it, you need to cleanse it. You need to, you know, reconcile it from one system to another to make sure that the data is the same.</p>	<p>Change in mindset: not taking away the job—but changing the work the accountant is doing.</p>

<p>So, that cleansing process, that extraction process, and then even that reconciliation process, is something what typical accountants were doing as part of their day-to-day work. Now, what we're seeing is that we can implement robots to do that work for us, and then really that added value or high level activity that an accountant should be doing is less for them to do. But all that preparation is something that we can automate" (2B2).</p>	
<p>"From real experience we can say is that what we have found is, it was fingers and toes the people's work that we are automating so at the most 20% of their time, and then we would just repurpose those individuals for other work to find that efficiency. So, for those folks that were primarily doing that type of work can be reassigned and developed in their career. And that's one of the initiatives that we have done at [Company B], is communicate and reeducate those folks that, again, we're not going to take away your job, but we're going to actually give you new opportunities to enjoy your work" (2B2).</p>	<p>Certain tasks of an accountant's job are being automated. Opportunities for career development are created.</p>
<p>"I think it's important also that the profession understands that this is going to continue evolving, and it's going to be moving more in a direction where accountants are going to be really process experts, rather than just doers of the processes" (2B1).</p>	<p>An accountant as process expert rather than doer of the process.</p>

## Appendix B

### RPA implementation example with UiPath.

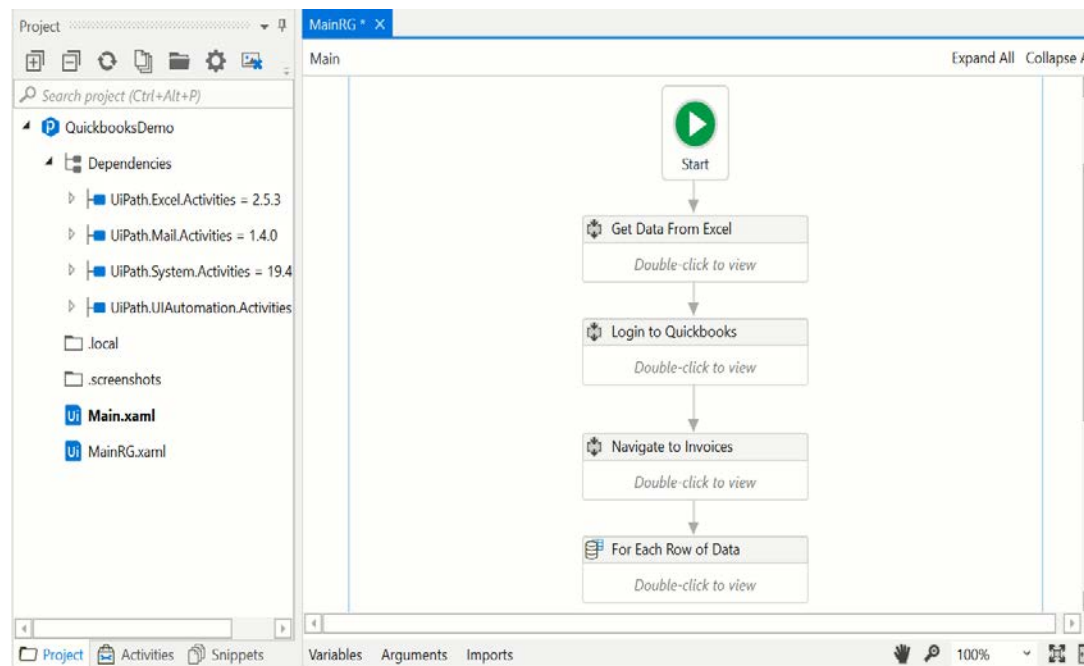
The use case in our sample implementation is a business consulting firm. Each week, the firm's consultants log their hours and client information into an Excel worksheet. At month-end, the company's accountant downloads this data from Excel, logs into the firm's QuickBooks Online Accounting System, and generates client invoices. Because the consulting firm would rather its accountant concentrate on analytical work, a bot was constructed to perform the routine invoice creation task. To code the bot, the RPA developer logged into the RPA software and performed the following five steps:



Step 5 is the most involved as the developer defines the detailed steps a human takes when interfacing with the QuickBooks invoice creation window. We present each of the five steps along with the UiPath flowcharts and process code below.

#### **Step 1—Create System Overview Flowchart**

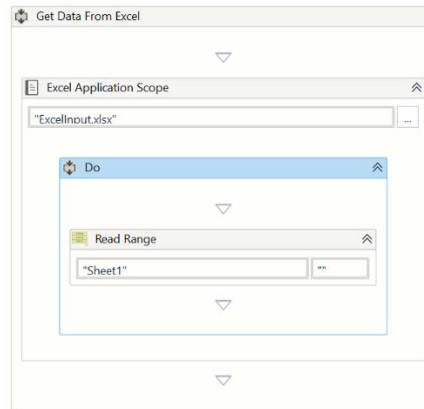
In the high-level system overview flowchart shown below, you see the four main activities the bot will perform. These include retrieving data from Excel, logging into QuickBooks, navigating to the invoice creation window, and then for each row of data in the Excel worksheet, populating the invoice window and generating a client invoice.





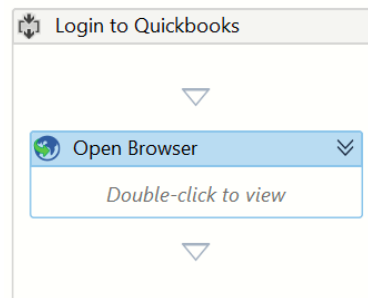
### Step 2: Specify Excel Filename and Location

Once the high-level flowchart is created, the developer double-clicks on each process and enters the associated code. In the *Get Data From Excel* process, the developer clicks on the ellipsis under the Excel Application Scope and specifies the Excel file name and its location. Under Do and then Read Range, the developer specifies the name of workbook sheet.



### Step 3: Define QuickBooks Login

From the main flowchart the developer click on the *Login to QuickBooks* process and documents the bot's pre-defined QuickBooks login credentials. This process shows the Open Browser activity since the consulting firm is running QuickBooks in the cloud.



After double-clicking on the Open Browser process above, the developer creates the lower level flowchart shown below. The developer single-clicks on Get Password, and enters the digital worker's password in the right side of the screen.

Main > Quickbook Invoices > Login to Quickbooks

Expand All Collapse All

UiPath.Core.Activities.GetPassword

The screenshot displays a UiPath Studio interface. On the left, a 'Login Sequence' workflow is visible, containing the following steps: 'Get Password', 'Maximize Window', 'Type Into 'User ID'', 'Type Into 'Password'', and 'Click 'Sign In''. Each 'Type Into' step includes a placeholder for an image and a text input field. The 'Type Into 'User ID'' step has 'username' entered in the input field. The 'Type Into 'Password'' step has 'password' entered. On the right, the properties panel for the 'UiPath.Core.Activities.GetPassword' activity is shown. It includes a 'Common' section with 'Display Name' set to 'Get Password' and a 'Misc' section with 'Password' set to '\*\*\*\*\*', 'Private' set to an unchecked checkbox, and 'Result' set to 'password'.

Common	
Display Name	Get Password
Misc	
Password	*****
Private	<input type="checkbox"/>
Result	password

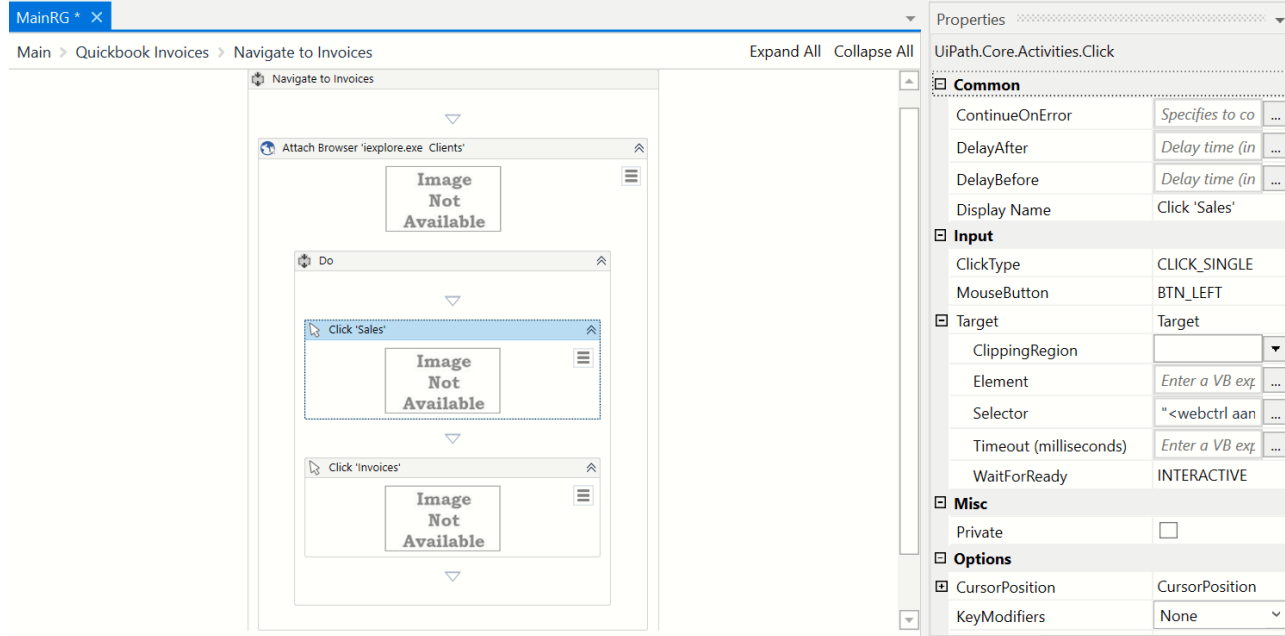
Next, the developer clicks on Variables at the bottom of the screen below and enter the bot's QuickBooks User ID or username. (Prior to this step, the developer had defined a system variable named username.) In the picture below, the bot's User ID, rgilleran, is entered on the right side of the screen.

Name	Variable type	Scope	Default
password	String	Login Sequence	<i>Enter a VB expression</i>
username	String	Login Sequence	"rgilleran"
ExcelDT	DataTable	Quickbook Invoic	<i>Enter a VB expression</i>
CustomerName	GenericValue	Quickbook Invoic	"Test1"
HoursWorked	GenericValue	Quickbook Invoic	"2"
ServicesDescription	GenericValue	Quickbook Invoic	"testing"
<i>Create Variable</i>			

Variables Arguments Imports 65%

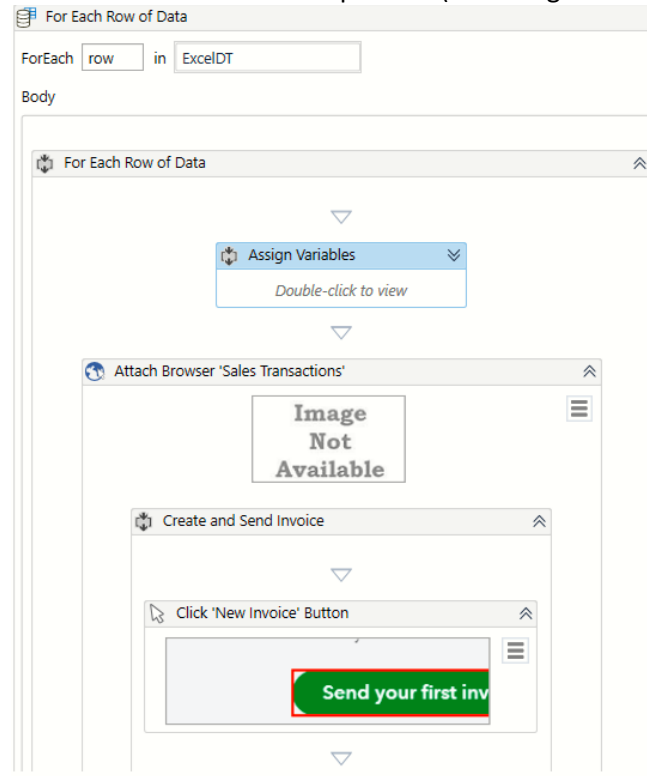
#### Step 4: Navigate to Invoice Creation Window

The developer clicks on the *Navigate to Invoices* process in the main flowchart and specifies how to navigate to the QuickBooks invoice creation window. The steps in this process consist of clicking on the Sales Menu and then the Invoices item. When you drill into these two processes, as you see in the properties window on the right-hand side of the Click 'Sales' screen below, the developer sets the Input to single-click with the left mouse button, just as a human would do.



### Step 5: Populate and Generate Invoices

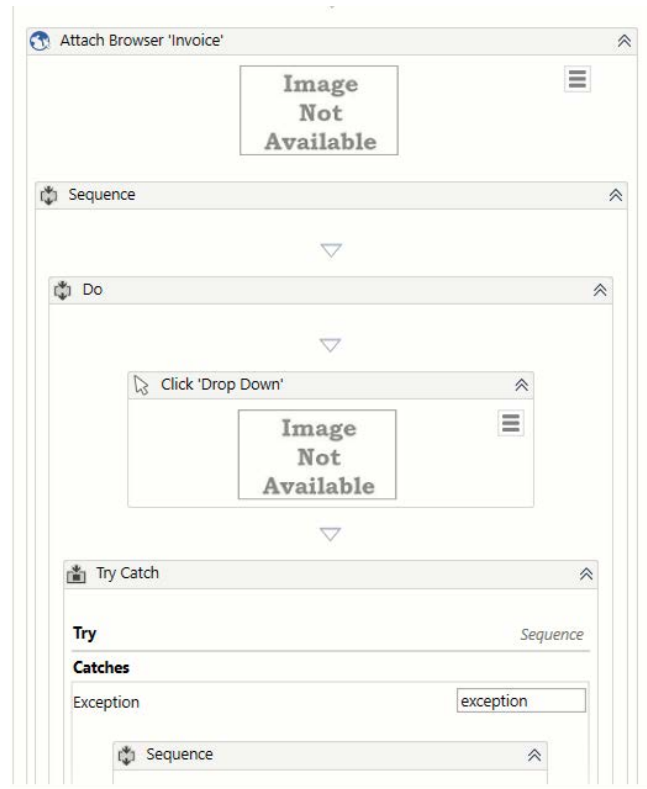
The developer clicks on the *For Each Row of Data* process in the main flowchart and defines the steps a human performs when populating the invoice creation window within QuickBooks. In Step 5a, the Send Your First New Invoice button is pressed (assuming this is the first invoice being created in QuickBooks).



#### Step 5a – Send an Invoice

In Step 5b, the Drop Down listbox is clicked and the customer name, from the first row in the Excel workbook, is selected from the list of valid values.

NOTE: For the customer name to appear in the dropdown listbox, a customer record must have been created within QuickBooks.

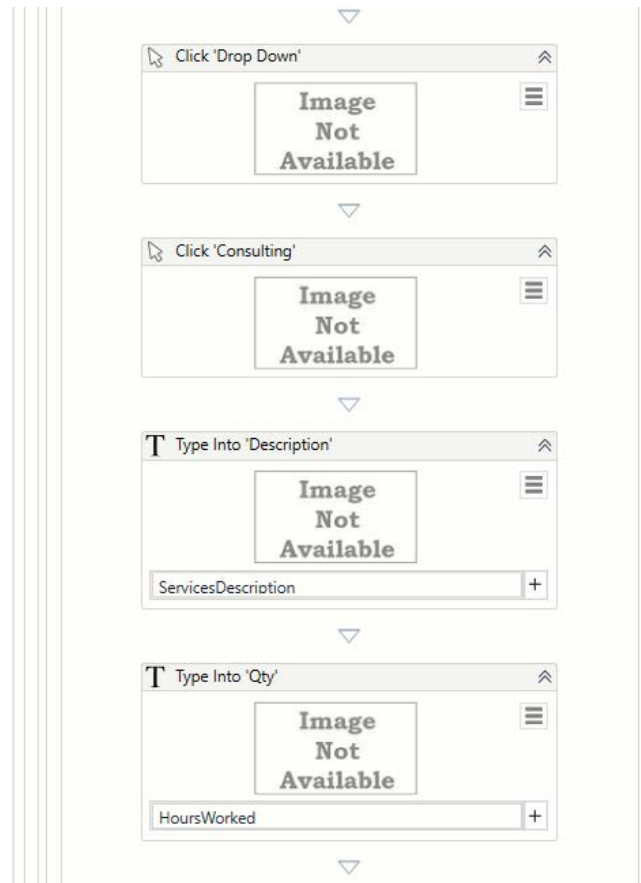


### Step 5b – Select a Customer

In Step 5c, using the data from the first row in the Excel worksheet, the (customer) Name, Customer Email, Product/Service, Description, and Qty (quantity) fields are populated.

NOTE: Customer and product/service records must have been previously created in QuickBooks for the values entered into the customer name and product/service fields respectively.





### Step 5c – Populate the Invoice Window

In Step 5d, since the accountant typically accepts the system defaults, the bot moves to the Save and Send field and creates the first invoice. The bot then loops through the code, creating invoices for the remaining clients, until the program reaches the last row in the Excel worksheet.





**Step 5d – Save and Send an Invoice**