Knowledge Workers' Reactions to a Planned Introduction of Robotic Process Automation—Empirical Evidence from an Accounting Firm

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Abstract In this paper, we investigate the initial reactions and perceptions of knowledge workers to a planned implementation of robotic process automation (RPA). Using purposive sampling, we conduct a case study in an industry in which workers' jobs are notoriously vulnerable to automation: we study an accounting firm that is planning to introduce RPA into their core accounting processes. While our informants did raise the expected concerns about job security and loss of control over work, the initial reactions to the technology were surprisingly positive. The informants even expressed enthusiasm and genuine curiosity towards the capabilities of RPA. Overall, our results challenge the views outlined in previous academic literature and popular press concerning the fears and anxieties associated with the introduction of automation technologies in information-intensive knowledge work. To conclude, we theorize on the emerging positively dispersed uncertainty concerning the nature of RPA and the relativistic nature of worker reactions that potentially impact workplace atmosphere.

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1 Introduction

Automation of knowledge-intensive work through cognitive automation (CA)[1] and robotic process automation (RPA)[2] has entered the mainstream discussion in industry and academia. In recent years, scholars, industry experts and journalists have put forward predictions concerning the implications of the introduction of such automation tools, ranging from cautiously optimistic accounts (Brynjolfsson and McAfee 2014) to warnings of a dystopian future (Carr 2015; Ford 2015). A widely cited paper released by two Oxford University scholars (Frey and Osborne 2017) claimed that nearly half of the jobs in the US are at risk of being automated. Frey and Osbourne estimate that jobs of accountants and auditors, for example, are particularly susceptible to automation (0.94 probability). Moreover, it has been argued that unlike the manufacturing automation that took place in the late 20th century and was centered on low-skill factory jobs, the new wave of automation is impacting jobs that require advanced cognitive capabilities, thus threatening even high-skill occupations (Akst 2013; Frey and Osborne 2017). For example, tools such as IBM's Watson aim to replace lawyers in various tasks related to pattern recognition and decision making (Fung 2014; Sills 2016). Some authors argue that this development has the potential to unleash an unprecedented rate of human labor automation, turning Keynes' prediction of mass technological unemployment (Keynes 1933) into reality (Autor 2015; Frey and Osborne 2017). Perhaps as a result of these gloomy projections, a recent longitudinal census conducted among European citizens reported a sharp deterioration in attitudes towards robots especially in the area of robots assisting humans at work (Gnambs and Appel 2019).

Notwithstanding the active ongoing discussion around the issue of knowledge-intensive work automation (Salovaara et al. 2019), we note a lack of empirical studies examining how the introduction of tools such as RPA impacts knowledge-intensive organizations and their workers, particularly how knowledge workers respond to the automation of some aspects of their work. It is safe to assume that the active discussion of job losses and technological unemployment in scientific publications (Frey and Osborne 2017), popular business literature (Ford 2015), and media (Cain Miller 2016; The Economist 2016) has had an impact on the reactions of knowledge workers to automation in occupations threatened by it. These reactions present an especially interesting research area in settings where automation plans have recently been announced. Based on the above, in this study, we seek to answer the following

[1]Cognitive automation leverages different algorithms and technology approaches to analyze unstructured data such as natural language processing, text analytics, data mining, semantic technology and machine learning (Lacity et al. 2018).

[2]While the word *robot* may bring to mind an image of a physical machine, RPA refers to software that automates service tasks previously performed by humans (Asatiani and Penttinen 2016; Lacity and Willcocks 2016). Software *robots* emulate human execution of tasks (Hallikainen et al. 2018). Instead of interacting with other software through application program interfaces, the software is rules based and interacts with the graphical user interface: typing login credentials to specified fields, moving and clicking a mouse, copying and pasting text from one window to another (Penttinen et al. 2018a).

research question: *How do knowledge workers react to a planned implementation of software robots?*

While earlier studies on the implementation of robots in the manufacturing setting (Argote et al. 1983; Chao and Kozlowski 1986; Herold et al. 1995) inform us on the perceptions, reactions and experiences of manual workers, we argue that this topic warrants a fresh investigation in light of the following points. First, the impact of manufacturing automation is assumed to be limited to unskilled, manual labor (Argote et al. 1983; Chao and Kozlowski 1986). What is novel about the emerging technologies drawing on CA and RPA is that skilled knowledge workers are becoming widely exposed to the rapid threat of automation. Second, contemporary knowledge workers possess more information on robots and work automation than their peers did during earlier industrial revolutions. Hence, the public image of robots is not limited to the *mechanical man* from science fiction (Chao and Kozlowski 1986). Third, knowledge workers have been exposed to the rapid decline in manufacturing jobs in industrialized nations, which is largely attributed to automation (Atkinson 2012). Based on these factors, we argue that knowledge workers' reactions to the introduction of automation tools differs from the reactions of workers within mechanical manufacturing.

Pre-implementation reactions are often overlooked because they are based on workers' preconceptions rather than resulting from first-hand experiences with the technology. However, it has been shown that pre-implementation reactions provide useful insights into post-implementation attitudes and future acceptance of automation (Argote et al. 1983; Blaker et al. 2013; Herold et al. 1995; Vaughan and MacVicar 2004). Therefore, in this study, we seek to establish a foundation for the discussion of the interactions between automation and knowledge workers by studying workers' reactions to the planned introduction of automation tools. We approach the problem by studying an accounting firm at the pre-implementation stage of RPA.

We proceed as follows. After this introduction in Sect. 2, we draw on earlier studies to conceptualize and inform workers' pre-implementation reactions associated with the introduction of automation tools. In Sect. 3, we describe our case company, explain the methodological choices we made, and present our data analysis techniques. In Sect. 4, we present the positive and negative worker reactions with illustrative quotes from the interviews. In the remaining sections, we discuss our findings and provide avenues for further research.

2 Conceptualizing and Informing Pre-implementation Reactions to Automation

Understandably, most scientific enquiry into humans' reactions to automation and robots has been focusing on ex-post implementation attitude, acceptance and assimilation. This focus is probably due to researchers' access and availability of data collection opportunities which are typically plenty in the implementation phase but

somewhat scarce in the pre-implementation. Pre-implementation reactions and subsequent attitudes are necessarily limited to workers' preconceptions of the technology in question. Earlier research on both manufacturing and office automation suggests that this stage is often characterized by mix of unfounded optimism (Argote et al. 1983; Chao and Kozlowski 1986; Faunce et al. 1962) and pessimism (Herold et al. 1995; Hoos 1960). Moreover, pre-implementation attitudes are prone to change as workers interact with the technology (Chao and Kozlowski 1986; Herold et al. 1995; Jacobson et al. 1959). Given these characteristics, pre-implementation reactions may appear to provide little value. However, earlier research indicates that pre-implementation reactions might serve as early warning signs (Abdinnour-Helm et al. 2003), impact the success of the implementation, and inform management about accommodations required for reducing friction with workers (Herold et al. 1995).

Pre-implementation reactions are not as straightforward as they may appear at first glance. In practice, workers rarely exhibit either radical Luddite or automation-enthusiast tendencies. Instead, a mix of positive and negative reactions reflect workers' positions within an organization and organizational context. Faunce et al. (1962) studying early office automation suggested that the reactions are not uniform across organizations and vary depending on individual's involvement with automation. The existing literature provides a wide variety of possible positive and negative reactions at the pre-implementation stage. Positive reactions include upgrading jobs, allowing workers to focus on more meaningful tasks (Blaker et al. 2013; Chao and Kozlowski 1986; Herold et al. 1995), enhanced productivity enabled by automation of labor-intensive tasks (Blaker et al. 2013; Gohmann et al. 2005; Herold et al. 1995), opportunities to move to managerial and supervisory roles (Chao and Kozlowski 1986), and reduced errors and streamlining of work tasks (Blaker et al. 2013; Herold et al. 1995).

Negative reactions in prior literature have focused on issues related to the loss of control over work as a result of tasks moving to a *black box* of automation or management scrutinizing work based on data generated by a new system (Argote et al. 1983; Gohmann et al. 2005; Majchrzak and Cotton 1988); job security due to the potential elimination of the need for human labor (Blaker et al. 2013; Chao and Kozlowski 1986; Davis 1962; Herold et al. 1995); social isolation due to a decreased need to interact with other human workers (Argote et al. 1983; Chao and Kozlowski 1986); expanded responsibilities in exchange for automated routine tasks (Argote et al. 1983; Blaker et al. 2013; Chao and Kozlowski 1986; Gohmann et al. 2005; Herold et al. 1995; Majchrzak and Cotton 1988); increased productivity expectations (Argote et al. 1983; Herold et al. 1995); the need to acquire new skills to be competitive within the context of a renewed job description (Chao and Kozlowski 1986; Davis 1962; Herold et al. 1995); and technical difficulties caused by malfunctioning automation (Blaker et al. 2013; Gohmann et al. 2005).

A general consensus from early automation literature is that for unskilled workers, automation presents a threat, while for high-skilled workers, it brings job enhancements (Chao and Kozlowski 1986; Delehanty 1966; Herold et al. 1995; Olson and White 1979). Therefore, in prior literature, the prevalence of either positive or negative reactions has depended upon the skill level of the worker. However, in the era

of CA and RPA, we now face a situation where workers impacted by the automation are overall relatively high-skilled. As a result, the observations from manufacturing automation research may not be applicable to this group.

Another aspect that has been found to influence the direction of pre-implementation reactions is the organizational context and capabilities of management to address issues related to business process reengineering. If workers feel that the change process is managed effectively and that change seems inevitable and necessary, they will be more accommodating to automation. On the other hand, if workers perceive that management is incapable of ensuring a successful transition and if there are no apparent benefits for workers, they will be critical towards automation (Herold et al. 1995). In contexts where automation is more clearly aimed at automating particular processes rather than substituting workers altogether, the concerns are somewhat different. One example of such a context is salesforce automation, where workers have been reported to be more concerned with usability issues, management control and the impact on their productivity (Gohmann et al. 2005; Jones et al. 2002) rather than with job security or skill development. Here, less experienced workers were found to be more open to the introduction of the technology, whereas more experienced salespeople were resistant. At the same time, experienced top performers had a more positive reaction to automation than underperformers (Keillor et al. 1997).

3 Method

As our aim was to probe how knowledge workers react to a planned implementation of an automation tool, we chose to conduct a qualitative case study (Yin 2013). Our strategy was not to validate the classes of positive and negative reactions that have been identified in prior literature and outlined in the previous section, as this would have yielded a somewhat mechanistic reporting of empirical evidence on ready-made types of reactions. Additionally, this kind of probing would have guided the workers too much, and we wanted to avoid that. Rather, we approached the case company and data collection openly, letting the informants speak freely and honestly about their perceptions of automation. We next proceed to describing our case selection, data collection, and data analysis in greater detail.

3.1 Case Selection

To select the case company, we employed purposive sampling (Polkinghorne 2005) with two main principles. First, we searched for an information-rich case company (Patton 2001) from an industry in which workers' jobs would be vulnerable to automation. Second, we wished to study a company operating within knowledge-intensive work that would be actively contemplating deploying automation tools,

thus providing a natural case setting where the decision-makers and workers would be realistically considering the roles of human experts and automation tools in knowledge-intensive work.

Based on these two principles, the case company chosen for this study was AccComp (pseudonym), a Finnish accounting company specializing in creating and maintaining solutions to data management, analytics and outsourcing. In 2016, AccComp generated a turnover of approximately 130 million Euros and employed slightly fewer than 1000 people. AccComp had three offices in Finland and eight offices in other Nordic countries. In this study, we focus on AccComp's financial process services offering, which is a complete financial services outsourcing solution that includes business process-as-a-service (BPaaS), software-as-a-service (SaaS) and IT support. Internally, AccComp organizes financial process services through shared service centers (SSCs). In SSCs, AccComp has migrated outsourced processes to modern information systems such as Microsoft Dynamics AX and Exflow AX. To further improve the operations, AccComp is in the process of incorporating RPA into its financial services and is considering adding machine learning as part of its palette of automation tools in the future.

3.2 Data Collection

We conducted 13 semi-structured, face-to-face interviews. All interviews were done in Finnish, and they were all audio-recorded and transcribed. The transcribed material resulted in 200 pages of text (single spaced). Immediately after the interviews, we recorded all our observations. We noted the date, location and other relevant circumstances of the interviews. The data collection took place between November 2016 and January 2017.

To select and contact informants within the case company, we used the known sponsor approach (Patton 2001). One of the authors had access to the senior management of the case company. Together with one of the senior managers, we selected informants for the study, ensuring that the participants would represent all the main functions within the financial administration SSCs and have different age profiles, positions in the organization, and educational backgrounds. Additionally, we wanted to interview both specialists (operative-level workers) and managers (executive-level workers) within the case company to obtain a rich overview of the reactions to the planned implementation of RPA. The nine specialist interviews were conducted with experts from order-to-cash (O2C), purchase-to-payment (P2P), record-to-report (R2R), and debt collection functions. Table 1 lists all of the informants and their work-related backgrounds. We have changed the names of the informants to preserve their anonymity.

The interview guides were iterated by the authors to ensure that the questions would be understandable for the interviewees and that the order of different topics would be logical. The questions focused on the knowledge-intensive work and specific actions taken in the work tasks. The questionnaire included questions about

Table 1 Informants

Type	Pseudonym	Age	Experience in financial administration	Interview length (min)
Specialist interviews	Specialist Susan	42	10 years: includes billing, P2P, O2C, R2R, financial statements, and tax returns	82
	Specialist Elizabeth	63	About 30 years: R2R and budgeting	75
	Senior specialist Jane	56	24 years: financial manager, financial controller	75
	Specialist Emily	32	Several years: payroll clerk, transactions handling, billing	68
	Specialist Margaret	56	36 years: R2R, accounts payable, and billing	67
	Specialist Jenny	35	Several years: accounts payable and receivable, debt collection	69
	Specialist Helen	45	Several years: accounts payable and receivable	62
	Specialist Sarah	29	4,5 years: R2R, accounts payable and receivable.	72
	Specialist Christine	51	About 30 years: Accounts payable and receivable, billing, and assisting in accounting	87
Manager interviews	Team lead John	48	Several years: shared service center manager, project manager	70
	Director Lisa	52	28 years: Financial manager, and senior vice president	85

(continued)

Table 1 (continued)

Type	Pseudonym	Age	Experience in financial administration	Interview length (min)
	Vice president Robert	60	27 years: Business controller, group controller, and senior vice president	55
	Manager Mary	50	25 years: Financial manager and software development manager	56

automation in general and how the interviewees perceived it. The interview protocol can be found in Appendix 1. Halfway through the interview, the informants were asked to recall two informative, introductory videos on software robots that they had been asked to view in preparation for the interview.[3] After that, the interviewer asked several questions to be able to decipher the informant's initial reactions to and perceptions of RPA.

3.3 Data Analysis

To analyze our data, we adopted elements of analysis from grounded theory (Bryant and Charmaz 2007; Charmaz 2006). With this decision, we sought to retain a holistic view while investigating a contemporary phenomenon in its real-world context (Yin 2013). Following the grounded theory approach, we pursued inductive theory-building that involved moving from detailed descriptions to more abstract concepts (Bryant and Charmaz 2007). We analyzed notes taken during and after each interview to refine our interview guides. All interviews were transcribed after the data collection stage was finished. We began the data analysis immediately after finishing the data collection.

We used the NVivo qualitative research software in our analysis and coded the data corpus in three iterations. We first started with an open coding to better learn our data. At this stage, we created codes based on informants' discourse to tag our data. As the end product of this coding stage, we created 30 codes with a total of 160 quotes. These 30 codes are described in Appendix 3 with illustrative example quotes. In this first stage of coding, we remained as open as possible and avoided theory-guided coding (Charmaz 2006).

[3]Link to one of the videos: https://www.youtube.com/watch?v=fjdLAqgwMKA.

In the second stage, we used the axial coding approach (Charmaz 2006; Strauss and Corbin 1998) to identify and relate categories within the 30 initial open codes. The purpose of this stage was to create axes to gather conceptually connected codes and, as a result, reduce a large number of codes to a smaller number of logical categories. This stage yielded eight axial codes that we then used in our theory-generating interpretive analysis.

In the last stage, we revisited the axial codes and coded data based on theoretical concepts identified in the literature review. This stage allowed us to create a framework with which to analyze the reactions and perceptions of workers. The three coding stages, the codes, and their description can be found in Appendix 3.

4 Findings

During the interviews, we started our discussion by addressing the reactions to the two RPA videos, asking whether the respondents had heard about RPA prior to the interview. We also asked about their general attitude towards technological change overall. We report these findings in our summary table in Appendix 2. Most of our informants were not familiar with RPA before they were exposed to the two videos. Three out of the nine informants had noticed articles in popular press but did not consider themselves as understanding the technology or its capabilities. The others had not heard the term RPA prior to our contact. Concerning the general attitude towards technology, the informants were quite adaptive, meaning that they understood that their profession (accounting) is one that undergoes significant disruptions and that as workers, they need to adapt and cope with that change. As their client firms employ different accounting information systems (AIS), accounting firms typically cater to various systems, both traditional locally installed AIS and cloud-based AIS. As a result, the respondents had become accustomed to using different kinds of systems and were regularly exposed to technological change.

4.1 Positive Perceptions of RPA

Somewhat contrary to our expectations, our informants' initial perceptions of the videos were rather positive. After seeing the two introductory videos, the informants were quite enthusiastic about RPA and excited to see it in their accounting work processes.

> I think that RPA is an innovative solution, although I have not seen one in action yet. I am eager to see that happen. Really interesting! (Senior accountant Jane)

> I found the videos interesting. I would like to see such software robots doing our work. It could definitely do many things, like in that other video, where the software robot takes the file from e-mail automatically, those types of things, it could easily do […] that would be interesting to see. (Accountant Sarah)

The informants were also curious about the software robots' capabilities to learn new skills:

> What is most interesting to me would be to see how I would teach my work tasks to this kind of software robot. From a sort of research perspective, does the robot understand it or not. And then, I would like to know if they learn to do work that way. (Accountant Jenny)

In more detailed discussions, the initial perceptions focused on RPA's possibilities for upgrading jobs, evening out peaks in the workload, enabling more in-depth analysis of accounting, and reducing errors. We next turn to presenting each of those categories with illustrative quotes from the interviews.

4.1.1 Upgrading Jobs

Most interviewees saw the introduction of RPA as an avenue for them to upgrade their work tasks from manual, routine work to more value-added work

> I am positive towards it [RPA]. It might not replace human work, but human experts start to do different work, and then, it might be that human experts focus more on analyzing numbers and not on manual work. It feels now that we do not have time to do that, that we could analyze the book-keeping more. When we get numbers from the client firm, we could serve the firm better by giving them useful ratios such as a solvency ratio or some other key figures that we could calculate. (Accountant Sarah)

Upgrading jobs was sometimes also associated with a reduced risk of offshoring accounting work outside national borders. The rationale for this was that if the amount of manual work can be reduced by introducing RPA, this would then lead to a decrease in the company's motivation to offshore accounting work to low-cost countries.

> [After having implemented RPA], the residual work requires higher education. Then, probably, these robots can work in Finland; no need to go to India. Maybe some of the accounting work will be back-sourced [from India] to robots in Finland. (Accountant Elizabeth)

4.1.2 Evening Out Peaks in the Workload

From a workload perspective, accounting is notoriously seasonal. The end of the month is usually hectic, as accountants need to ensure that all required receipts and bookings are in the systems for the end-of-month closing. The time around the closing of the financial period (typically the end of the year) is also hectic. Several informants felt that technological advancements such as RPA would have the potential to even out peaks in the workload.

> My initial thoughts [about the videos] were very curious and positive. From resourcing and scalability perspectives, an accountant is a difficult resource. In any given month, only 1.5 weeks consist of efficient work time, and that is at the turn of the month. During that period, an accountant can handle only a limited number of client firms. So how could we add more client firms? Exactly like that, that someone else would do the routine job, either a

> knowledgeable student or automation or something else. So that the accountant could simply look at the end result and verify with his/her expertise that the figures are correct. Then, more client firms could be allocated to that accountant. So, this is very important from a scalability perspective and overall efficiency. (Manager Mary)

4.1.3 Enabling More In-Depth Analysis of Accounting

Most accountants are quite meticulous and like to keep things under control. However, the seasonality and hectic nature of accounting work do not always allow accountants to double check and verify the input data and the outcome of accounting. Many accountants perceived RPA as a tool to offload manual work so that this type of verification and checking could be done.

> [By using this kind of RPA], I could, especially at the turn of the year, focus on those numbers because you always have that feeling of 'What did I do?' when you do them in a hurry and the schedule is tight. So, I would take a deeper dive into the numbers to get them right. It would be wonderful to have time for doing that, to get a feeling that they are correct and I have checked them. (Accountant Christine)

4.1.4 Reduced Errors

Like all information-intensive work processes, accounting work is prone to human errors. The informants were willing to have their work descriptions changed to accommodate the introduction of RPA, and this was partly motivated by the foreseeable decrease in the number of human errors.

> [Through the implementation of RPA], the amount of manual work decreases and, supposedly, the amount of errors should decrease. Because when you insert numbers manually, there is always the possibility of human error. (Accountant Emily)

4.2 Fears and Anxieties Vis à Vis RPA

While the majority of the reactions we coded were positive, there were some negative perceptions as well. These were mainly associated with job security and loss of control over work through fragmentation of work tasks.

4.2.1 Job Security

Quite unsurprisingly, the most cited negative perception of RPA implementation was its negative effects on job security. RPA emulates the actions of humans, and the informants understood that some human work would be replaced by these robots.

> I am not sure if I am right, but these robots will replace a lot of human jobs. (Accountant Elizabeth)

> This is an interesting situation when we start to have more and more people that are pushed aside, and they might have very little expertise, so what do we do? […] For the first time, we are in a situation where we cannot offer them alternatives. Before, there was always something; we could have them making and archiving paper folders and copying stuff, but that has now been changed. (Vice president Robert)

Job security was often mentioned as a side note in conjunction with positive perceptions, such as that RPA would upgrade jobs and reduce errors. The following pair of quotes illustrate this:

> It would be positive that it would handle the routine stuff, but then again, it would replace my work. (Accountant Helen)

> I am quite positive towards RPA. It speeds up the process [by reducing the number of human errors], but then again, there is the other side: where to allocate the workers when we do not need as many of them as before. (Accountant Susan)

4.2.2 Loss of Control Over Work Through Fragmentation of Tasks

Informants were worried about how they would keep track of their work flow if an RPA took responsibility for certain tasks. They felt that through the implementation of RPA, tasks might be fragmented and accountants might not be able to form a good overall understanding of the process, possibly leading to deskilling of the accountants. They thereby perceived a well-known problem known as one the main *ironies* of automation (Bainbridge 1983):

> Yes, [an accountant] would probably no longer have this kind of overall understanding of what book-keeping is if a robot did some tasks in every part of the process. So, an accountant that has not done the book-keeping process from start to finish would not understand what is happening in book-keeping. If the process is fragmented, then the accountant would not know what leads to what, how income statements are formed from invoices and other documents, and which data the balance sheet consists of. (Accountant Elizabeth)

> I think it would be more difficult to track down the errors made by the software robot; it is easier to track down human errors. And then if everything became so automated […] if there were errors, I might not be able to track them or even know what transactions were posted and how. There should be some sort of mechanism to keep track of these things. (Accountant Sarah)

4.2.3 Perplexity of What a "Robot" Is

The rules-based nature of the software robots was something that the informants talked a lot about in the interviews. In accounting, there are accounting laws and regulations that, to a great extent, dictate the outcomes of accounting processes. However, the informants were uncertain how the rules that the software robot followed would be written into the systems.

> I do not know how capable the software robot is. Could it draft a tax report and balance sheet? I do not know how it would do that. The balance sheet is a sort of collection of existing data, and if someone just finds them and inserts them into the correct cell, those figures, it [the RPA] can probably code that balance sheet as well. Why not tax reports, as well, so that it picks out the numbers? Because the numbers are ready in the book-keeping, you can define them […] so, why couldn't a software robot do it? […] Everything can probably be in electronic form if the software robot is capable enough. It depends on the programmer [who writes the rules onto the RPA]. (Accountant Elizabeth)

Additionally, the informants were confused about the different types of automation. RPA is a good example of a lightweight IT (Bygstad 2016) that operates on the front-end using graphical interfaces and is relatively easy to implement. The informants found it difficult to draw a line between this type of lightweight automation and the more heavyweight automation requiring modifications to back-end systems.

> Still I must say that it is quite difficult to think when it is a robot and when it is a rule programmed into the system; it is difficult to grasp [the difference]. [I mean] I am unsure if I am thinking of the wrong thing [type of automation] when talking about software robots. (Accountant Susan)

4.3 Summary

The idea of RPA elicited both positive and negative responses among our informants. In different ways, RPA was seen as a force that may change the nature of workers' organizational role and status (e.g., positively through upgrading their jobs or negatively through threatening unemployment). It was also seen more concretely as a mechanism that changes particular work tasks (e.g., positively, as a means to reduce errors, or negatively, as a change agent that fragments one's work). In the following discussion, we will provide interpretive lenses that help analyze these differential responses and consider some of the implications of such effects.

5 Discussion

In this paper, we present a study that probed the initial reactions of knowledge workers to a planned introduction of RPA. Our study contributes to both theory and practice, and we next turn to the theoretical and managerial contributions.

5.1 Theoretical Implications

We theorize our findings of the case study through two lenses. First, we theorize on the emerging positively dispersed uncertainty concerning the nature of RPA, whether

symbiotic or augmentative. Second, we claim that the relativistic nature of worker reactions potentially has an impact on workplace atmosphere.

5.1.1 Metaphors for Human-RPA Cooperation

When interpreting the observations made in the empirical study, an important theme pertained to the uncertainty on what RPA actually is and how much artificial intelligence (AI) it entails. Perplexity about RPA's true meaning is an important issue, as our findings (see Sect. 4.2.3 on perplexity) show.

Uncertainty about the future often leads to anxiety. In the case of RPA, uncertainty exists on two levels: on the level of the meaning of a "robot" and on the level of AI that automation can have, independently of whether it is robot-like. In both cases, workers are under-equipped with the knowledge and competence needed to understand the technology they are soon about to start closely interacting with. Educating workers to be more knowledgeable about AI, thus debunking myths around it, may be one solution for decreasing the perplexity; however, we think that a more useful approach may be to develop easily understandable yet accurate enough metaphors for human–automation (or human–RPA) cooperation.

Human–computer interaction (HCI) research offers two classic metaphors for human–computer cooperation, and these can be analyzed as candidates for human–RPA automation as well. Licklider's *symbiosis* metaphor (Licklider 1960) presented humans and computers as co-dependent entities but with different roles. In this metaphor, humans define the goals and make the decisions, while computers carry out routine work that is needed to prepare for insights. This idea of division of tasks based on a "humans are good at, computers are good at" principle pervades much of HCI thinking even today. Engelbart's *augmentation* metaphor (Engelbart 1962) is another prominent classic in HCI research. Instead of starting from a premise of labor division, this metaphor presents computers as a means to improve humans' senses, cognitive capacity and execution of actions. Compared to the symbiosis metaphor, the augmentation metaphor posits more agency for the user.

RPA's vision, according to which work that is currently carried out by humans would be automated, seems more closely tuned in with the symbiosis view. This involves, however, a twist: RPA absorbs an increasingly larger scope of tasks in a human–RPA dyad's total work content, without offering reciprocal benefits for the humans. This shakes Licklider's original idea of a balanced reciprocal symbiotic relationship. In the absence of other strong positive metaphors for human–automation relationships, one approach for increasing the meaning of humans in future work is to combine the two metaphors. The imbalance in the symbiosis could then be counterbalanced with more active augmentation of intellect on the human side (Asatiani et al. 2019).

However, IS and HCI researchers should also seek to develop new metaphors. Mixed-initiative interfaces (Horvitz 1999) where humans and computers act as equal partners offers one such metaphor. This metaphor would also be compatible with a concept of cooperation with an intelligent robot. However, as of now, the metaphor

does (yet) not match reality and results in false perceptions. More work is needed for better conceptualizing and communicating to workers how their work may change with an introduction of RPA.

5.1.2 Workplace Atmosphere Implications

Although the participants were receptive to the idea of RPA, the findings also revealed a rich variety of negative perceptions. The topics that emerged reflect very well the open questions that have generally been asked about the increase in automation and for which conclusive settled answers have not been found. Questions such as whether automation leads to unemployment in some profession and whether they lead to a loss of control of one's job, for example, are being heavily debated.

It seems to us that in the valence dimension (i.e., whether the perception of RPA is positive or negative), the differences can be interpreted more deeply through the concept of coping strategies. The theory of coping, developed in psychology (Lazarus and Folkman 1984), posits that humans have a tendency to react to hardships and challenges actively or passively, depending on their sense of locus of control. Persons who find themselves helpless (i.e., who perceive a lack of control) are more likely to adopt passive strategies that seek adaptation to surrounding conditions. High levels of locus of control, correspondingly, are related strategies where people seek possibilities to change their surroundings.

This theory seems to apply to our data in a similar manner as has been reported in other contexts of information systems use (Beaudry and Pinsonneault 2005). The positive perceptions, such as those expressed in relation to the upgrade of jobs (Sect. 4.1.1) or possibilities for more detailed analyses (Sect. 4.1.3), seem to be related to the respective workers' beliefs that they have the power to craft their jobs with RPA's help. The negative perceptions, in turn, such as job loss (Sect. 4.2.1) and loss of control (Sect. 4.2.2), have a very clear connection to a sense of powerlessness. While the active coping strategies were related to reorganizing one's job, upskilling it, or spreading one's work so that it will include deeper analyses, the workers who expressed negative perceptions adopted more adaptation-oriented passive strategies, such as what one could call "damage control" or "bounded acceptance". For example, they described the limits that RPA should have in their work roles. Thus, RPA would be welcome if it took away "routine stuff" (Accountant Helen, Sect. 4.2.1). Beyond that, however, the effect could be seen as negative due to fragmentation of one's work. In these cases, RPA would therefore be resisted.

According to the coping theory, a person's coping strategy is determined at an appraisal stage, where the person weighs the effects of an event on one's personal life. In our case, the appraisal's outcome seems to be affected by *relativistic response*: an evaluation of whether the effects of RPA (and automation in general) are going to hit oneself harder than other people. Thus, some of our participants welcomed backshoring (Accountant Elizabeth; Sect. 4.1.1) because they felt that they would be on the winning side of its effects. Similarly, in the perceptions of possible job

losses (Sect. 4.2.1), the defining question seemed to be whether workers considered themselves as those who are going to be "pushed aside" and replaced.

If relativistic response is indeed an important factor in workers' evaluations of RPA's and automation's effects, it may lead to an increased sense of a competitive atmosphere in professions where such peer comparisons have not been commonplace. This relationship could be an interesting topic for future research.

Increased peer competition may foreground tougher values in workplaces. Whether RPA will decrease the peer support, collegiality and generally positive atmosphere in workplaces is a question whose answer remains largely unknown because RPA and automation in general are very recent developments. Earlier research on other forms of automation provides some insights to this question. As discussed in Sect. 2, the workers' reactions to automation are impacted by the context. Workers who consider themselves to have an advantage (e.g., young workers who are comfortable with modern technology (Chao and Kozlowski 1986) or top performers (Herold et al. 1995; Keillor et al. 1997) tend to be enthusiastic towards automation. On the other hand, unskilled and older workers (Chao and Kozlowski 1986; Herold et al. 1995) tend to perceive automation as a threat. This would suggest that automation could potentially influence the workplace atmosphere negatively and divide workers into opposing camps. However, as of yet, there is no evidence to suggest that RPA may lead to similar effects.

The positive reception and curiosity that our study revealed about workers' reactions attests that the impact of RPAs and software robots depends on a wide variety of worker characteristics. The negative impacts on workers, although easy to picture, need empirical verification. The paper is one of the first evaluations of this important research path.

5.2 Managerial Implications

Our results offer several potentially valuable recommendations for managers contemplating the introduction of automation tools in knowledge work and specifically accounting. We next discuss these managerial implications on three fronts: (1) automation tools and their fit with the seasonality of accounting, (2) indications of peer competition, and (3) opportunities to harness positively dispersed curiosity concerning RPA.

Accounting is a notoriously *seasonal work domain*, with the end of month and the beginning of the year being typically more hectic than other periods. Several times in the interviews, it was stated that automation tools can provide relief from this seasonal work stress by offering to offload certain manual tasks to automation at peak workload times. Managers can use this kind of argumentation and reasoning when communicating about the introduction of RPA to their workers. Overall, accountants welcome the possibility to focus and double check their work, and automation tools are key in providing these kinds of opportunities to accountants.

Our results suggest that within the domain of accounting, not all tasks and workers are hit by automation in a similar way, resulting in an effect called relativistic response, which we discussed in the previous section. This, in turn, might lead to increased levels of competition among workers that managers need to be aware of (*indications of peer competition*). Within accounting, there exist a myriad of different types of work tasks, ranging from manual, routine tasks of invoice (both sales and purchase) handling to tasks requiring more cognitive capabilities, such as payroll processing and tax management. Managers need to take our findings into account when implementing automation tools in accounting, conduct a careful task-level analysis of the potential impacts of automation on each worker and interpret the associated responses.

Finally, overall, our results highlight workers' curiosity towards automation tools rather than fear and anxiety. Managers should try to harness this *positively dispersed curiosity* of workers to their advantage. They could, for example, develop a careful RPA implementation strategy through which they would clearly articulate the capabilities and deficiencies of the planned automation tools to workers.

5.3 Limitations and Further Research

Like all empirical studies, ours is not without its limitations. First and most importantly, our data corpus consists of a limited number of interviews with informants from one company and one geographical area: Finland. Finland is a very advanced country in terms of accounting software implementation (firms are used to using cloud-based AIS) and penetration of standards associated with structured data (e.g., Finland has the highest penetration of electronic invoices[4]). This maturity in using sophisticated cloud-based AIS coupled with advanced standards might have distorted our findings. Further research could examine whether similar findings can be found through empirical research in less advanced countries. Additionally, our sample consisted of accountants who were not strongly against technological changes in their environment (see Appendix 2 for details). They had become accustomed to technological change by being exposed to several AIS and having gone through several system transitions. Second, while we aimed to provide neutral videos to trigger initial perceptions, the choice of video material might have primed our informants. While the first video was a neutral informative video on the functioning of the RPA tool, the second one portrayed RPA as an assistant to the accountant in a rather positive light. Different video choices might have yielded different initial reactions among our informants.

[4]See, for example, Penttinen et al. (2018b) or the e-invoicing market reports in Koch (2014) or the Eurostat statistics in https://ec.europa.eu/eurostat.

6 Conclusions

In this paper, we set out to investigate the initial reactions and perceptions of knowledge workers to a planned implementation of RPA, responding to calls for research on artificial intelligence in knowledge work (Sutton et al. 2016). We studied an accounting firm that was planning to introduce RPA to its core accounting processes. Based on earlier academic literature and popular press on automation, we expected the reactions to be guided by fear and anxiety. While our informants did raise the expected concerns about job security and loss of control over their work, their initial reactions to the technology were surprisingly positive. The informants even expressed enthusiasm and genuine curiosity towards the capabilities of RPA. Based on our results, we discussed two main theoretical implications: we first theorized on the emerging positively dispersed uncertainty concerning the nature of RPA and its effects on human–computer interaction. Then, we theorized on the relativistic nature of worker reactions potentially having an impact on the workplace atmosphere. Finally, we provided guidance for managers on issues to consider when contemplating the potential introduction of automation tools within the domain of accounting.

Appendix

Appendix 1: Interview Questionnaire

Interview guide for specialist interviews

Respondent's background information

- Age and education?
- Prior work experience?
- Positions held at AccComp?
- Current responsibilities at AccComp?

General questions of daily work

- What systems are you currently using in your work and for what purposes? Do you move information from one system to another manually?
- AccComp implemented a new accounting information system recently. Has your work changed after the implementation of the new system? How has it changed?
- Does the system(s) that you use have the necessary features to be able to carry out your work?
- What is your estimate of the ratio of data that you receive in paper or digital format?

Initial reactions to and acceptance of new technology

- Tutorial videos of RPA:
- Thinking about the tutorial videos about a software robot, have you heard of or used that kind of software robot before?
- What kind of initial feelings do software robots evoke in you?
- Did your understanding of what software robots are and how they work change after you watched the video?
- Do you see the software robot as a positive or negative thing regarding your work, and if so, why?
- Let's look at this list of different financial accounting processes. What processes in this list do you handle at work?
- Can you take me through the [specific financial accounting from the list] process step-by-step and describe it in as much detail as possible? For example, how you enter information into the system, what problems you might encounter, what is repetitive and routine in the process where you can just "switch your brain off," when do you need to focus to get the information right in the system, and so on.
- *Follow up:* Do you follow a clear workflow list written by someone else, or have you yourself formed an informal workflow in your work?
- How often do you react to unpredictable anomalies in your work that require a lot of thinking and attention? Can you handle those situations alone, or do you need help from someone else?
- How many clients do you have at the moment, and do you feel you have enough time to handle your work without feeling overloaded at all times?
- Can you describe how you solved a problematic situation(s) that you encountered in the accounting system(s) or overall?
  - Have you noticed that a small error would lead to a bigger error? Can you give an example?
- Do you report errors forward, and if so, how do you do it?
- What parts of your work tasks do you especially enjoy?
- If you consider that a software robot can take over some of your tasks, what would you do with the time that is left over? Would you, for example, want to take more clients or concentrate more deeply on current clients, aim for a better work position that has a higher salary, or possibly something else?
- Is it a good thing if repetitive mechanical work decreases or is even eliminated from your work? If so, why?
- Are you more willing to embrace a new, more efficient accounting system that you can set to automate some tasks, or a software robot? For what reasons?
- Do you consider software robots to be a progressive, innovative solution to be used in knowledge work?
- If you think on a more general level, how easy or hard do you find it to adapt to technological changes?

- How do you feel about learning new skills, for example, learning how to use a new software to set up software robots to run certain tasks, as in the videos?
- Would you be ready to change your work description and take new tasks to handle, for example, teaching a software robot how to carry out work tasks?
- Would it be harder to keep up your skills that you need in work if a software robot handled some of your tasks in a [specific financial accounting process]?
- Overall, do you feel that you are informed well enough of these software robots and their actual impacts on work? What would you want to know more about?
- Would it be important for you that you can participate in the software robot design process?
  - *If yes*: In what ways would you want to participate, and what kind of impact would you aim to have by participating in the design process?

Interview guide for manager interviews

Respondent's background information

- Education?
- Prior work experience?
- Positions held at AccComp?
- Current responsibilities at AccComp?

General questions

- Does AccComp follow certain management principles, for example, Lean, Six Sigma or TQM?
- What kind of role does technology have at AccComp, and do you follow your field of work's latest technological developments?
- What kind of message does the C-suite aim to give about the role of technology within the organization?
- Does AccComp have an automation strategy?
- Do the business and IT functions work together? If so, how much and in what kind of matters?

Initial reactions to and acceptance of new technology
Tutorial video of RPA

- If you think of the tutorial video about software robotics, have you heard of or seen that kind of software robot in action before?
- Did your image of what software robots are and how they work change after you watched the video?
- What kind of initial feelings software robots evoke in you?
- When you think of the video, do you see the software robot as a positive or negative thing regarding financial management work in the company? If so, why?

- If you consider that a software robot can take over some financial management tasks, how would you allocate the financial management professionals' time that is left over?
- Do financial accounting specialists have the expertise to, for example, teach software robots how to handle work tasks or the willingness to learn new skills?
- Are your workers aware of the possibilities and changes that come with software robots? Have you heard them talking about these software robots or similar topics?
- Do you have a roadmap for implementing RPA yet?
  - *If yes*: Have you done an RPA proof of concept yet?
- Do you have a communications plan to inform about the software robots?
- *If yes:* How long before you decide to start implementing them are you going to begin communicating about software robots?
- Do you already know what you want to achieve with robotic process automation in your unit?
- How easy or hard do you find it to adapt to new technological changes from your own and the organization's point of view?
- Do you consider software robots to be a progressive, innovative solution to be used in knowledge work?
- When you think of recruitment for financial management positions (e.g., accountants, payments receivable clerks), what characteristics and/or skills do you emphasize in recruiting for these positions?
- How much do you anticipate the changing needs in skill sets when recruiting new personnel?
- How have the specialist teams been composed? Does your team have diverse expertise?
- How independent are, for example, accountants and payments receivable clerks in their work?
- Do the specialists follow a clear workflow list written by someone else, or have they formed an informal workflow when they carry out their tasks?
- Do you rotate clients or tasks from time to time between your subordinates, or do they work on the same client and tasks all the time?
- Do you take pre-emptive actions to prevent errors from happening in work?
- Have you noticed that a small error could lead to a bigger error? Can you give an example?
- Do you think that errors could be better anticipated or avoided with training?
- What kind of training or retraining do you provide for workers?

Appendix 2: Informant Profiles

Name	Age; education	Familiarity with RPA	Attitude towards technology	Pre-implementation perceptions of RPA
Specialist Susan	41; business college graduate	Had heard about RPA around a year ago, examples of purchase invoice process development. Not familiar with true implications on work processes	Technological change does not frighten Susan; she has cautious attitude, "let's see [what it can do]."	Positive codes: enhanced productivity Negative codes: job security, technical difficulties, loss of control over work
Specialist Elizabeth	63; business college graduate	Not familiar with RPA prior to interview	Is glad to learn new skills, even coding	Positive codes: new opportunities at work, upgrade of jobs, reduced errors Negative codes: job security, fragmentation of work processes, loss of control over work, potential deskilling Neutral codes: RPA's cognitive capabilities, expansion of responsibilities
Senior specialist Jane	56; BBA	Not familiar with RPA prior to interview	Works primarily in development, so the threshold for taking on new technologies is not so high	Positive codes: reduced errors, upgrade of jobs, new opportunities at work Negative codes: job security, fragmentation of work processes Neutral codes: expansion of responsibilities

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Name	Age; education	Familiarity with RPA	Attitude towards technology	Pre-implementation perceptions of RPA
Specialist Emily	32; BBA	Not familiar with RPA prior to interview	Is quite knowledgeable about systems (other than RPA), follows developments with interest, and finds it easy to adopt new information technology and systems	Positive codes: upgrade of jobs, reduced errors, new opportunities at work Negative codes: job security
Specialist Margaret	56; business college graduate	Not familiar with RPA prior to interview	Does not mind learning to use new systems; on the contrary, she finds it interesting	Positive codes: even out peaks in workload Negative codes: job security, simplification of work tasks (neg)
Specialist Jenny	35; business college graduate	Other than having noticed some articles in the popular press, was not familiar with RPA prior to interview	Positive attitude towards technological change. Is cautious about the long-term impacts [of technology implementation], but adopting new technologies is not a problem	Positive codes: upgrade of jobs, simplification of work tasks (pos)
Specialist Helen	45; BBA	Not familiar with RPA prior to interview	When prompted about her attitude towards technology, Helen stated that "You get used to everything, everything changes."	Positive codes: upgrade of jobs, enabling more in-depth analysis of accounting Negative codes: job security Neutral codes: RPA's cognitive capabilities

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Name	Age; education	Familiarity with RPA	Attitude towards technology	Pre-implementation perceptions of RPA
Specialist Sarah	29; BBA	Has read news about RPA replacing workers, e.g., in claims handling. Not very familiar with the technology; however, understands that they are rules based	Adapts well to technological changes; the older she gets, the more training she feels is necessary	Positive codes: upgrade of jobs, RPA driving BPR, enabling more in-depth analysis of accounting. Negative codes: job security, loss of control over work.
Specialist Christine	51; vocational school graduate	Not familiar with RPA prior to interview	Adapts relatively well to new systems. Has been involved in many system changes during the last 10 years	Positive codes: enhanced productivity, upgrade of jobs, enabling more in-depth analysis of accounting.
Team lead John	48; BBA	Has heard the term RPA but is not familiar with the technology	Some technological changes are easier than others. If there exist good documentation and guidelines, then it is easy. Depends much on the user interface, as most of accounting software has the same functionalities and just the user interface varies	Positive codes: even out peaks in workload, simplification of work tasks (pos), enhanced productivity Negative codes: hazardous work processes.

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Name	Age; education	Familiarity with RPA	Attitude towards technology	Pre-implementation perceptions of RPA
Director Lisa	52; MSc Econ	Has read white papers and attended seminars on RPA. Understands the business case but is not familiar with RPA in practice	Depends on the usability, if it is intuitive and Lisa does not need to spend time searching for functionalities [then it is easy]. If there is a testable prototype of a system, then Lisa is interested; if not, then she might feel reserved	Positive codes: reduced errors, RPA driving BPR, RPA as marketing tool Negative codes: need to reallocate workers to new tasks
Vice president Robert	60; MSc Econ	Somewhat familiar with RPA.	In Robert's position, he feels that he needs to actively adopt new technologies. Overall, he is excited about them but would not want to adopt beta versions of systems; he likes to adopt mature, established systems	Positive codes: upgrade of jobs, easy implementation, heavyweight vs lightweight automation Negative codes: job security
Manager Mary	50; MSc Econ	Understands quite well what RPA is	Takes what is coming at her. Is used to system changes. Finds it natural, in her position, to learn how to use new systems	Positive codes: upgrade of jobs, even out peaks in workload, enhanced productivity, reduced errors

Appendix 3: Coding Scheme

		Coding stages				
Description	Example quote	Open coding	#	Axial coding	#	Thematic coding (reference)
Informant expresses enthusiasm regarding RPA	"Software robots create suppliers in the system, receive invoices, do the postings, interpret the content of the invoice and send them out for approval. So in my mind, there are endless opportunities, and that we are in the forefront thinking about this and taking them into use." (Team lead John)	Enthusiasm	4	Upgrade of jobs	28	Upgrade of jobs (Blaker et al. 2013; Chao and Kozlowski 1986; Herold et al. 1995)
Informant feels that RPA will lead to an expansion of responsibilities	"How can one person work with the robot? [I mean] the human expert would need to master large and wide work entities if the robot replaced much of the manual work." (Specialist Elizabeth)	Expansion of responsibilities	2			Opportunities to move to managerial and supervisory roles (Chao and Kozlowski 1986)
Informant feels that RPA could provide new opportunities at work	"With RPA in place, I could take more customer companies." (Specialist Elizabeth)	New opportunities at work	3			

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		Coding stages				
Informant feels that RPA might lead to simplification of work tasks with positive consequences	"[the implementation of RPA] could generate insights on how to "straighten out" our processes … then, RPA could take care of the routine tasks." (Specialist Jenny)	Simplification of work tasks (pos)	2			
Informant feels that using RPA will lead to upgrade of jobs	"Now it feels that we don't have time to analyze the numbers; [with RPA] we could also analyze book-keeping data, and we could serve our clients better by saying, hey, this is your solvency ratio, I prepared this for you." (Specialist Sarah)	Upgrade of jobs	17			
Informant views RPA as a way to even out peaks in workload	"… we need to get things done by the third day of any given month … so the first week is very hectic … [the work process] would be smoother with RPA." (Specialist Margaret)	Even out peaks in workload	3	Even out peaks in workload	13	Enhanced productivity enabled by automation of labor-intensive tasks (Blaker et al. 2013)

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		Coding stages				
Informant feels that productivity would be increased through RPA implementation	"I think the time required for one client would decrease, so you would need to take something to compensate for that. You cannot just think that, ok, I am going to take a bit longer coffee break. So you would take more clients." (Specialist Susan)	Enhanced productivity	6			
Informant feels that RPA can ignite business process development (BPR) and digitization initiatives	"[With RPA], we would like to improve our pace in developing automation. … we have the as-is situation and then to-be situation, and we would like to get to the to-be situation quicker with RPA." (Director Lisa)	RPA driving BPR and digitization of work processes	4			

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		Coding stages				
Informant perceives RPA as something that will enable him/her to conduct more thorough analysis of accounting data	"I could use the time that is freed up to search for discrepancies in the figures because now we have had to leave the small differences hanging there in the balance sheet, because we have not had time [to correct them], and they may have been there since 2012 when I was not even the book-keeper for this client." (Specialist Sarah)	Enabling more in-depth analysis of accounting	3	Enabling more in-depth analysis of accounting	6	Informating (Zuboff 1988)
Informant discusses RPA as a means to document work processes	"… we talk about work documentation. Often, accountants have some documentation for their own tasks … sometimes we need to shift work between our two offices, and then, we have at least two invoice processing systems in place." (Senior specialist Jane)	Documentation tool	3			

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		Coding stages				
Informant feels that the amount of errors would be reduced with RPA	"Some of my work, such as processing these energy invoices, is very routine-like. You type in the invoice number and first find the contract number, then you type it in, dates, due dates, reference number, amount, VAT code and VAT, then row information, basic fee, energy fee, and then you accept. That's routine. And prone to errors because you do it by hand. Now that's being developed [through RPA]." (Specialist Emily)	Reduced errors	8	Reduced errors	8	Reduced errors (Blaker et al. 2013; Herold et al. 1995)
Informant fears that RPA might have detrimental effects on job security	"I am not sure if I am correct, but these software robots will probably remove a lot of jobs, and the residual work is expert work that requires higher education." (Specialist Elizabeth)	Job security	9	Job security	10	Job security (Blaker et al. 2013; Chao and Kozlowski 1986; Herold et al. 1995)

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		Coding stages				
Informant feels that RPA implementation might require the reallocation of workers to new tasks	"There might be challenges in relocating the persons whose jobs are being automated. Will all of them be able to become, through retraining, experts on RPA?" (Director Lisa)	Need to reallocate workers to new tasks	1			
Informant feels that RPA will lead to fragmentation of work processes	"… no, I don't think it would be difficult [to learn to interact with RPA], but I do think that the nature of the work would change a lot. The work would be fragmented and divided such that in the end, humans would just search for errors in the system. This is a big prejudice." (Specialist Elizabeth)	Fragmentation of work processes	2	Loss of control over work through fragmentation of work	22	Black boxing (Argote et al. 1983; Gohmann et al. 2005; Majchrzak and Cotton 1988)

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		Coding stages				
Informant expresses fear that RPA might lead to hazardous work processes	"In accounting, a person handling purchase invoices and doing book-keeping and handling payments, that person cannot be the same [due to the Finnish accounting legislation]. … this would be a type of dangerous work task combination if robots were handling all of these [tasks]." (Team lead John)	Hazardous work process - lack of validation	1			
Informant fears that RPA might result in a loss of control over work	"I think it would be more difficult to track down if the robot has made a mistake – more difficult to track down those mistakes than the ones that I make." (Specialist Sarah)	Loss of control over work	4			

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		Coding stages				
Informant expresses concerns on potential deskilling resulting from RPA implementation	"With RPA in place, you would not learn how to do accounting in the same way [as without RPA]. You would need to get that learning experience from elsewhere." (Specialist Elizabeth)	Potential deskilling	12			
Informant feels that RPA might lead to simplification of work tasks with negative consequences	"I would not want to just monitor what the RPA does. That's not my… if I am at work, I need to have something [concrete] to do. Otherwise, I get bored." (Specialist Margaret)	Simplification of work tasks (neg)	2			
Informant fears that RPA might cause technical difficulties	"As someone working in accounting, you are of course worried that are they [RPA rules] correct, and what if something goes wrong? When will we catch it and notice it?" (Specialist Susan)	Technical difficulties	1			

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		Coding stages				
Informant discusses RPA's cognitive capabilities	"It was shown that the RPA could learn the task that is given and programmed. I don't know what happens if there is a problem. … Can the RPA go forward and navigate and search somewhere else?" (Specialist Helen)	RPA's cognitive capabilities	2	Perplexity of what a "robot" is	15	
Informant questions whether he/she can trust the capabilities of RPA	"I feel more comfortable trusting the data that I have entered into the system … maybe if I would use robot and see with my own eyes on the screen [what it does], then that would increase my level of trust [in RPA]. (Specialist Susan)	Trust	2			
Informant is unsure about the capabilities of RPA	"If we start from there, where robots have traditionally been implemented in manufacturing, the contrast to these kinds of robots that would "think," it is difficult to grasp." (Manager Mary)	Uncertainty - curiosity of the capabilities of RPA	11			

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		Coding stages				
Informant discusses his/her attitude towards technology in general	"I am positive towards new technology. I want to stay on top of things." (Specialist Jenny)	Attitude towards technology	19	Respondent background	41	N/A
Informant discusses his/her familiarity with RPA prior to the research project	"I am not well aware of [what] RPA [is]. What is the true impact. I have not followed companies that have implemented it or how it has made processes quicker." (Specialist Susan)	Familiarity with RPA	22			N/A
Informant discusses an application area that he/she finds suitable for RPA	"I would implement RPA in the purchase invoice handling process, in the front part of that process. On the video, RPA went into the e-mail, so it should be able to retrieve [purchase invoice] data from there." (Manager Mary)	Application area	4	N/A		N/A

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		Coding stages				
Informant finds RPA easy to implement	"In that robotics example, when there are several software programs, they do not need to be integrated; instead, you operate on top of the software, which has not been possible before." (Vice president Robert)	Easy implementation	1	N/A		N/A
Informant considers his/her preferences over front-end vs. back-end automation	"[In back-end automation], the challenge is integration, which is a pain. [RPA is a delight]. The robot sits on top of existing IT infrastructure and starts move between systems without [requiring heavy] integration. That, in my mind, is the biggest issue changing the landscape." (Vice president Robert)	Front-end vs. back-end automation	9	N/A		Lightweight vs. heavyweight automation (Bygstad 2016)

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		Coding stages				
Informant feels the need to ensure domain knowledge in the development of RPA	"[When developing RPAs], it would be good to have someone involved who really understands accounting and its requirements. If it is developed simply by engineers who have not done accounting, then it might not work as they initially planned." (Specialist Helen)	Need to ensure domain knowledge in development of RPA	1	N/A		N/A
Informant feels that RPA could be used as a marketing tool towards customers	"Our vision includes the digital dimension, and automation is related to this digitalization. It is an important part of our strategy and customer promise. And I see that these software robots are a part of digitalization." (Director Lisa)	RPA as marketing tool	2	N/A		N/A

References

Abdinnour-Helm, S., Lengnick-Hall, M. L., & Lengnick-Hall, C. A. (2003). Pre-implementation attitudes and organizational readiness for implementing an enterprise resource planning system. *European Journal of Operational Research, 146*(2), 258–273.

Akst, D. (2013). Automation anxiety. *The Wilson Quarterly Summer, 3,* 1–13.

Argote, L., Goodman, P. S., & Schkade, D. (1983). The human side of robotics: How workers react to a robot. *Sloan Management Review, 16*(1), 1–33.

Asatiani, A., & Penttinen, E. (2016). Turning robotic process automation into commercial success - Case OpusCapita. *Journal of Information Technology Teaching Cases, 6*(2), 1–8.

Asatiani, A., Penttinen, E., Rinta-Kahila, T., & Salovaara, A. (2019). Implementation of automation as distributed cognition in knowledge work organizations: Six recommendations for managers. In *40th International Conference on Information Systems,* Munich (pp. 1–16).

Atkinson, R. D. (2012). US manufacturing decline and economic development prospects. *Economic Development Journal, 11*(3), 5.

Autor, D. H. (2015). Why are there still so many jobs? The history and future of workplace automation. *Journal of Economic Perspectives, 29*(3), 3–30.

Bainbridge, L. (1983). Ironies of automation. *Automatica, 19*(6), 775–779.

Beaudry, A., & Pinsonneault, A. (2005). Understanding user responses to information technology: A coping model of user adaptation. *MIS Quarterly, 29*(3), 493–524.

Blaker, K., White, L., & Poyser, W. (2013). Dispensary assistants' attitudes and perceptions regarding automated dispensing machines in community pharmacies. *International Journal of Healthcare Technology and Management, 14*(1/2), 90.

Bryant, A., & Charmaz, K. (2007). *The sage handbook of grounded theory*. Sage.

Brynjolfsson, E., & McAfee, A. (2014) *The second machine age: Work, progress, and prosperity in a time of brilliant technologies*. WW Norton & Company.

Bygstad, B. (2016). Generative innovation: A comparison of lightweight and heavyweight IT. *Journal of Information Technology, 32*(2), 180–193.

Cain Miller, C. (2016). The long-term jobs killer is not China. It's automation. [WWW Document]. The New York Times. Retrieved April 17, 2018, from https://www.nytimes.com/2016/12/21/upshot/the-long-term-jobs-killer-is-not-china-its-automation.html.

Carr, N. (2015). *The glass cage: How our computers are changing us,* 1 edn. W. W. Norton & Company.

Chao, G. T., & Kozlowski, S. W. J. (1986). Employee perceptions on the implementation of robotic manufacturing technology. *Journal of Applied Psychology, 71*(1), 70–76.

Charmaz, K. (2006). *Constructing grounded theory: A practical guide through qualitative analysis*. London, United Kingdom: SAGE Publications.

Davis, L. E. (1962). The effects of automation on job design. *Industrial Relations: A Journal of Economy and Society, 2*(1), 53–71.

Delehanty, G. E. (1966). Office automation and the occupation structure. *IMR; Industrial Management Review* (pre-1986) *7*(2), 99.

Engelbart, D. (1962). Augmenting human intellect: A conceptual framework. *Contract, 49*(3578), 80.

Faunce, W. A., Hardin, E., & Jacobson, E. H. (1962). Automation and the employee. *The ANNALS of the American Academy of Political and Social Science, 340*(1), 60–68.

Ford, M. (2015). *Rise of the robots: Technology and the threat of a jobless future*. Basic Books.

Frey, C. B., & Osborne, M. A. (2017). The future of employment: How susceptible are jobs to computerisation? *Technological Forecasting and Social Change, 114,* 254–280.

Fung, H. P. (2014). Criteria, use cases and effects of information technology process automation (ITPA). *Advances in Robotic and Automation, 3*(3), 1–11.

Gnambs, T., & Appel, M. (2019). Are robots becoming unpopular? Changes in attitudes towards autonomous robotic systems in Europe. *Computers in Human Behavior, 93,* 53–61.

Gohmann, S. F., Guan, J., Barker, R. M., & Faulds, D. J. (2005). Perceptions of sales force automation: Differences between sales force and management. *Industrial Marketing Management, 34*(4), 337–343.

Hallikainen, P., Bekkhus, R., & Pan, S. L. (2018). How OpusCapita used internal RPA capabilities to offer services to clients. *MIS Quarterly Executive, 17*(1), 41–52.

Herold, D. M., Farmer, S. M., & Mobley, M. I. (1995). Pre-implementation attitudes toward the introduction of robots in a unionized environment. *Journal of Engineering and Technology Management, 12*(3), 155–173.

Hoos, I. R. (1960). The impact of office automation on workers. *International Labour Review, 82,* 363.

Horvitz, E. (1999). Principles of mixed-initiative user interfaces. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems the CHI is the Limit—CHI'99* (pp. 159–166).

Jacobson, E., Trumbo, D., Cheek, G., & Nangle, J. (1959). Employee attitudes toward technological change in a medium sized insurance company. *Journal of Applied Psychology, 43*(6), 349.

Jones, E. L. I., Sundaram, S., Chin, X. Y., & Chin, W. W. (2002). Factors leading to sales force automation use: A longitudinal analysis. *Journal of Personal Selling & Sales Management, 22*(1993), 145–156.

Keillor, B. D., Bashaw, E. R., & Pettijohn, C. E. (1997). Salesforce automation issues prior to implementation: The relationship between attitudes toward technology, experience and productivity. *Journal of Business & Industrial Marketing, 12*(3), 209–219.

Keynes, J. M. (1933). Economic possibilities for our grandchildren. essays in persuasion, 358–373.

Lacity, M., Scheepers, R., & Willcocks, L. P. (2018). Cognitive automation as part of Deakin University's digital strategy. *MIS Quarterly Executive, 17*(2), 4.

Lacity, M., & Willcocks, L. (2016). Robotic process automation at Telefónica O2. *MIS Quarterly Executive, 15*(1), 21–35.

Lazarus, R. S., & Folkman, S. (1984). Stress, appraisal, and coping, stress, appraisal, and coping.

Licklider, J. C. R. (1960). Man-computer symbiosis. *IRE Transactions on Human Factors in Electronics HFE-1* (1), 4–11.

Majchrzak, A., & Cotton, J. C. (1988). A longitudinal study of adjustment to technological change: The case of job transfers from mass to computer-automated batch production. *Journal of Occupational Psychology, 61*(1), 43–66.

Olson, M. H., & White, N. H. (1979). Impact of office automation on society: Implications for education, policy and research.

Patton, M. Q. (2001). *Qualitative evaluation and research methods, qualitative evaluation and research methods* (3rd ed.). London: SAGE Publications.

Penttinen, E., Kasslin, H., & Asatiani, A. (2018a). How to choose between robotic process automation and back-end system automation? In *26th European Conference on Information Systems, ECIS 2018* (pp. 1–14).

Penttinen, E., Halme, M., Lyytinen, K., & Myllynen, N. (2018b). What Influences Choice of Business-to-Business Connectivity Platforms? *International Journal of Electronic Commerce, 22*(4), 479–509.

Polkinghorne, D. E. (2005). Language and meaning: Data collection in qualitative research. *Journal of Counseling Psychology*.

Salovaara, A., Lyytinen, K., & Penttinen, E. (2019). High reliability in digital organizing: Mindlessness, the frame problem, and digital operations. *MIS Quarterly, 43*(2), 555–578.

Sills, A. (2016). ROSS and Watson tackle the law [WWW Document]. IBM Watson Blog. Retrieved April 17, 2018, from https://www.ibm.com/blogs/watson/2016/01/ross-and-watson-tackle-the-law/.

Strauss, A., & Corbin, J. (1998). *Basics of qualitative research techniques*. Thousand Oaks, CA, USA: SAGE Publications.

Sutton, S. G., Holt, M., & Arnold, V. (2016). "The reports of my death are greatly exaggerated"—Artificial intelligence research in accounting. *International Journal of Accounting Information Systems, 22,* 60–73.

The Economist. (2016). Automation and Anxiety [WWW Document]. The Economist. Retrieved April 17, 2018, from https://www.economist.com/news/special-report/21700758-will-smarter-machines-cause-mass-unemployment-automation-and-anxiety.

Vaughan, K., & MacVicar, A. (2004). Employees' pre-implementation attitudes and perceptions to e-learning a banking case study analysis. *Journal of European Industrial Training, 28*(5), 400–413.

Yin, R. K. (2013). *Case study research: Design and methods*. SAGE Publications.

Zuboff, S. (1988). *In the age of the smart machine: The future of work and power*. New York: Basic Books.