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Robotic Process Automation and Consequences for Knowledge Workers; a Mixed-Method Study

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Abstract. This paper explores an overly optimistic and tenacious claim in the literature that robotic process automation (RPA) will only free knowledge workers from mundane tasks and introduce more interesting work. We explore this claim and other consequences for knowledge workers using data from a sequential quantitative-qualitative, mixed-method study in Norway. 88 RPA users from different sectors and industries were first surveyed to identify differences in utilization and effects from RPA. Then, differences were explored in 24 in-depth interviews in the public and private sectors, including financial industry, manufacturing, and oil and gas. Results indicate that RPA is used to either layoff or not reemploy knowledge workers, but also to empower knowledge workers with more interesting tasks. Private sector was different from public sector in that private, financial companies have experienced the strongest reduction in the need for employment. RPA often lead to layoffs indirectly, and to reduced need for consultants, especially in financial companies. In contrast, public companies use RPA more for innovations in their service production from increased quality in data registration, handling of invoices, and data migration between systems. We conclude that RPA is maturing as a management tool motivated by cost reductions from reduced employment, and we suggest propositions for further research.

Keywords: Robotic process automation, RPA, knowledge work, knowledge workers

1 Introduction

The majority of academics occupied with knowledge workers and robotic process automation (RPA) seem to assume that automation will free knowledge workers from highly structured routine and manual tasks (e.g. [1, 14, 15]) but not lead to lay-offs. For knowledge workers, the liberation from mundane tasks is especially important for their productivity [8]. As a result, this would lead to empowerment of knowledge workers who will contribute to companies through applying their convergent, divergent and creative thinking skills rather than being made obsolete. According to Drucker, the first requirement in increasing the productivity of knowledge workers is to find out what their tasks are, what they should be, and which tasks should be eliminated [8]. Since even knowledge workers have mundane and repetitive tasks, it seems reasonable then, to assume that they will also be subjected to lay-offs following automation.

Knowledge work and knowledge workers are elusive concepts since their content often is defined as the residual after applying intelligent software via machine learning and artificial intelligence tools [2]. As the result of dynamic changes in the capability of these technologies, we see a growing number of examples of automation affecting Healthcare workers, Lawyers, Accountants and Auditors, all in areas traditionally described as characterized by knowledge work [2].

These assumptions regarding knowledge workers and lack of clarity on knowledge work itself, represent weaknesses in the literature on the applicability and consequences of robotic process automation. As a result, the motive for this study is to contribute to the literature by investigating the following research questions:

How is RPA utilized to transform work in Norwegian companies and what can explain potential differences?

What are the consequences for knowledge workers affected by automation?

The article is organized as follows. In the next section we present relevant studies in the literature on automation and knowledge work. We then describe the combination of methods used to provide information to answer our research questions, before we present results and discuss potential implications for further research and practice.

2 Theory

In the literature, Robotic Process Automation (RPA) has been defined as: "A preconfigured software instance that uses business rules and predefined activity choreography to complete the autonomous execution of a combination of processes, activities, transactions, and tasks in one or more unrelated software systems to deliver a result or service with human exception management" [12]. Following this definition, the result is reproduction of work done by humans by automating their tasks motivated by cost reductions, flexibility, increased speed and resource utilization, improved service capabilities and quality [17]. In the society, we see a growing number of examples of automation and RPA in many industries including the financial industry with banking, insurance and auditing [18, 13], and in public and private healthcare [20]. This development of automation can be explained by Drucker [8] who claims that the biggest challenge for companies in the 21th century whether business or non-business, will be to increase the productivity of knowledge work and knowledge workers (p. 79). Following Drucker [8], six factors define not only knowledge work, but also knowledge workers and their productivity: their tasks can be defined, they are autonomous and responsible for their own productivity, they are continuously innovating and learning, not primarily measured on quantity but rather quality, and treated as "assets" rather than "costs". These factors, following Drucker, except quality, are almost the exact opposite of what characterize manual work and the situation of the manual worker [8].

The definition of RPA above says nothing about the consequences for workers other than that their tasks are automated. Lacity and Willcocks [14] and Lacity, Willcocks and Craig [15, 16] are often cited in the academic and the practitioner literature, on their argument that RPA will liberate knowledge workers from highly structured, routine and mundane tasks so that they can focus on more interesting work. This optimistic view of the consequences, coupled with RPA's simplicity, where people with no programming skills can start applying RPA after just a few weeks of training, are probably two of the most important reasons for its growing popularity.

The general literature on automation describes a less harmonic picture. Here, the impact of task automation is described as increasingly dramatic [17]. Jobs will disappear or be redefined and new will be created [3, 7]. The driver behind automation is associated with underlying data analytics and cognitive technologies as artificial intelligence (AI), machine learning, big data, and natural language processing. Development in these technologies will enable automation of unstructured tasks that previously were impossible to automate [9]. As a result, this advancement in cognitive technologies is also challenging the concepts of knowledge work and knowledge workers.

Despite the positive prospects of RPA in the literature, there are few studies available to support the claim that knowledge workers will be freed from dreary tasks to work with more interesting tasks. Logically, when tasks are freed from the knowledge worker, it is likely that a company instead of providing knowledge workers with more interesting tasks, might need fewer knowledge workers and either lay them off or not reemploy new ones following retirement. The literature has not been able to follow pace with the advancement in technology and provides no clear guidelines on the boundaries between work and knowledge work, or between regular workers and knowledge workers. As a result, the concepts of knowledge work and knowledge workers in the literature appear as residuals after cognitive technologies and data analytics constantly push the borders of what tasks can be automated.

To sum up, the literature on RPA is scarce, unclear and lacks studies on the nature and impact of RPA in organizations and of its human and societal consequences in particular. As a result, we still see the widely cited but largely untested claim that knowledge workers will walk free from the negative consequences of automation, as being replaced or laid off. We lack empirical studies that can confirm or challenge this claim, and thus we do not know how RPA is influencing workers through their tasks in organizations, and whether and where automation might support humans or rather be taking over their jobs [11]. The development in cognitive technologies calls for further theorizing as it challenges central conceptualizations in the literature.

3 Research Approach

To answer our research questions, we chose a sequential quantitative-qualitative mixed method research design [6, 19] with data from Norway. A quantitative survey identified differences in the utilization of RPA that were followed up by in-dept interviews. This elicited potential explanations for the identified differences. Additional interviews were used to target effects of RPA on knowledge workers.

The survey was based on a literature review and input from three consultants on RPA, to identify functions subjected to automation: financial operations, human relations, IT, customer-oriented functions, supply chain management, shared services, and operations. The literature also identified potential effects on employment, productivity, innovation and quality. A survey instrument was then developed and included background information, experience with RPA, number of employees, sector and industry, type of functions automated (economy/finance, human relations, IT, customer support, supply chain, shared services, operations, other), and effects from RPA (downsizing, reduction in mundane tasks, reduced costs, increased productivity, increased innovation, increased service quality, general satisfaction). Response format ranged from 1 (totally disagree) to 7 (totally agree). The identification of respondents used snow-ball sampling, since no coherent database of the population exists. The responses were analyzed using SPSS version 22.

The semi-structured interviews included 24 respondents selected after the quantitative results, representing a sequential quantitative-qualitative data analysis [19]. The interviews were then taped and transcribed, and the qualitative data related to both research questions. Our mixed-method research strategy follows Creswell et al.'s [6] recommendations, where the analyses should progress in different steps related to the research questions. In interpreting the combined results, qualitative data were used to understand quantitative data and vice versa.

4 Results

The instrument was distributed to 438 companies receiving 88 responses (20%). 37 respondents were willing to take part in a follow-up interview. The majority of responses (65) came from private companies in the financial industry (23) and 23 responses from the public sector. Average scores indicate that downsizing is not common (2.1-3.4) but slightly more common in the financial industry (3.4) than in public (2.1) and private sectors (2.8). Reduction of mundane tasks is common in public and financial companies (6.0), and cost reductions (5.2-5.8) and productivity effects (5.6-5.9) were also reported in particular in financial companies. Innovation (5.2) and quality improvements (6.1) were more frequently reported in the public sector. The average satisfaction with RPA was positive and equally strong (5.8-5.9). See Table 1 for an overview.

Experience with RPA ranged from 0 and up to 8 or more years. Private sector (1.4) and financial industry (1.6) report longer experience with RPA than public sector (0.7). Public sector reported less than 2 years of experience, whereas the financial industry reported close to 4 years of experience. Private sector reported short of 3.5 years.

Table 1. Average scores on effects of RPA in public and private sector, and financial industry.

Organizations	Public sector			Private sector			Financial industry		
	<i>n</i>	\bar{x}	<i>S</i>	<i>n</i>	\bar{x}	<i>S</i>	<i>n</i>	\bar{x}	<i>S</i>
Downsizing	19	2.1	1.3	62	2.8	1.9	22	3.4	1.9
Cost reductions	19	5.2	1.7	63	5.5	1.6	22	5.8	1.5
Productivity	19	5.6	1.6	63	5.7	1.5	23	5.9	1.4
Innovation	21	5.2	1.8	63	4.9	1.7	23	4.6	1.7
Quality improvements	20	6.1	0.9	64	5.5	1.6	23	5.6	1.8
Fewer mundane tasks	20	6.0	1.3	64	5.6	1.8	23	6.0	1.7
Satisfaction with RPA	20	5.8	1.5	65	5.9	1.0	23	5.9	1.2
Experience with RPA	23	0.7	0.5	65	1.4	1.2	23	1.6	1.2

Independent samples t-test identified systematic differences, see Table 2. To fit the exploratory purpose, $p < 0.10$ and a two-tailed test identified systematic differences to be included in in-depth interviews.

Table 2: T-test to identify systematic differences between effect scores.

Organizations	Public vs Private sector		Financial vs Other	
	Mean difference	Sig.(2tailed)	Mean difference	Sig.(2-tailed)
Downsizing	-0.68	0.083	1.070	0.028
Cost reductions	-	-	-	-
Productivity	-	-	-	-
Innovation	-	-	-	-
Quality improvements	0.55	0.058	-	-
Fewer mundane tasks	-	-	-	-
Satisfaction with RPA	-	-	-	-
Experience with RPA	-0.65	0.001	0.48	0.10

Table 2 shows average scores on significant differences in effects of RPA, satisfaction with RPA, and experience with RPA between public and private sector, and between the financial industry and other companies in general. Downsizing is less common in the public than private sector. The financial industry reports more downsizing than other companies. Quality effects are more common in public sector than in private sector, and experience with RPA is lower in the public sector than private sector, and longest in the financial industry.

Table 3 reports whether effects from RPA are related to the functions being automated. Two functions were different from functions in general – economy/accounting, and operations. Companies who automate economy/accounting functions experience less downsizing than those who automate other functions. Companies automating economy/accounting functions report significantly less experience with RPA. Companies choosing to automate operations, experience more downsizing than companies selecting other functions. The same appears for innovation, quality and reduction in mundane tasks, where companies automating

operations experience higher effects than companies automating other functions. Companies automating operations are more experienced with RPA. The next section describes potential explanations for these differences, identified through in-depth interviews with selected companies that participated in the survey.

Table 3: T-test of systematic differences in effects from RPA between automated functions.

Automated Functions	Economy/accounting (n=31) vs. other functions		Operations (n=28) vs. other functions	
	Mean difference	Sig.(2tailed)	Mean difference	Sig.(2tailed)
Responses				
Downsizing	-0.97	0.024	1.11	0.028
Cost reductions	-	-	-	-
Productivity	-	-	-	-
Innovation	-	-	0.69	0.052
Quality	-	-	0.82	0.004
Fewer mundane tasks	-	-	0.82	0.010
Satisfaction with RPA	-	-	-	-
Experience with RPA	-0.40	0.085	0.68	0.014

Following Creswell et al. [6] it is necessary to select interviewees from survey respondents for a truly mixed method. Of 88 respondents, 37 were willing to participate in a follow-up interview, showing an interest in the topic area. Table 4 shows the distribution of interviewees in the 24 interviews conducted, including their background. The interviewees had an average of two years of experience with RPA, and three years in the finance industry. Companies primarily automate rule-based and high-volume processes, consistent with the RPA literature.

Functions being automated

Back-office tasks were automated in the finance industry, particularly when RPA was first introduced. This included moving data between systems, invoice processing, updating information in legacy systems, customer management, and customer interaction tasks that customers could perform on their own. Most respondents in the finance industry had automated loan application processing, illustrated by respondent 8: “It would take weeks and days, where 10–15 people were working full time on this. [...] [It now takes] six minutes before the customer gets an offer [...] without any employees involved.”

RPA was employed in various ways in private sector companies, and the respondent from the supplier industry emphasized two main areas: back-office tasks such as moving data between systems and accounting, and data retrieval from web or internal systems, where system integration or APIs were not sufficient. A respondent from the energy sector emphasized HR tasks as travel expense and payroll. The respondent from manufacturing industry reported supply chain processes, for example quality documentation and document processing. The respondent from the Oil industry reported use of RPA most extensively in finance and control. RPA was employed differently in the public sector, mostly for accounting and logistics that were not emphasized in public health enterprises. Many tasks were automated, such as HR,

medical and administrative processes. Respondents from municipalities reported more traditional use of RPA in accounting and invoice processing, and data migration.

Table 4: Roles and affiliation of Interviewees

Respondent	Role	Industry	Sector	RPA Experience
1	Project manager	Municipality	Public	2 years
2	RPA team leader	Health	Public	2 years
3	Value chain coordinator	Manufacturing	Private	3 years
4	Project manager	Oil	Private	2 years
5	Development leader	Insurance	Private	3 years
6	Automation architect	Bank	Private	3 years
7	Project leader/coordinator	Energy	Private	2 years
8	RPA analyst	Bank	Private	3 years
9	Project manager	Bank	Private	3 years
10	Strategic manager	Bank	Private	3 years
11	Advisor	Health	Public	n/a
12	Process analyst/specialist	Bank	Private	4 years
13	IT and development leader	Supplier	Private	2 years
14	Development leader	Municipality	Public	2 years
15	CEO	Wholesale	Private	2 years
16	RPA team leader	Public authority	Public	1.5 years
17	Senior advisor RPA	Health	Public	2 years
18	RPA team leader	Energy	Private	1.5 years
19	Development leader	Bank	Private	2.5 years
20	Manager robotics	Bank	Private	3.5 years
21	Business developer	IT Infrastructure	Private	3.5 years
22	RPA manager	Energy	Private	2 years
23	RPA advisor	Municipality	Public	2.5 years
24	Project manager	Bank	Private	3 years

Work-related consequences

The finance industry stood out as a special case with longer experience with RPA, and more focused on cost reduction. The respondents pointed at the strategic focus on cost efficiency in their industry. Respondent 10 noted: “Yes, there is a lot of [downsizing] in the finance industry. There are severance packages three times a year.” The strong push for cost efficiency can be related to increased competition from new entrants with a strong focus on digital transformation of the industry and the society. This has opened up for new actors, such as Apple and Facebook, where Apple launched Apple pay that forces the incumbent actors to push for more efficiency and innovation in systems solutions and business models. Norwegian banks have therefore invested significantly in new IT technology, which has increased costs and resulting in payroll cost reductions. The largest Norwegian bank (DnB) aims to reduce costs by approximately €200 millions by 2020 using RPA as one of the tools. One respondent (10) noted that his employer did not reveal the full intension behind RPA: “We got a percentage estimate of the workforce that would be replaced by this. My employer stated quite clearly that no one in Norway would be sacked as a result of this. It was a sales gimmick to make people positive.” Another respondent (14) from another bank noted that the strategy of headcount reduction started before they implemented RPA – but that RPA has

contributed to achieving these strategic goals: “It was a strategic decision taken before we started with RPA [...]. RPA has been a very important contributor to achieving these goals.” Respondent 10 added that RPA has influenced recruiting -- they do not hire new people; they employ RPA instead. Respondent 14 asserted: “We have had a quite substantial reduction in headcount, and we process higher volumes than before we started the layoffs.” Both respondent 10 and 14 argued that as RPA was more employed for layoffs, the attitudes among employees become more negative. Respondent 14 noted that “People are afraid of losing their jobs [...]. Those who [work in the processes] are not always the ones that are most willing to assist [with the RPA effort].” The picture is not as dramatic in other industries. Cost reduction and efficiency were a major motivation but without significant effect on layoffs. For many companies, RPA is a way to manage growth and higher process volumes. The respondent from the energy sector noted that there was a push for both cost efficiency and digital transformation. He asserted: “It has been a strong focus on innovation. [...] There has not been a lot of innovation in this industry [...] but [we] are in a technology shift in relation to digitalization. This comes from corporate management.” Respondent 5 from the manufacturing industry corroborated that digital transformation was a driver for change and noted: “we have seen that we can achieve massive cost reductions from using digital technologies. [It implies] new ways of working.”

Respondent 9 from the energy industry commented on headcount reduction: “No, it is not the goal with RPA. It is more value adding work, pleasurable, less ‘mouse arm’ and such that are the benefits.” This was supported in the manufacturing industry where respondent 6 noted: “We have not laid anyone off, and we have no intentions of doing that. [...] people have too much to do. [...] there is always something else that you can fill your days with [...] that is more value adding or reasonable.” The respondent from the supplier industry reported no layoffs due to RPA because of more customers and work, and that it is too early to tell if RPA will lead to layoffs: “We grow without [hiring] new people. [...] RPA is a way to handle a part of the growth.”

The major motivation in the public sector for acquiring RPA was process and service quality improvements. For health enterprises this means freeing up health workers from administrative tasks to patient care. Respondent 4 noted: “We have very little focus on [cost reduction]. [...] if you save a few hours for a Chief physician, you don’t reduce his hours, and he will spend his time more effectively on the tasks that he should perform, for example with the patient. [...] for us it is more freeing up time, and to a great extent [achieving greater] quality.” Respondent 13 corroborated and noted that a major goal with RPA was to increase patient security and freeing up health personnel from administrative tasks. One respondent from a municipality noted that cost efficiency was a major motivation for acquiring RPA as an inexpensive way to solve systems integration problems, and that RPA reduced the need for new employees with payroll cost reduction over time.

Consequences for knowledge workers

All companies interviewed pointed at positive consequences from more efficient work processes with fewer routine tasks, and at new and more important tasks for the company. These tasks were also more meaningful for the employees. Respondent 16 from the public sector asserts: “It has been a change in tasks where those tasks we still do are those that need human judgement, but we have got rid of those boring tasks [...] so we can concentrate on new and unsolved tasks”. Respondent 15 from a wholesale company adds: “In our case, workers work more with sales tasks which leads to better market relations and increased sales – this is what makes a salesperson valuable”. Respondent 19 from a bank argues: “They [workers] do other and newer tasks because it [RPA] frees up capacity to prioritize differently and learn from new insight into process and technology”. Respondent 18 from an energy company also point at learning: “In those processes where we have had a full-time employee, we are working to find new alternatives for them. Out in the business units there are plenty of tasks to do, so business units are challenged to making sure that we learn to create value in new ways”. Similar stories are told across industries and sectors. Companies point at the increased efficiency created by the removal of routine task, which has created opportunities to take on new tasks and to learn new skills. This means that knowledge workers are freed from mundane tasks and given new and more meaningful opportunities. Still, this is not the whole story. Most companies were reluctant in admitting that knowledge workers could lose their jobs. Rather, they argue that they meet downsizing with automation or that retirement will not be met by recruitment, as respondent 24 from a bank asserts: “We have removed tasks from the regional offices, which has made us downsize through retirement without laying people off”. Respondent 22 from an energy company points to other effects: “We have some consultants in the company, so one alternative is not to hire so many of those and [thus] create more value per employee”.

Respondents from the public sector and across private industries point at the communication around potential layoffs as challenging. Informant 20 from a bank reports: “Cutting costs can be done in many ways. Everybody thinks immediately that people will be fired as the only way of cutting costs. This is totally wrong because you might rather use their time to do tasks that you so far have not been able to do in the company, including new services and tasks that have been neglected for a long time. You can simply do more with the same workforce and thus save money”. The difficulty of talking about layoffs was further elaborated by respondent 23 from a public company: “You cannot brag too much about how many positions you have saved up because you have to keep managers, workers and unions happy”.

5 Discussion and Implications

This research explored how RPA are used to transform work (RQ1) and what consequences are for knowledge workers (RQ2) in Norwegian organizations. We

identified several interesting issues in the quantitative phase that was further explored in the interviews, and in a combined analysis. The main contribution of our work is to refute the assertion that RPA will not lead to layoffs among knowledge workers [14]. Our findings demonstrate no reason to believe that knowledge workers are exempt from the consequences of RPA. While RPA has mainly been seen as a tool for liberating knowledge workers from tedious tasks, we found that RPA is indeed used for layoffs among knowledge workers, particularly in the finance industry. This industry has longer experience with the RPA than other industries and the public sector in our data, and it is reasonable to assume that financial companies are among the most mature RPA users. The finance industry had significantly more reduction in headcount than the other industries. The interviews showed that the reduction came from reduced hiring and layoffs, even though RPA in one instance was sold in as not leading to layoffs, but indeed used in this way eventually. This contrasts case studies of Lacity, Willcocks and Craig [15, 16] and the assertion that RPA will not lead to layoffs among knowledge workers [14]. One might ask why the myth that RPA will not lead to layoffs for knowledge workers seems so persistent? Obviously, being open with the fact that knowledge workers risk losing their jobs would create socio-political resistance against RPA. Resistance from knowledge workers is probably more challenging than resistance from regular workers, and silence to avoid resistance, combined with the likelihood that reduced need for knowledge workers emerges over time, stand out as a potential explanation for the myth. Until recently, it was perceived that jobs susceptible to automaton were in the middle of the workforce skill spectrum [9], leading to a decrease in jobs in this skill spectrum [10]. Technological development in cognitive IT technologies such as AI and machine learning enables automation of tasks that require human judgment [13, 17]. We argue that when RPA applications are programmed to access such cognitive IT applications, they can automate most knowledge worker assessments and reduce the need for most types of knowledge workers.

Studies of RPA implementation indicate that 30-50% of projects fail (Hindle et al. 2018 according to [18]) and one important reason is lack of stakeholder buy-in. We argue that it is important that management is realistic and open about the consequences of RPA adoption, and not paint an unrealistically positive picture. The management of any organization will always be looking for ways to improve the bottom line, and we argue that RPA is a handy tool for reducing personnel costs. We further conjecture that RPA will enter the management's standard toolbox as organizations become more mature RPA-users, and RPA will be used to reduce personnel costs. For organizations needing to reduce costs and improve efficiency, like businesses in the finance industry, layoffs are relevant. Thus, we raise the following proposition: P1: *As organizations gain experience with the RPA technology, they will use it more extensively for reducing personnel costs, including laying off among knowledge workers.*

The finance industry has little room for differentiation [4, 5] and experiences a strong focus on cost leadership and efficiency. It not surprising that RPA has been utilized for

achieving cost reduction. We believe that the same logic applies for any industry with a low differentiation, and for companies with a cost-leadership strategy in any industry. We therefore argue that organizations or industries with little differentiation, and thus a strong focus on cost leadership, will find RPA attractive for reducing costs. We raise the following propositions: P2: *Industries with little product or service differentiation will use RPA more for reducing personnel costs, including laying off knowledge workers.* P3: *Organizations with little product or service differentiation will use RPA more for reducing personnel costs, including laying off knowledge workers.*

Second, public sector organizations had a limited focus on personnel cost reductions from RPA and instead focused on increasing service quality by freeing up personnel from administrative tasks. RPA can be a valuable tool to improve public sector services, especially in public sector health enterprises struggling to cope with a growing need for elderly healthcare in Norway as in other industrialized countries. We saw that municipalities used RPA for reducing payroll expenses, and we argue that even if organizations in the short term may use RPA to free up knowledge workers for more meaningful tasks, RPA will eventually enter management's standard toolbox, and be used to cutting personnel costs among knowledge workers. Some benefits will be achieved by giving employees new job assignments, but we argue that knowledge workers are not exempt from economic reality and may become redundant. We expect that RPA will lead to layoffs of knowledge workers, and we forward the following propositions: P4: *RPA will be used to improve service quality in the public sector.* P5: *RPA will lead to layoffs among knowledge workers in the public sector.*

Third, quantitative analysis showed that organizations with the longest experience with RPA in operations had larger effects from cost reductions, innovation, quality and reduction of mundane tasks. These findings illustrate that operational tasks are the most important application area related to the creation of products or services. In the finance industry such processes could be loan application processing, and in the manufacturing industry it could be quality documentation processing. Further research should address how RPA is utilized in various functions and look at variations in the effects.

Our exploratory study has several limitations. First, no database of companies using RPA existed at the time of study, necessitating a snowball sampling with low control with how the sample represents the population. Second, automation with RPA is highly dynamic and change as new cognitive technologies emerge, challenging our use of concepts related to automation and knowledge work.

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