ROBOTIC PROCESS AUTOMATION FOR KNOWLEDGE WORKERS – WILL IT LEAD TO EMPOWERMENT OR LAY-OFFS?

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Abstract

This paper explores an almost axiomatic claim in the literature that robotic process automation (RPA) represents no threat to knowledge workers who will get fewer routine tasks and more interesting and cognitively challenging work. We explore this claim with data from a sequential quantitative-qualitative, mixed-method study in Norway. 88 RPA users from different sectors and industries where first surveyed to identify differences in their perceived effects from RPA. Then, differences were followed up in 14 in-depth interviews from public sector, financial industry and manufacturing, and oil and gas. Findings revealed that RPA indeed is used to lay-off or not reemploy knowledge workers. Further, we found different effects in public and private sector, and that private, financial companies have experienced the strongest reduction in the need for employment. We find that RPA often lead to lay-offs indirectly, and to reduced need for consultants, especially in financial companies. Public companies focus more on using RPA for innovations in their service production by increasing quality in data registration, handling invoices, and migrating data between systems. We conclude that RPA is maturing as a management tool where cost reductions through reduced employment is an important motivator, and we present propositions for further research.

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. Aguirre and Rodriguez 2017, Lacity and Willcocks 2015, Lacity, Willcocks and Craig 2015) but not lead to lay-offs. For knowledge workers, the liberation from mundane tasks is especially important for their productivity (Drucker 1999). 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. 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 (e.g. Boulton 2018). 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 (Boulton 2018).

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 question:

What are the effects of robotic process automation on knowledge worker employment – to what extent are knowledge workers empowered or obliterated by automation?

The article is structured as follows. In the next section we elaborate further on previous studies in the literature on automation and knowledge work. We then describe the methods chosen to provide information to enlighten our research question, before we present results and discuss potential implications for further research and practice.

2. THEORY

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"* (IEEE Corporate Advisory Group, 2017). According to this definition, the result is reproduction of work done by humans by automating their tasks. Motives for such automation are cost reductions, flexibility, increased speed and resource utilization, improved service capabilities and quality (Marshall and Lambert 2018). As a result, we see a growing number of examples of automation and RPA in many industries including the financial industry with banking, insurance and auditing (e.g. Moffitt, Rozario and Vasarhelyi 2018, Kokina and Davenport 2017), and in public and private healthcare (e.g. Wasen 2010). This development fits well with Drucker (1999) 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). According to Drucker (1999, p. 83), there are six factors that define knowledge workers and determine 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, are with the exemption of quality, almost the exact opposite of what is characterizing the situation of the manual worker.

The definition of RPA above says nothing about the consequences for workers other than that their tasks are automated. Lacity and Willcocks (2015) and Lacity, Willcocks and Craig (2015a, 2015b) are often cited in the academic as well as 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.

In the general literature on automation, the impact of task automation is pictured as increasingly dramatic (Marshall and Lambert 2018). Jobs will be eliminated or redefined and new will be created (Brynjolfsson and McAfee 2011, Davenport and Kirby 2016). The advancement in 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 (Frey and Osborne 2017). The concepts of knowledge work and knowledge workers are challenged by this advancement in cognitive technologies.

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 is

not clear on the boundaries between work and knowledge work, or between workers and knowledge workers given the advancement in technology. The concepts of knowledge work and knowledge workers in the literature appears as a residual after cognitive technologies and data analytics constantly push the borders of what tasks can be automated.

To conclude, 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. There is a widely cited by still largely untested claim that knowledge workers will walk free from the negative consequences as being replaced or laid off. We still do not know how RPA is influencing workers through their tasks in organizations, and whether and where automation might support humans or taking over their jobs (Ghisilieri, Molino and Cortese 2018). Moreover, the development in cognitive technologies is challenging central conceptualizations within the literature and calls for further theorizing.

3. RESEARCH METHODS

We have chosen a sequential quantitative-qualitative mixed method research design (Creswell, Klassen, Plano Clark and Smith 2011, Venkatesh, Brown and Sullivan 2016) with data from public and private companies in Norway to shed light on our research question. First, we use a quantitative survey to identify differences between sectors and industries. Second, we follow up on the differences identified with in-dept interviews of informants from sectors and industries where differences were identified. This approach allows us to go deeper into potential explanations (qualitative approach) for differences that we have evidence to assume are systematic (quantitative approach). As such, the combination of research methods allows us to focus on empirical data that both are interesting and that have a greater potential to present relevant explanations.

3.1. Quantitative phase 1

A review of the literature was used to identify which functions were subjected to automation with RPA in organizations along with input from three consultants on RPA. Functions identified included financial operations, human relations, IT, customer-oriented functions, supply chain management, shared services, and operations. Based on the literature, we identified potential effects on employment, productivity, innovation and quality. A survey instrument was developed which also included background data including experience with RPA. The instrument included background information on number of employees, sector and industry, experience with RPA in years, type of functions subjected to automation (economy/finance, human relations, IT, customer support, supply chain, shared services, operations, other), and experienced effects from RPA (downsizing, reduction in mundane tasks, reduced costs, increased productivity, increased innovation, increased service quality, general satisfaction). Response format on effects ranged from 1 (totally disagree) to 7 (totally agree) with a don't know response option. Finally, the instrument asked whether the respondent would be willing to participate in a follow-up interview and asked for contact information.

The lack of a data base of RPA users in Norway made it impossible to identify a coherent sample of companies as the basis for distributing the survey instrument. Rather, we created a list of users through a combination of approaches involving already known users and companies, LinkedIn search and snowball sampling. The search in LinkedIn identified public organizations and private companies from many industries including finance and insurance, construction, energy, tourism, health services, logistics, education, shipping and others. Companies were invited to participate in a survey (in SurveyXact) by email and also asked to forward the link to the instrument to other users or companies in their network. The responses were analyzed using SPSS version 22.

3.2. Qualitative phase 2

The qualitative part of the research methods represents a follow-up on the findings identified in the quantitative phase 1. The analysis of the empirical survey data was done before the qualitative approach was designed to allow for an in-depth analysis of the empirical results, representing a sequential quantitative-qualitative data analysis (Venkatesh et al. 2016) where the selection of interviewees was done after the quantitative results were clear.

Interviews were scheduled with those respondents in the survey that indicated they were willing to be interviewed and who provided their contact information. The interviews were semi-structured containing issues covered in phase 1 as well as open-ended questions. They were then taped and transcribed. The subsequent analyses of the qualitative data related to the relevant part of the research question.

3.3. Combined analyses phase 3

Our strategy for analysing data follows Creswell et al.'s (2011, p. 84) recommendations where the analyses should progress in different steps related to the research questions. In interpreting the combined results, the data should be integrated by using both qualitative data to understand quantitative data and vice versa.

4. RESULTS

4.1. Quantitative phase 1

The snowball sampling approach distributed the instrument to a total of 438 companies who activated the link to the instrument, out of which 88 responded (20%). The survey was active for two weeks. 37 respondents were also willing to take part in a potential follow-up interview and provided us with relevant contact information.

Table 1 shows that the majority of responses (65) came from private companies where responses from the financial industry were dominating with a total of 23 responses. This industry is therefore reported as a specific group in addition to private companies in general in the subsequent analyses. A total of 23 responses came from the public sector. Average scores (ranging for 1: totally disagree/very low extent, to 7: totally agree/very high extent) indicate that downsizing is not generally experienced by the sample (2.1-3.4) and slightly more common in the financial industry (3.4) than in public (2.1) and private sectors (2.8) in general. Reduction of mundane tasks is equally quite common in public and financial companies (6.0). Cost reductions (5.2-5.8) and productivity effects (5.6-5.9) were also positive in the sample and 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 in all companies (5.8-5.9).

The response format for experience with RPA in the survey presented different groups of experience, ranging from 0 (0-1 years), 1 (2-3 years), 2 (4-5 years), and up to 4 (8 or more years). Table 1 shows that private sector in general (1.4) and financial industry in particular (1,6) report longer experience with RPA than public sector (0.7). Public sector reported in average less than 2 years of experience, whereas the financial industry reported close to 4 years of experience. On average, private sector reported short of 3.5 years of experience.

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

Organizations	Public sector			Private sector			Financial industry		
Responses	*N*	*Average*	*Std.dev.*	*N*	*Average*	*Std.dev.*	*N*	*Average*	*Std.dev*
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

Standard deviations show that the variability in the responses differs from low (0.9) for quality effects in public sector, to rather high as for downsizing effects in financial and private companies in general (financial industry included). It is not clear whether differences between effects are systematic or random. To identify areas where these differences in reported effects are systematic, we conducted an independent samples t-test, reported in Table 2. Since this study is exploratory in nature, we selected a significance level up to $p<0.10$ and a two-tailed test as the basis for identifying areas where differences are most likely systematic to be followed up in in-depth interviews.

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

Organizations	Public vs Private sector		Financial vs Other	
Responses	*Mean difference*	*Sig.(2-tailed)*	*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 comparisons of average score on 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 (private and public). Downsizing is significantly less frequently reported in the public than private sector. The financial industry reports significantly more downsizing than companies in general. Quality effects are significantly more common in public sector than in private sector, and experience with RPA is significantly less in the public sector than in the private sector. Experience with RPA is significantly longer in the financial industry.

Finally, we investigated whether the reported effects from RPA were related to the type of functions that were subjected to automation. Two functions areas emerged that were different from functions in general – economy/accounting, and operations. Table 3 indicates significant differences in reported effects of RPA between automated functions.

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

Automated Functions	Economy/accounting (n=31) vs. other functions		Operations (n=28) vs. other functions	
Responses	*Mean difference*	*Sig.(2-tailed)*	*Mean difference*	*Sig.(2-tailed)*
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

Table 3 shows that companies who have chosen to automate economy/accounting functions have experienced significantly less downsizing compared to those that selected other functions. Moreover, companies selecting economy/accounting functions report significantly less experience with RPA.

For companies choosing to automate operations, the opposite picture emerges in that they experience significantly more downsizing than companies selecting other functions. The same can be observed for Innovation, quality and reduction in mundane tasks, where companies that have automated operations experience significantly greater effects than companies selecting other functions. Finally, companies automating operations have also significantly longer experience with RPA.

In the next section we will describe how we addressed these differences to identify potential explanations through in-depth interviews with selected companies that also participated in the survey.

4.2. Qualitative phase 2

According to Creswell et al. (2011) it is necessary to select the interviewees from the survey respondents for a method to be truly mixed. Of the 88 respondents that returned survey data, 37 were willing to participate in a follow-up interview. This relatively large interest for taking part in the interview illustrates that the topic area was of interest to the participants. Building on identified differences from phase 1, 14 semi-structured interviews were scheduled from public and private companies, and companies in the Finance industry. Table 4 shows the distribution of interviewees.

Table 4: Distribution of Interviewees in Phase 2

Category	Number of Interviewees	Respondent #
Bank/finance/insurance	6	7,8,10,11,12,14
Other private companies	4	2,5,6,9
Public sector	4	1,3,4,13

We recruited interviewees that were involved in RPA projects. They represented different roles and had varying experience with RPA. Table 5 provides detailed information regarding their background.

Table 5: Roles and affiliation of Interviewees in Phase 2

Respondent	Role	Industry	Sector	Experience with RPA
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 and RPA 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 and RPA specialist	Bank	Private	4 years
13	IT and development leader	Supplier	Private	2 years
14	Development leader	Municipality	Public	2 years

The interviews corroborated that the respondents on average had two years of experience with RPA, and that respondents from the finance industry had longer experience. The respondents from the finance industry had on overage three years of experience. We found that the companies would primarily automate rule-based and high-volume processes, consistent with the RPA literature. We identified some interesting issues not commonly reported in the literature. We first address the functions being automated and then the work-related consequences.

Functions being automated

The interviews showed that there was an emphasis on automating back-office tasks in the finance industry. This was particularly true when RPA was first introduced. This related to tasks such as moving data between systems, invoice processing, and updating information in the legacy systems. Customer management was also automated, especially customer interaction task that customers would be able to perform on their own. Almost all respondents in the finance industry had automated loan application processing. This is illustrated by the following assertion from 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 has been employed in quite various ways in private sector companies. The respondent from the supplier industry emphasized two main areas. The first one was back-office tasks such as moving data between systems and accounting. The second area was data retrieval from the web or from internal systems, where system integration and standard APIs were not sufficient. Such data were used for analysis purposes. The respondent from the energy industry emphasized HR tasks such as travel expense and payroll. The respondent from the manufacturing industry noted that they had focused on supply chain processes, for example quality documentation and document processing. The respondent from the Oil industry reported that they had utilized RPA most extensively in finance and control.

RPA has also been employed in various ways in the public sector. In contrast to the private sector companies, accounting and logistics had not been emphasized in the public health enterprises interviewed. A wide range of tasks has been automated, such as HR, medical and administrative processes. The respondents from the municipalities reported that they had employed RPA in a

more traditional way, in accounting and invoice processing. One of the municipalities had also used RPA for data migration.

Work-related consequences

It was evident that the finance industry was a special case. They had a longer experience with RPA, and they were more focused on cost reduction. The respondents from this industry noted that it is a strategic focus on cost efficiency in their industry. Respondent 10 noted that: "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 an increased competition from new entrants with the strong focus on digital transformation. The digital transformation of the industry and the society has opened up for new actors in the finance industry, such as Apple and Facebook. Apple had launched Apple pay, and this 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 led to higher costs. They have therefore targeted significant payroll cost reductions.

The largest Norwegian bank (DnB) has announced that it aims to reduce costs by approximately €200 millions by 2020. RPA is one of the tools for achieving this cost reduction. One of the respondents (10) noted that his employer did not reveal the full intension with implementing 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 also added that RPA also has influenced recruiting -- they do not hire new people; they employ RPA instead. Respondent 14 also asserted that: "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 asserted that as RPA had been more employed for layoffs, the attitudes among employees had 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 that dramatic in the other industries. Cost reduction and efficiency has been a major motivation but has not had any significant effect on layoffs. For many companies, RPA has been 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 as well as for digital transformation. He asserted that: "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 that "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 noted that the motivation from acquiring RPA was not headcount reduction: "No, it is not the goal with RPA. It is more value adding work, pleasurable, less 'mouse arm' and that kind of things that are the benefits." This was also the experience in the manufacturing industry. Respondent 6 noted that RPA frees up people to do more value adding work. He asserted that: "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 value adding or reasonable." The respondent from the supplier industry noted that they had not yet had layoffs due to RPA. This was due to a growth in number of customers and work. The respondent asserted that is was too early to tell whether RPA would lead to layoffs. He

noted that "We grow without [hiring] new people. […] RPA is a way to handle a part of the growth."

The major motivation for acquiring RPA in the public sector was related to process and service quality improvements. In the health enterprises this would mean freeing up health workers form administrative tasks to patient care tasks. Respondent 4 noted that "We have very little focus on [cost reduction]. […] if you save a few hours for a Chief physician, you don't reduce his hours. The Chief physician will spend his or her time more effectively on the tasks that he or she 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 this perspective and noted that a major goal by implementing RPA was to increase patient security and freeing up health personnel from administrative tasks.

However, one of the respondents from a municipality noted that cost efficiency was a major motivation for acquiring RPA. It was an inexpensive way to solve systems integration problems. RPA had also reduced the need for hiring new employees in this municipality, and that payroll cost reduction will be achieved over time.

5. DISCUSSION AND IMPLICATIONS

We have explored how RPA have been employed in Norwegian organizations. We identified several interesting issues in the quantitative phase that was further explored in the interviews, and in a combined analysis. We discuss the most important findings and raise several propositions for further research. First, the main contribution of this paper is to refute the assertion that RPA will not lead to layoffs among knowledge workers (Lacity and Willcocks 2015). Our findings demonstrate that there is no reason to believe that knowledge workers are exempt from the consequences of RPA adoption. While RPA has mainly been perceived as a tool for liberating knowledge workers from tedious tasks, we found that RPA is indeed used for layoffs among knowledge workers. This is particularly evident in the finance industry. This industry has a significantly longer experience with the RPA technology than the other industries and the public sector, and it is therefore reasonable to assume that companies in the finance industry are among the most mature RPA users. The finance industry had significantly more reduction in headcount than the other industries. The interviews showed that this reduction did not only come through reduced hiring, but also through layoffs. We also saw that RPA in one instance was sold in as not leading to layoffs, but that it was indeed used in this way eventually. This is in contrast to the findings in Lacity, Willcocks and Craig's case studies (2015a, 2015b) and the assertion that RPA will not lead to layoffs among knowledge workers (Lacity and Willcocks 2015).

Until recently, it was perceived that tasks susceptible to automaton were jobs in the middle of the workforce skill spectrum (Frey and Osborne 2017), leading to a decrease in jobs in this skill spectrum (Goos and Manning 2007). As technological development advances, advanced cognitive IT technologies such as AI and machine learning will be able to automate tasks that requires a great deal of human judgment (Kokina and Davenport 2017; Marshall and Lambert 2018). We therefore argue that when RPA applications are programmed to access such cognitive IT applications, it can automate most knowledge worker assessments. Automation may therefore lead to less need for most types of knowledge workers.

Studies of RPA implementation have indicated that 30-50% of projects fail (Hindle et al. 2018 ref. in Moffitt et al. 2018 p.9). One important reason for this is lack of stakeholder buy-in. We argue that it is therefore important that management is realistic and open about the consequences of RPA adoption, and not paint a too positive picture.

The management of any organization will always be looking for ways to improve the bottom line, and we argue that RPA will be a handy tool for reducing personnel costs. We further conjecture that as organizations become more mature RPA-users, RPA will enter the management's standard toolbox, and will be used for reducing personnel costs. For organizations that need to reduce costs and improve efficiency, like businesses in the finance industry, this may also imply layoffs. We therefore raise the following proposition:

P1: As organizations gain experience with the RPA technology, they will use it more extensively for reducing personnel costs, including layoffs among knowledge workers.

The finance industry is an industry with little room for differentiation (Campbell-Hunt, 2000; Chan Kim and Mauborgne 2004). This industry has therefore experienced a high focus on cost leadership and efficiency. It should therefore not be surprising that RPA also has been utilized for achieving substantial cost reduction in this industry. 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 an attractive tool for reducing costs. We therefore raise the following propositions:

P2: Industries with little product or service differentiation will use RPA more for reducing personnel costs, including layoffs among knowledge workers.

P3: Organizations with little product or service differentiation will use RPA more for reducing personnel costs, including layoffs among knowledge workers.

Second, we saw that public sector organizations had a very limited focus on achieving personnel cost reductions from RPA. They instead focused on increasing service quality by freeing up personnel from administrative tasks. We thus see that RPA can be a valuable tool to improve public sector services. This may especially be true in public sector health enterprises struggling to cope with a growing need for elderly healthcare in Norway as well as in other industrialized countries. However, we also saw that municipalities had already used RPA for reducing payroll expenses. We argue that even if organizations in the short term may be using RPA to free up knowledge workers for more meaningful tasks, RPA will eventually enter management's standard toolbox, and then also be used to cutting personnel costs among knowledge workers. Some of that will be achieved by giving employees new job assignments, but we argue that knowledge workers are not exempt from economic reality, and they may also become redundant. We therefore expect to see that RPA will lead to layoffs of knowledge workers. We therefore 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, the quantitative analysis showed that the organizations had longest experience with RPA in operations. They also had significantly larger effects on cost reductions, innovation, quality and reduction of mundane tasks for this function. These findings illustrate that operational tasks have been the most important application area. These tasks are related to the creation of products or services. In the finance industry such processes would for example 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.

6. CONCLUSION

This study explored a common claim in the literature that automation with RPA does not lead to lay-offs of knowledge workers. We found that RPA does indeed lead to lay-offs and especially among knowledge workers in companies with extensive experience with RPA such as the finance industry.

Our study has several implications for further research, formulated through several propositions. We believe that this would contribute to a more realistic view on automation through RPA both in research and in practice.

There are several limitations in our exploratory study. First, no database of companies using RPA existed at the time of study, necessitating a snowball sampling approach. This implies less control with the sampling procedure. However, for an exploratory study like this, a representative sample is not required. Second, the phenomenon of automation with RPA is highly dynamic and changing rapidly for example as new cognitive technologies emerge. This challenges our use of concepts related to both automation and knowledge work.

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Appendix 1: Survey instrument

1. In what industry is your organization? (Multiple selection possible)

1 Bank/Finance	2 Personnel/recruitement	3 Construction	4 Retail
5 Fisheries/Agriculture	6 Insurance	7 Property	8 Energy
9 Health care	10 Hotel/catering	11 Manufacturing	12 Information technology
13 Municipality	14 Logistics/transportation	15 Media	16 Public management
17 Oil/gas	18 Production	19 Auditing/accountancy	20 Shipping
21 Telecom	22 Education	23 Other (specify)	

2. In what sector is your organization?
1: Public 2: Private

3. Number of employees
1: 0-24. 2: 25-49. 3: 50-249. 4:250-999. 5:1000+. 6: Don't know

3. Experience with RPA (years)?
0: 0-1. 1: 2-3. 2: 4-5. 3: 6-7. 4: 8 or more 5: Don't know

4. Which functions have totally or partially been automated?

1 Economy/accounting	2 HR/Personnel mngmt	3 Information technology	4 Customer contacts
5 Supply chain mngmt	6 Shared services	7 Operations	8 Other (specify)

5. Effects from RPA? (Response formats from 1: Totally disagree, to 7: Totaly agree, with 8: Don't know)
- Using RPA has led to downsizing
- Using RPA has freed employees from mundane tasks
- Using RPA has led to reduced costs
- Using RPA has led to increased productivity
- Using RPA has led to more innovation
- Using RPA has increased quality of services

- In total, we are satisfied with using RPA

6. Are you willing to take part in a follow-up interview?
- If so, please provide contact information

Appendix 2: Interview guide

1. Background for the study, ethical issues, confidentiality and consent

2. Background of the interviewee
- education, experience, years employed, role in the organization

3. About the RPA project in your organization
- Which functions are totally or partly automated?
- How is the RPA work organized?
- How long experience do you have with RPA?
    - do the length of experience matter for the RPA work?
    - Who took the initiative to adopt RPA in your organization?
    - What was your motivation for using RPA?

4. Has RPA led to reduced costs?
    - (If yes) how significant have these reductions been?
    - Were these effects as you anticipated prior to the project?
    - (If no) What do you think were the reasons why?

5. Have you experienced increased productivity after implementing RPA?
    - (If yes) In which department/area do you see the highest productivity increase?
    - Why do you see more productivity increase here than in other areas?
    - (If no) What do you see as the reasons for this lack of productivity gains?

6. Did you experience increased quality in the delivery of services after you started using RPA?
    - (If yes) How did RPA influence the quality in service delivery?
    - What are the reasons for higher quality after using RPA?
    - Which areas/functions had the most visible increase in quality?
    - Our study shows that public sector experience higher quality effects than private sector. Do you have any ideas why this might be the case?
    - (If no) What could be the reason for no quality increase after using RPA?

7. Did you experience more innovation after implementing RPA?
    - (If yes) To what extent did you see an increase in innovation?
    - In what area/function did the innovation take place?
    - Do you have a culture for innovation in your organization?
    - Our study shows that public sector experience more innovation than the private sector following RPA. Do you have any idea why this might be the case?
    (If no) Are you going to explore options for innovation from automation with RPA?

8. How you experienced down-sizing after using RPA?
    - (If no) Have employees received other tasks/roles?
    - Which functions were automated in your organization?
    - Have you in any way changed your recruitment following RPA?
    - (If yes) Can you describe how this took place?
    - How extensive has this down-sizing been?
    - Which functions/areas have been automated that led to down-sizing?

9. Is RPA a long-term strategy in your company?

10. Our survey showed longer experience with RPA in private sector compared to public sector. Do you see why this is the case?

11. In total, are you satisfied with your use of RPA so far?

12. If you were to implement RPA again - is there something you would have done differently?

13. Closing remarks, access to transcript, process to sort out potential misunderstandings, etc.