Robotic Process Automation as a change agent for business processes: Experiences and expectations

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Abstract: Robotic Process Automation (RPA) is a technology area that has quickly become part of business processes both in public administration as well as in corporations. The expectations for RPA lie in its potential to shift routine work to robotic applications and thus free resources within company functions for more strategic and development-focused work. The development pace for RPA applications and usage has "outspeeded" academic research of and education on RPA. As a response, various academic institutions have established RPA study units to their degree studies and/or special study packages (advanced diplomas) to respond to the market demand for RPA capabilities. The paper studies the experiences and expectations that participants of the RPA education i.e. early adopters set for the RPA as a technology, its perceived applicability generally and specifically to their field of work. The paper aims at discussing how the theoretical models of technology acceptance and utility fit into the phenomenon under study and addresses the enablers and obstacles for this area of robotic technology on the pragmatic level. The paper uses quantitative survey-based data collection and as an early step on the research field, sheds light on the phenomenon by descriptive statistics. The findings are assumed to inform further research on the issue and thus contribute into framework building in the academic fields of business process management and robotics.

Keywords: Robotics, technology acceptance, RPA, process management, automation

1. Introduction

Digitalization and automation of business processes has been a topic of academic research and discourse for long, and pragmatic solution for it have also been in active development and deployment at an accelerating pace the last two decades. In early 2000s the rise of web-technologies enabling e-commerce as well as commercial success of Enterprise Resource Planning (ERP) system vendors have given impetus to automating and digitalizing business processes across company functions (Casati and Shan, 2000; Rittgen, 2000). Lately, the rise of RPA has marked the renaissance of business process modelling and automation. Business process modelling consists of process analysis, process modelling and optimisation, process automation and measurement of process indicators in relation with performance indicators (Hammer & Champy, 1993). The novel but widespread concept of industry 4.0 has been another tendency increasing the need for process digitalization (Steiner, 2019) and thus calling for wider and better RPA solutions. The available RPA offering is growing wider in terms of number of applications and vendors. The usability and ease-of-implementation has also developed: The current RPA solutions does not necessarily need advanced computing and programming skills, since systems can record the manual operations of a human actor between programs and databases and emulate the workflow in an automated mode.

The development and spread of RPA solutions has been faster than the growth of body of academic knowledge on the subject. As Syed et al. (2020) note, research on RPA "lacks the sound theoretical foundations that allow for objective reasoning around its application and development", slowing down achievement of meaningful advances in the field.

However only the view on technology falls short. In order to fully benefit from new technologies, the business process improvement potential of technology must be analysed in the context of the socio-technical system of technology and reflected to the structure and behaviour of human organisation (Hirsch-Kreinsen et al., 2018; Franken & Wattenberg, 2019). The systematic literature review by Syed et al. (2020) identified human-aspects to be considered for a successful RPA implementation to include managing fear of potential job loss the need for clear communication, dealing with RPA concept and technology mistrust, the need to set the expectations correctly and the role of change process leadership. This interplay between organizational and human resources with technology are also reflected in the recent predictions of a leading RPA vendor UiPath (2018) that forecasted attended robots and demise of seeing RPA as a replacement of human labour as trends impacting RPA adoption on a short term.

The aim of this article is to study the perception and attitudes towards RPA of experienced professionals across educational levels, orientation and current work environments. The underlying research questions are specified as follows:

1) How do the experiences of RPA learners corresponds to their initial expectations?
2) How do the RPA learners assess the enablers and obstacles for RPA deployment as well as the pace and potential areas of RPA deployment?
3) Which factors contribute to the perceptions, attitudes and intentions of RPA acceptance and should be incorporated into future frameworks of technology acceptance in a mandatory environment?

The paper is structured as follows: In Chapter 2, the key literature of Robotic Process Automation and technology acceptance is reviewed to lay foundation for the empirical part of the study, the methodological choices and implementation of which get introduced in Chapter 3. The results of the empirical study are reviewed in Chapter 4, after which the paper concludes its findings in Chapter 5. The discussion part in Chapter 6 focuses on the theoretical implications of the study as well as the potential pragmatic implication for practitioners aiming at starting the RPA journey or improving the existing business processes including RPA deployment. Lastly, the paper discusses its limitations for generalizability and proposed directions for further research on the issue area.

2. Literature Review

Robotic process automation is one of the currently hyped automation and robotics applications, where the vendors and market data aggregators have repeatedly forecasted 40-60 % gross annual growth rates (GAGR) for a short term future. Saukkonen et al. (2019) coined the RPA term (in their study of impact of an array of emerging technologies to a specific corporate function" as "software that can be easily programmed to do basic tasks across applications just as human workers do. The software robot can be taught a workflow with multiple steps and applications. RPA software is designed to reduce the burden of repetitive, simple tasks".
According to van der Aalst, Bichler and Heinzl (2018) RPA is an umbrella term for multiple tools that operate on the user interface of other information systems in the replicating the way a human would do those operations. What is specific of RPA is that it aims to replace and enhance human work by in an "outside-in'' manner, differently to the classical "inside-out" paradigm for information systems development. When applying the RPA, the information systems involved to the process remain intact (ibid.). This nature of RPA has democratized integration and automation (compared to traditional IT system deployment) and paving way to widespread business adoption (Gartner, 2018).

RPA is thus a new technology that can take over human´s role in running business processes. Ambiquity prevails whether RPA is fundamentally a part of business process reengineering (BPE) or just an automated instantiation of the same process model. Anagnoste (2018) is a proponent of the first view, stating that the end to-end RPA process starts by (Step 1) Process identification, (Step 2) Process assessment and (Step 3) Process reengineering. On the other hand, van der Aalst et al (2018) note that van der Aalst, Bichler & Heinzl (2018) note that the process are bound to the context of their configuration. RPA agents that mimick people can start making incorrect decisions because of contextual changes. This may remain unnoticed and lead to very unwanted situations. (ibid.). In the same vein, Kirchmer (2017) points out that the use of RPA may also act as a cover of symptoms without correcting the real root causes for issues. In the mid and long-term it would be much more beneficial to correct the issues leading to the faults than having an automated system, which is quick to identify and correct the faults. Hence, in a negative scenario RPA may hinder real business process progress (ibid.).

The dual nature of RPA as a process and as a technology/system also shows in the views of the renowned ICT consulting firm Gartner in their RPA predictions for two consecutive years. In 2018, Gartner, when predicting 2019 outlooks, stated it is imperative that sourcing, procurement and vendor management leaders stay at the helm of RPA use and trajectories. This would potentially ensure sourcing efficacy and business agility". A mere year later Gartner (2019) saw imperative that IT leaders should be the ones who stay ahead of RPA use and developments on the market to ensure efficacy and business agility. The latter view may related to the necessity of RPA to co-function with other solutions. Figure 1 shows one depiction of RPA´s connection needs to other systems.

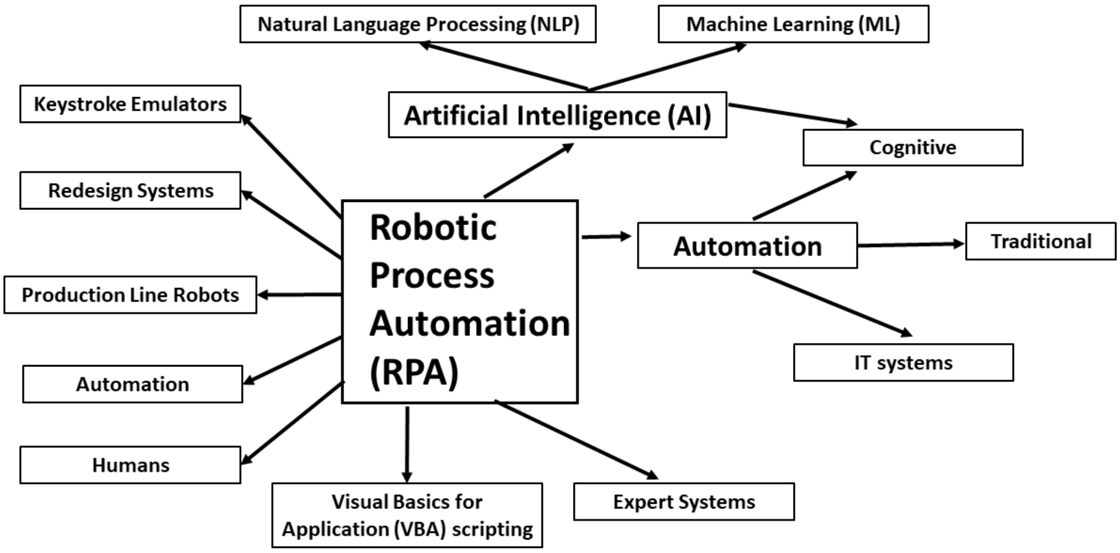

Figure 1: RPA and its connections to other technologies (adapted from Syed et al., 2018).

A RPA vendor UiPath (2018) indicated that the future directions of RPA contain death of outsoucing i.e. firms taking stronger ownerships and artificial intelligence (AI) becoming mainstream. As a result, there will be increasing need to integrate AI to other systems and layers such as RPA. This integrability/interoperability may thus impact the spread of emerging technologies in an increasing manner, and analyses on individual technologies may be shortsighted.
For a technology to spread to the market it needs to show relevancy that leads to acceptance and further to techlogy adoption by its potential users. Davis published the original technology acceptance model (TAM) in 1985. The model (Figure 2) depicts the trajectory to actual use of a new technology to be a function of attitudes and intention towards technology usage that are grounded on perceptions of usefulness and ease of use. External variables are in the model latent variables that affect the manifest variables i.e. perceptions.

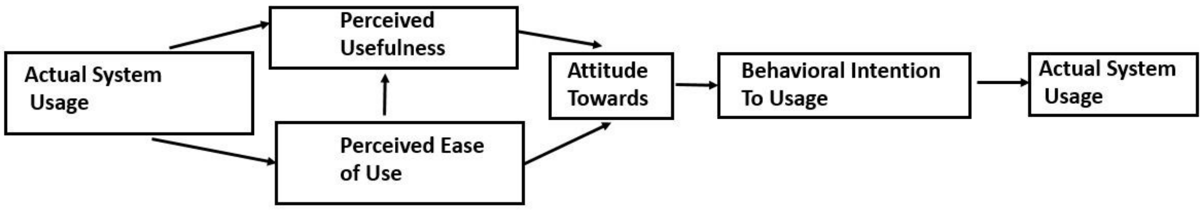

Figure 2: Technology acceptance model (Davis, 1985)

The later work (see Figure 3) by Davis (with Venkatesh) elaborated on the based model by making explicit the latent variables impacting perceptions on usefulness. The new model also introduced experience as a moderator to both usefulness as well to usage intention and voluntariness as a moderator to the intention.

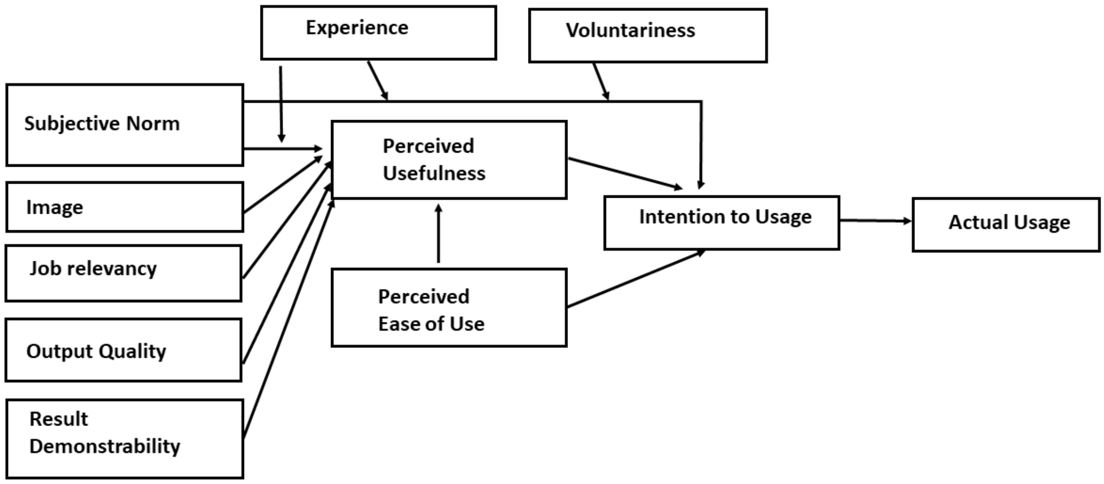

Figure 3: Technology acceptance model –improved version (Venkatesh and Davis, 2000).

TAM models are *per se* not dedicated to business-to-consumer nor business-to-consumer markets, but have been applied to both contexts. Since the technology in the focus of this paper, RPA, is typically a B-to-B technology, it is plausible to review some specific viewpoints on acceptance of technologies for business usage. Dalcher & Shine (2003) build a bridge between the user- and company views by pointing out that improved end user satisfaction (EUS) with the newly implemented system is likely to lead to wider acceptance. nd Subsequently, increased acceptance leads to increased usage that in turn justifies the systems' costs by improving productivity. The EUS model (ibid.) consists of three sequentially related dimensions: attitudinal, perceptual and behavioural. The model uses mostly the elements of Venkatesh and Dais (2000) but adds computer self-efficacy and system quality to constructs that contribute to the attitudes.

Snowden et al. (2006) note that there are additional questions relating to the implementation of new technologies on the level of the whole business organization. The first question relates to the ease of system integration: how the change to the new system will affect the way in which systems (internal and external to the organisation) work together. The other question relates to the need for any application of technology to have a positive effect on business fundamentals, specifically return on investment. These are issues that a base-level end-user cannot reliably assess but can naturally have a perception of.

Accordingly, to achieve full potential of state-of-the-art RPA environments some expert know-how is required (Kirchmer, 2017). This should be part of the process management– typically involving only a few end-users - of the organization or RPA expectations may not be met or at least not met fully. E.g. Geyer-Klingeberg et al. (2018) proposer process mining and RPA making a perfect match. Instead of running a process the RPA system in this case would identify, analyse and optimise processes. In this scenario RPA turns into a tool difficult to assess and accept/reject at the end-user level. The attitudes, perceptions, intentions and final behaviour happen instead in a mandatory environments in which users are required to use a specific technology or system in order to keep and perform their jobs (Brown et al., 2002).

Dalcher and Shine (2003) propose that these mandatory environments do not build perceptions of new systems as they are *per se* but via perceptions held by key individuals. The perceived operating and usage environment may and may not correspond with what will actually happen. Juntunen´s (2018) findings from a case study suggest that contextual factors related to innovation, organizational, individual and managerial facilitation attributes are perceived to influence the adoption of RPA. Factors such as organizational structure, new technology uptake, pressure from external environmental pressures are part of the technology acceptance in b-to-b context (Dalcher and Shine, 2003). Skard & Nysveen (2016) also underline the role of external (to the organization) value system partners in affecting technology acceptance. Since the systems of different value system members are interlinked and they interchange information, new systems impact the trust between companies. Trusting beliefs in the technology´s reliability influences technology loyalty directly, as well as indirectly through beliefs about the company's ability and benevolence (Skard and Nysveen, 2016).

This view on sensitivity and effect of system choices to company image and trust may be reflected also in the recent projection of the RPA vendor UiPath (2018) stating that outsourcing of RPA will die. The view can be justified not only with the trust but also integration viewpoint.

The points made above largely explain the organizational inertia, slowness of adoption of new technologies even in cases where the assumed technology investment time is short, rather calculated to be months rather than years (as often referred by RPA technology vendors and technology market analyst companies). Mohr et al. (2010) described this inherent phenomenon of technology markets with the concept of FUD - fear, uncertainty and doubt – that concerns the supplier choice, technology usefulness, usability and longevity of the technology competitiveness.

3. Research method, sample, data collection and analysis

The empirical data foror this paper was collected as a quantitative study in May-June, 2020. Data collection was implemented using online survey tool Webropol. The respondent pool consisted of participants of a specialization program (a Higher Education Diploma) jointly arranged by 3 universities in a blended learning environment. The participants responded to survey anonymously.

The target of this initial study was to screen experiences and opinions of people in the latter half of their studies in RPA in the light of the model(s) of technology acceptance. The study was designed to prepare ground for larger quantitative data collection and for an interview-based qualitative study in the end of the studies, scheduled to the end of 2020/beginning of 2021.

The respondent pool gathered consisted of 25 people out of the 50 people total participating to the program. Even though the survey gave data containing demographic data of respondents in addition to the data focusing to the many facets of RPA, the sample was not large enough for full-scale statistical analysis and test hypotheses. Thus the results should be seen as indicative, and they are analysed and presented via descriptive statistics (see Chapter 4: Results).

Despite respondents coming from the participants of one and same university program, the respondent pool was heterogeneous looking at the respondents´ initial educational background, current employer´s area of activity as well as length of employment history. Table 1 summarizes some key characteristics of the respondent pool. As can be seen in the summary, the respondents were rather experienced – as is typical for such a skills upgrade program that does not lead to a full degree and demand commitment of multiple years.

Table 1: The structure of the respondent pool

Respondent age	Employment history length	Initial (to the program) education level	Initial education orientation	Area of activity of the current employer	Current occupation function
25-34 yrs: 12 % 35-44 yrs: 40 % 45-54 yrs: 40 % 55+ yrs 8 %	6-10 years .8 % 11-15 yrs 16% 16-20 yrs 24 % 21-25 yrs 20 % 25+ yrs . 32 %.	Vocational and High School 32 % Undergrad. 32 % Graduate ,36 %	Business 60 % Technology 32 % Natural science 4% Humanities4 %	Business and Hospitality 20 % Technology and Logistics……28 % Public service incl. safety 36 % Social and Health Care 4 % Other 12 %	Sales and Marketing 4 % HR and Salary Management 8 % Financial Manage-ment 36 % Production 12 % IT Manage- ‘ ment 12 % R&D 20 % Other 12 %

The nature of the inquiry in this paper is rather exploratory and interpretive than predictive. The study is aimed at understanding specific aspects of RPA as a technology and create a cross-sectional view of the technology´s current status and potential as perceived by people with first-hand view on RPA from the user angle. Instead of deploying earlier TAM models to measure likely acceptance/non-acceptance of the technology the study set to explore and identify the variables needed in the (future) framework building for this type of mandatory environment emerging technology. By interpreting the expriences and

4. Results

This chapter summarizes the data collected in the research and thus serves as a basis for the upcoming conclusions and answering the research questions (Chapter 5).

4.1 Perceived technology acceptance enablers

As the literature review showed, RPA has been linked with multiple potential benefits on the company level as well as on the level of individual workers and their job contents. These potentially benefits can be seen as enablers of RPA adoption and acceptance i.e. as drivers of change towards more RPA-laden future. The respondents were asked to list three top enablers they see as proponents of RPA adoption.

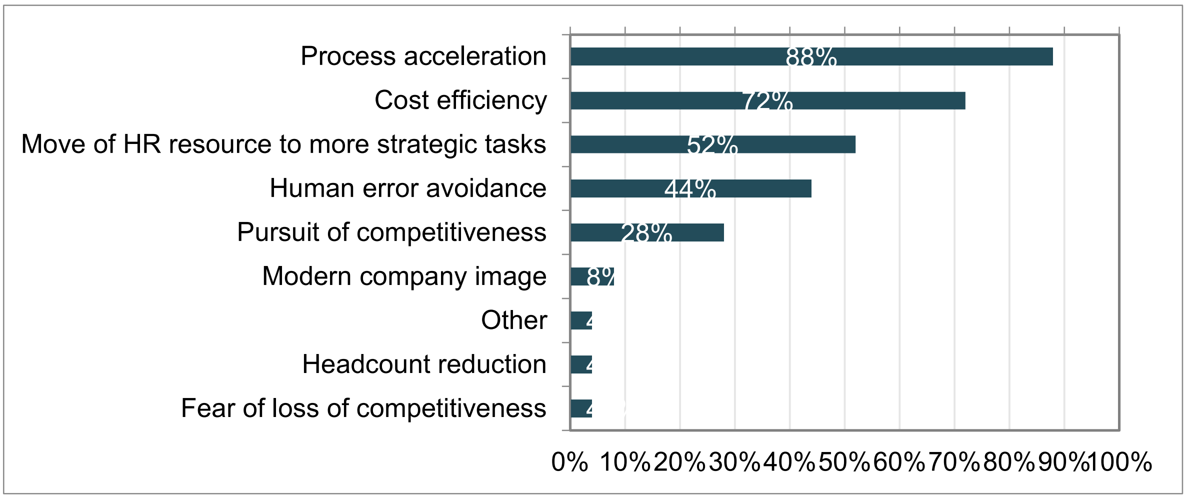

Figure 4: Perceived enablers for RPA adoption

4.2 Perceived tech acceptance challenges

Generic research on technology acceptance and specific IT system adoption literature state that multiple factors can act as obstacles or at least as roadblocks to the adoption of a novel technology. Like in previous question on RPA adoption enablers, the respondents were asked to list top three challenges to RPA adoption that potentially slow down the spread of RPA technology.

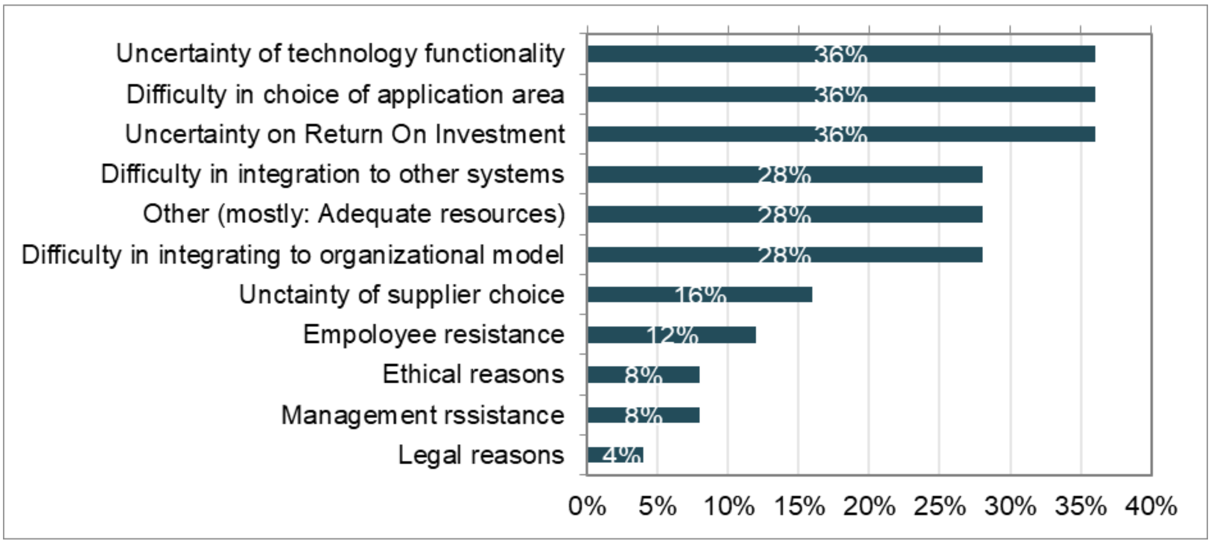

Figure 5: Perceived obstacles/challenges for RPA adoption

4.3 Personal level technology acceptance

The respondents reported their experiences of the technology vis-à-vis to their initial expectations. In the lack of a baseline measurement (e.g. an evaluation of a technologies in use in the same context) these assessments served as a proxies of variables that effect the perceived usefulness and ease of use, as the TAM models suggest.

Overall the RPA technology had been a positive experience, since 3,00 points would have meant neutral (not positive nor negative experience vs. initial expectations. It is interesting that the respondents ranked reliability of the technology relatively low, but were yet positive both of its benefits to the business as well as the contents of the jobs in the organization.

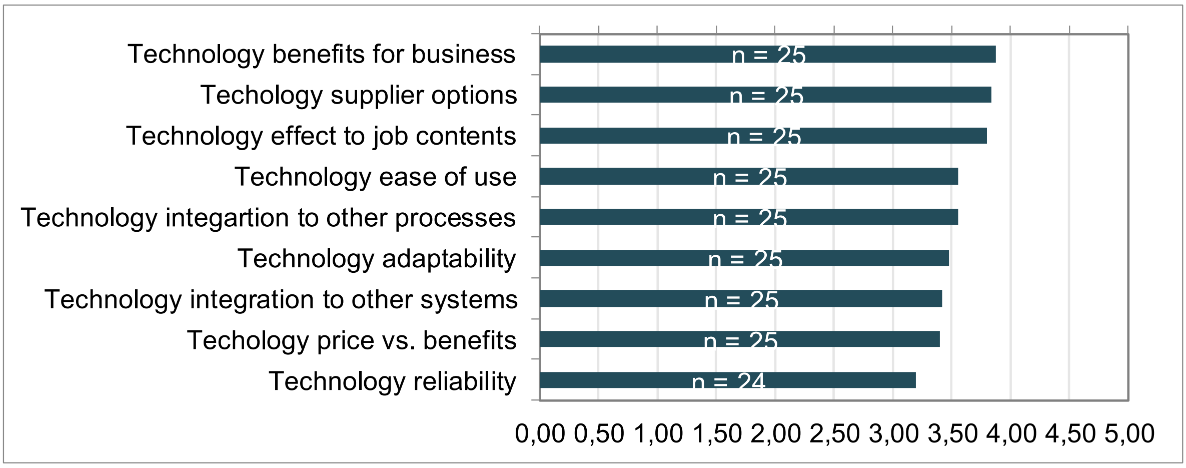

Figure 6: Assessment of RPA characteristics vs. initial (pre-program) expectations

The respondents were also asked (with a scale of 0-5) their overall attitude to RPA, their voluntariness to use as well as their likelihood to use RPA. Both the attitude towards the technology as well as the voluntariness were remarkably high (4,64 for both variables) and higher than the likelihood of becoming a RPA user (4,04). This indicates that the individuals see a situation where they have the readiness for RPA but the organizations they are working for are less ready for RPA adoption.

4.4 Other findings

The assessment of the time to RPA technology adoption showed that despite the reported doubts of technology reliability the respondents felt rather positive towards relatively short timeframe of RPA adoption in their working environment.

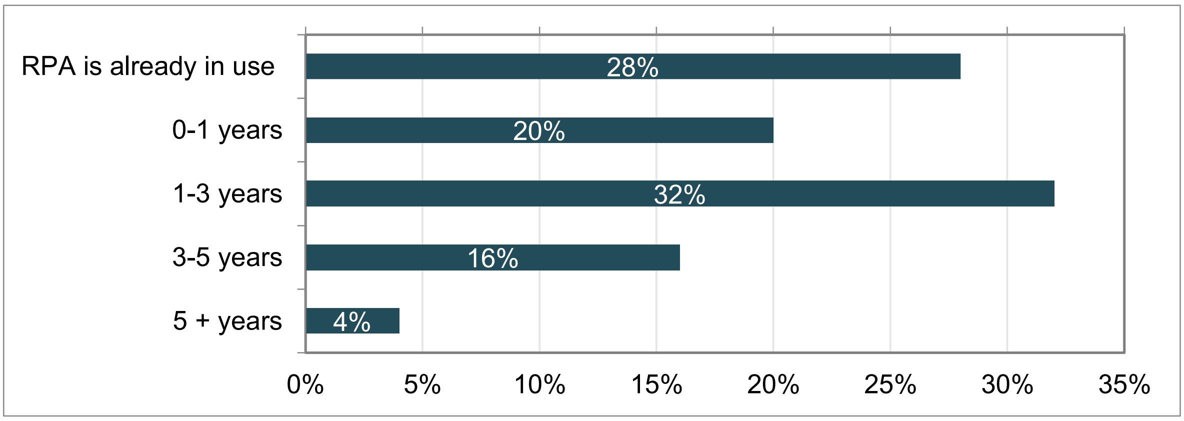

Figure 7: Estimated time for RPA adoption

An interesting finding that repeats the results of Saukkonen et al. of the AI adoption as assessed by HRM professionals (2019); The business process (firm´s inputs) development towards modern technologies has developed more slowly than its output i.e. the technological sophistication of the products and services the firms offer. The difference of 0,5 points (in a scale of 0 to 5) represents the organizational inertia in BPE.

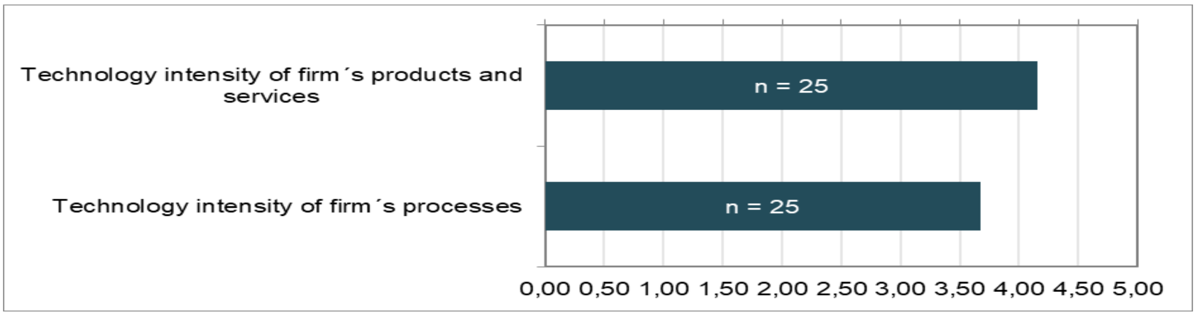

Figure 8: Firm´s products and services vs. processes in their technology intensity

A natural consequent question is: In which processes and functions could the technology gap caused by abovementioned inertia be filled. The differences of business process prone to bend to RPA are noticeable. Most prominent areas for RPA are seen to be processes with high amount of data points in a time and clear repetitiveness, such as Financial, IT and HR Management, whereas application areas that have unique situations (R&D) and/or low number of transactions (General management) are less likely to benefit from RPA.

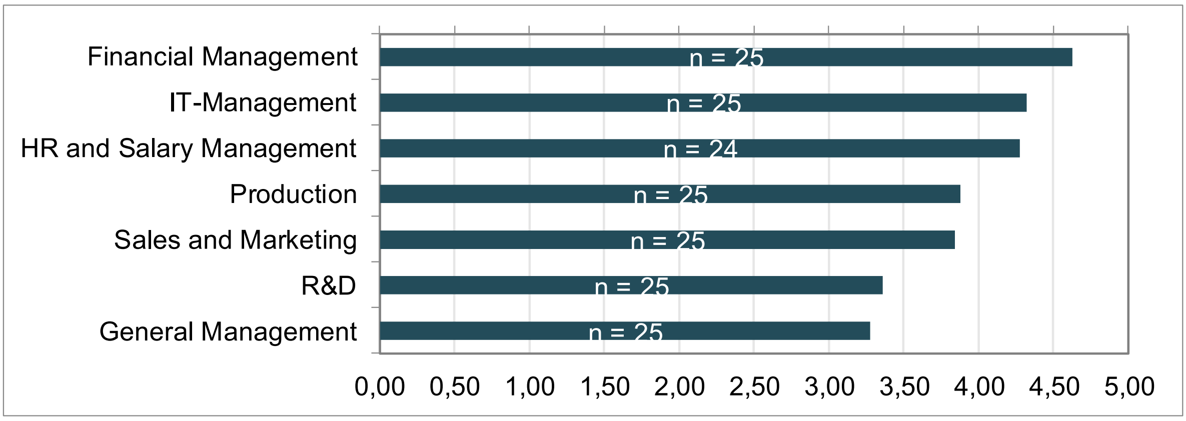

Figure 9: The most potential corporate functions for RPA deployment

5. Conclusions

The results indicate that a RPA is a technology that has not reached maturity, as the respondents ranked the technology reliability relatively low. Also the fit of RPA to present organizational models and integration to other systems was not ranked as high as e.g. business benefits and impact on work contents. This indicates the potential future users see a novel technology as an evolving platform that can yield benefits prior to final technological sophistication and robustness.

Unlike the authors expectations prior-to the study suggested, the RPA learners saw their own attitude towards RPA as well as voluntariness to use RPA to be higher that their perceived likelihood to be future users of RPA. The logical expectation would be that for technology adoption in a mandatory environment (where the end-users do not have a final say whether or not to use as system) likelihood would outweight voluntariness. These results indicate that the organizations' preparedness for RPA adoption decisions was seen as hindrance for RPA to spread to organizations and functions within them. This unpreparedness was linked to technology and supplier uncertainties of right application area where return of technology investment would pay off.

6. Discussion

The findings of the study gave indications of the potential as well as of challenges for novel robotic technology looked at from the user point of view. We believe our findings contribute to both theory development for technology business research as well as offer practical considerations to firms offering RPA solutions or adopting them. To conclude we present the limitations to the generalizability of our findings as propose ways forward to the research community to further improve the accumulation of knowledge of robotic technologies and factors affecting their market adoption.

6.1 Theoretical Implications

The findings of the study propose that frameworks for (successful) technology adoption and acceptance in a mandatory environment – a typical scenario for RPA as it is a business process tool to which the users cannot opt in or out - should contain both variables pertaining to the organizational layer as well as variables that link to the end-user layer. Figure 10 depicts a proposition for such a model to be elaborated on. The role of end-users knowledgeable of the technology in question in the choice and benefit analysis (to support management decision) would potentially increase the odds of success to the current vendor and IT-management driven processes.

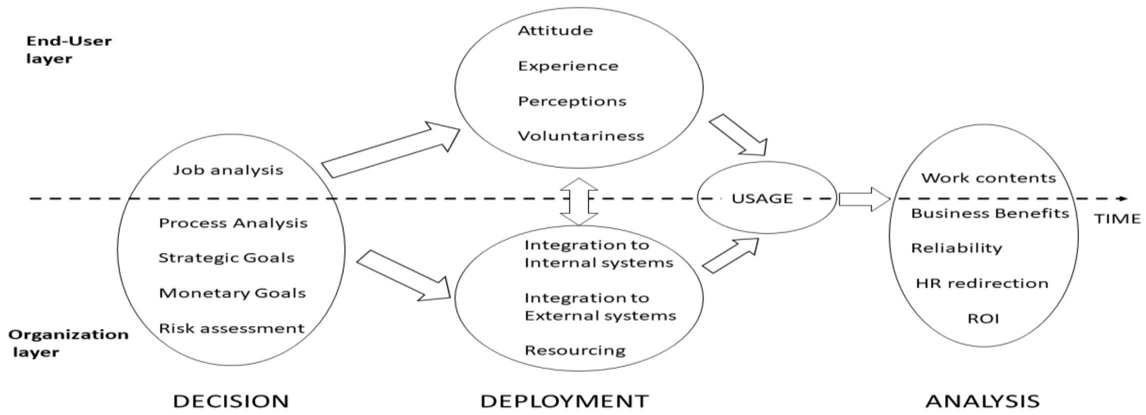

Figure 10: Proposition for a framework of new technology adoption in a mandatory environment

6.2 Practical implications

Our study indicated that the overall impression of RPA as a novel business process technology was positive, leading to high levels of voluntariness to use the technology despite its shortcomings in reliability and integration possibilities to other systems. The impact of robotic solutions to the contents of work was seen positively, indicating that the human-machine collaboration and operational mode of attended robots proposed by earlier research got supported. The voluntariness of the people now knowledgeable in the RPA technology did not match with their perceived likelihood to use RPA in their working environment. The study pointed out to the organizations´ difficulties in decision-making in RPA technology acquisition. These difficulties culminate in the doubts of functionality and correct choice of relevant application area for RPA, both conirtubuting to worries of return on RPA investment

6.3 Limitations

The sampling frame for the study consisted of a rather homogenous group in cultural and socio-technical context. Since the educational program was conducted in Finnish, it limited the participants and subsequently the survey respondents to be residing in Finland. However, looking at the educational background, level of education possessed and area of business activity of the participants´ employer, it can be stated that the survey sample was heterogeneous within the Finnish context, offering a cross-sectional view on RPA experiences and resulting perceptions and attitudes in the context. Another limitation was that the leaders of the educational program had to make a choice of the RPA platform to be used due to short-term nature of the program, instead of familiarizing the participants to many competing systems. Results are also in this respect context bound. The context for RPA usage was also one created for the learning, and experiences based on real-life implementations would most likely deviate from our results somewhat. As a direction for future research a comparative study of different RPA environments would add additional value and serve also for practitioners in their system choice. Implementation of such comparative study is, however, not easy to implement in a manner that guarantee reliability and validity. Additional direction for future research would be to do a longitudinal follow-up study of the respondents perception after real-life usage of RPA systems.

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