Chapter 9
The Use of Robotic Process Automation for Business Process Improvement

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Abstract In this paper, we aim to analyse the stage of innovation in business processes, to highlight the major themes related to the Business Process Management, and to analyse which are the criteria that must be taken into account by companies that want to implement a program to improve the business processes they already use or by companies that are new to the market and want to start their activity using advanced technologies that allow them to be dynamic and flexible. The main purpose of this paper is to investigate the business benefits of implementing Robotic Process Automation (RPA) and find the key factors that help such implementations succeed. The data sources are both primary and secondary and for the qualitative research, we mainly used primary data, collected through structured and semi-structured interviews with RPA specialists. The main characteristics associated with RPA projects and the typical phases that must be followed to implement a robot for a customer were discovered based on the interviews. The paper also presents the properties and attributes of processes that can have a positive impact on the successful implementation of RPA projects, focusing on how these properties should be used for the best results.

Keywords Robotic Process Automation · Business Process · Process Analysis · Business Process Management · Process Mining

9.1 Introduction

Robotic Process Automation is a topic that became more and more attractive over the last few years. According to IEEE Standards Association (2017) this new type of technology has emerged since around 2010. Nowadays, companies can gain a

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competitive advantage if they manage to successfully implement RPA. This paper investigates the benefits of implementing Robotic Process Automation and highlights the key factors that help such implementations succeed. This study is especially relevant for entrepreneurs looking for methods and models that they can use in their businesses to increase the efficiency of internal processes and partially or fully automate them. Since our research is at an early stage, we aim to review the literature related to our topic in the first phase, taking into consideration the results we want to achieve, and to use the interviews to test our hypotheses in the second phase.

Business Process Management (BPM), Process Mining, and Robotic Process Automation are the three most important technologies, which allow us to design, implement, analyse, and automate processes. BPM is a mature technology that can be used to shape and design any kind of business activity from scratch. As we know, things rarely go as we expect right from the beginning, so operational realities must be analysed and documented to be able to identify the differences, this being the moment when process mining is necessary as a tool. RPA is the next step after the analysis generated by process mining, an activity that creates added value for companies. RPA, according to the IEEE Standards Association, is "a preconfigured software instance that uses business rules and predefined activity choreography to complete 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 Standards Association, 2017, p. 11).

With a clear definition of RPA and keeping in mind the stated goals of this paper we are performing further investigation via interviews with RPA specialists. Our objective is to find useful insights and provide management with the right knowledge and tools so that businesses can confidently start the implementation of robots in order to benefit from cost savings, increased speed, and greater quality.

9.2 Literature Review

In the past, to be more precise in the industrial period, the way to improve business processes was based on tools such as financial modelling or the Deming improvement cycle (Dahlgaard et al., 2008). With the transition to the information age, we observe three periods:

- The 1970s–1980s, representing the first wave of process improvement, are marked by the improvement of tools; Total Quality Management was introduced (Pambreni et al., 2019).
- In the 90s, representing the second wave focused on process engineering, we observe the beginning of the use of Six Sigma tools (Smith, 1993) and the introduction of the method engineering and process reengineering concept.
- After 2000, in the third wave focused on BPM, we observe the emergence of tools such as the Balanced Scorecard method (Butler et al., 1997) and of some

BPM methodologies that were also analysed in the study conducted by Recker and Mendling (2016) in which the authors synthesized the studies carried out in this field between 2003 and 2014.

BPM is defined as "a body of methods, techniques, and tools to identify, discover, analyze, redesign, execute, and monitor business processes in order to optimize their performance" (Dumas et al., 2018, p. 6). According to the same source, BPM can be viewed as a continuous cycle that has the following phases (Dumas et al., 2018, pp. 22–23):

- Process identification: in this phase, a problem is proposed and formulated, and the processes relevant to it are identified, marked, and the relationship between them is documented. The result of this step is the outline of a flow that presents an overall picture of the process. Based on this draft, it will be decided which components are going to become part of the next steps;
- Process discovery: in this step, the current state of each process or sub-process is documented;
- Process analysis: in this phase, all the issues that are discovered in the as-is processes are documented and, if it is possible, the issues will be qualified using performance measures;
- Process redesign: the purpose of this phase is to identify possible changes to the process that would help to address the issues identified in the previous phase;
- Process implementation: concerns two aspects or components – automation and organizational change management. Automation represents the development and deployment of the IT systems that transform the process into an automated one, while organizational change management will address the necessary activities to change the way of working of all employees involved in the process;
- Process monitoring: after the redesigned process has been implemented and is running according to the customer's plan and expectations, metrics will be collected to measure the level of process efficiency.

Although nowadays there are various methodologies and templates that can be used under the aegis of the BPM (Barros et al., 2005), there is still no study conducted on the implementation of autonomous artificial intelligence systems by companies to drive and define or dramatically improve, without human intervention, the existing processes. The implementation of such systems is an activity that requires both financial and human resources, time, and research; thus, the details related to this type of implementation are not made accessible to the general public; they are considered commercial secrets by companies, being part of their intellectual property.

There are, however, various comprehensive studies that, for example, investigate the literature related to the quality of business process modelling such as the study conducted by Moreno-Montes de Oca et al. (2015) in which the authors conclude that the industry lacks an encompassing and generally accepted (by all entities using BPM) definition of business process modelling quality. The study of Cognini et al. (2018) presents an overview of the software products used to support business processes flexibility.

In their paper, Syed et al. (2020) provide us with a set of details and features of RPA, thus, based on the information presented in the article, the following definition of RPA becomes obvious: a software-based solution that mimics the human interactions with multiple applications to automate the work-flow management based on routine tasks with standardized data. Not all tasks are suitable for RPA, there are several characteristics that were identified by Syed et al. (2020) based on the literature review and are summarised in Table 9.1.

There are some areas that are better candidates for RPA compared to others: "accounts payable, accounts receivable, travel expenses, fixed asset accounting, master data management, billing, keeping employee records" (Aguirre & Rodriguez, 2017, p. 3), inventory management, software installation, or data migration.

RPA offers a number of advantages; these benefits were highlighted in several studies (Aguirre & Rodriguez, 2017; Lacity & Willcocks, 2015; ***, 2021; Sobczak, 2021):

- Rapidity (increasing process speed);
- Increased accuracy, error reduction;
- Higher consistency;
- Reliability (24-h service coverage);
- Increased efficiency;

Table 9.1 Characteristics of RPA-suitable tasks/processes

Process/task characteristics	Description
Highly rule-based	The decision logic needs to be expressed in terms of business rules
High volume	The transaction volume must be high enough to help maximize the benefits of an RPA implementation
Mature	Tasks that have been in place for a while and are stable
Easy to achieve and show impact	Tasks performed within processes with the best return (a clear understanding of current manual costs) and simplest delivery
Has digitised structured data input	Input data must be digital and structured
Highly manual	Do not require much human intervention (or creative thinking)
Transactional	Dealing with transactional work
Standardised	Higher degree of standardisation (how consistently process execution follows a predefined path)
Low-levels of exception handling	Should not have to deal with exceptional behaviours
Highly repetitive	Automating highly repetitive tasks will help to yield a better return on investment
Less complex processes	Processes should be simple enough so that bots can be implemented quickly.
Well-documented	Process descriptions that accurately detail processes are essential
Interacts with many systems	Processes that need access to multiple systems

Source: Created by authors based on (Syed et al., 2020, p. 5)

- Improved employee morale and experience: employees can focus on non-routine tasks that require judgment, creativity, etc.;
- Flexible virtual workforce;
- Cost reduction based on productivity improvements;
- Increased level of innovation.

However, companies must take into account the risks and shortcomings associated with the RPA (Asatiani & Penttinen, 2016):

- Change management – due to the fact that employees will be reluctant to help the implementation of robots that will take over some of their work;
- Unrealistic expectations that lead to minor benefits or to the introduction of risks;
- Limitations when it comes to being able to automate vaguely defined or incompletely defined processes which have medium or increased complexity.

Some other challenges of RPA were synthesized by Chugh et al. (2022) and were grouped into four categories: "awareness and perception of RPA; uncertainty about how to prepare for RPA; change management challenges while implementing RPA; and challenges associated with RPA vendors" (Chugh et al., 2022, p. 17).

RPA solutions can be classified based on their specific requirements and strategies in: assisted RPA, unassisted RPA, autonomous RPA, and cognitive RPA (Burnett et al., 2018).

Next, we will draw a parallel between these principles and the literature that addresses process discovery and process automation or robotization:

- Process discovery by modelling, observation, or automated discovery methods:
  - Dumas et al. (2018) describe a methodology to discover processes based on the event logs generated by the systems that perform the processes;
  - Asatiani and Penttinen (2016) present a case study for OpusCapita where the discovery was made based on consultants by observing the employees and documenting their activities and through meetings and seminars;
  - Gartner (2008) defined the concept of "automatic discovery of business processes", which is another way to discover processes.
- Process discovery based on interviews that are held with product or process managers and experts in the field:
  - Willcocks et al. (2017) document the process discovery based on interviews. Unfortunately, these interviews were done in a lack of structure, so the interviewees tend to present a very subjective and non-standardized version.
- Process discovery based on workshop:
  - This method is the most complex in terms of the number of activities and observations due to the fact that there must be a continuous and long-term dialogue between the RPA implementation team and the people working with these processes. Because of this, the discovery of processes based on workshops is very little used, thus making this method the least used. Considering

these characteristics, we notice a very limited number of works that address this method, the most representative being that of the authors Asatiani and Penttinen (2016).

Since a general overview is necessary to find the best way to implement RPA, Sigurðardóttir (2018) proposes a dynamic roadmap for successful implementation which takes into account multiple other studies and interviews with people from different industries. The proposed roadmap covers different phases of RPA implementation starting with the identification of the business problem, choosing an automation tool, choosing an RPA software provider, identification of process, checking the process readiness for automation, and generating a proof of concept for validation. It continues with a second part, where the operating model is designed and built, implemented, evaluated, and then continuously improved. The framework proposed by Herm et al. (2022) can also be used as a guide by the companies that are willing to implement RPA projects. It is divided into three main phases "initialization, implementation, and scaling" and it was validated using interviews and workshops with RPA experts (Herm et al., 2022).

9.3 Research Methodology

The data sources for this research are both primary and secondary, while for the qualitative research, we mainly used primary data, collected through structured and semi-structured interviews with RPA experts. The purpose of the interviews was to discover how specialists implement, make decisions, and help clients. The protocol used is documented by Castillo-Montoya (2016), while the selection strategy involved intentional sampling, allowing us to select a well-balanced group that can provide us with information on the researched topic (Liu, 2018). The interviews took place between April and May 2021 with a team of RPA specialists with experience in implementing such systems.

To achieve our goal, we have chosen a multinational company that operates in the field of logistics with activity in over 150 countries and with more than 75000 employees. At the end of 2017, the company began to test various RPA products and slowly began to increase its level of maturity and to establish the internal structure for such projects and a global Center of Excellence. This global center was founded to provide internally the platform, knowledge, tools, developers and analysts, a governance model, and finally a community, all of which are necessary for RPA implementation at the regional level. Currently, there are dozens of developers at the regional level who have received training in creating simple robots based on the software solutions offered by Automation Anywhere. With over 300 robots implemented at the company level to date, and more than 108000 h gained in a year through automation, the level of maturity is considered high.

We interviewed a set of RPA experts, both from the regional and global level, with the aim of discovering how they implement, make decisions, and help end

clients, and we also interviewed two clients to discover aspects specific to their point of view. In the case of RPA experts, we used a structured interview, and in the case of clients, we used a semi-structured interview. The interviewees selection strategy involves intentional sampling of a well-balanced group. In sampling, there is a risk of talking only to the elites in the organization, and according to Liu (2018) lack of confidence can also be a problem. Given these risks, we chose to vary the level of the interviewees, talking to people at both manager and architect level, RPA developer, regional project manager, or application support, so the level of variation in the sampling is high.

We interviewed eight people from different geographical areas, teams, seniority levels, or areas of responsibility (see Table 9.2). For all these interviews, we used the Microsoft Teams on-line communication platform for the best interaction possible. Due to the COVID-19 pandemic, but also due to geographical location, the interviews could not be conducted face-to-face. We used the protocol documented by Castillo-Montoya (2016), thus using introductory, transition and key questions, ending with closing questions. Trying to identify which are the most appropriate methods to implement automation, we used the questionnaire to find out as many relevant details as possible.

The level of experience of the interviewees dealing with RPA implementation is at least 2 years, with the average around 3.3 years, together implementing 182 robots, with an average of 30 robots per person. All interviews were conducted in English, recorded, and transcribed. In total, the audio recordings for the interviews have a duration of 500 min and base on them we generated 176 pages of transcriptions.

9.4 Results and Discussions

Considering the typical characteristics associated with the RPA projects, the experts indicated the following:

- automate the processes that a person executes;
- increase the efficiency and decreases the costs;
- are easily scalable;
- increase the quality of work;
- increase the data consistency and availability for multiple platforms and software solutions;
- eliminate repetitive and boring activities from the employee's area of responsibility;
- eliminate the risk of mistakes that came from data manipulation;
- can easily integrate systems that cannot natively exchange data.

These RPA projects are seen by all interviewed persons as the next technological step, a natural step in the evolution of human work. In the case of the typical

Table 9.2 Interview details

Person	Role	Region	RPA experience	Business	Date	Duration	Interview type
I	RPA Implementation Manager	Latin America, Brazil	4 years	Corporate solutions	31-Mar-21	60 min	structured
II	Project Manager	Asia-Pacific, Singapore	3 years	IT Governance	1-Apr-21	20 min	structured
					12-Apr-21	10 min	
					14-Apr-21	30 min	
III	Director, Center of Excellence for RPA, and Finance Solutions	Europe, Holland	3 years	Corporate solutions	2-Apr-21	25 min	structured
					18-May-21	25 min	semi structured
IV	RPA Developer – Global, Center of Excellence	Europe, Spain	3 years	Corporate solutions	5-Apr-21	100 min	structured
V	RPA Architect, Global Center of Excellence	Europe, Holland	5 years	Corporate solutions	8-Apr-21	60 min	structured
VI	RPA Developer, Global Center of Excellence	North America, Mexico	2 years	Corporate solutions	14-Apr-21	60 min	structured
VII	Technical support – Global – Finance	Europe, Holland	more than 3 months	Support applications	16-Apr-21	30 min	semi structured
					16-Apr-21	30 min	
VIII	RPA support, Global	North America, United States of America	3 years	Corporate solutions	19-Apr-21	50 min	semi structured

Source: created by authors based on interviews conducted as part of this study

properties of RPA processes, many of the details already documented by Syed et al. (2020) also appear in the responses received.

Based on the responses received, we generated Fig. 9.1, where the values represent the weight of each property in the total number of mentions.

The RPA experts have indicated that the typical phases that must be followed to implement a robot for a customer validate the cycle proposed by Dumas et al. (2018). However, a discovery is worth mentioning relative to the process' phases: it

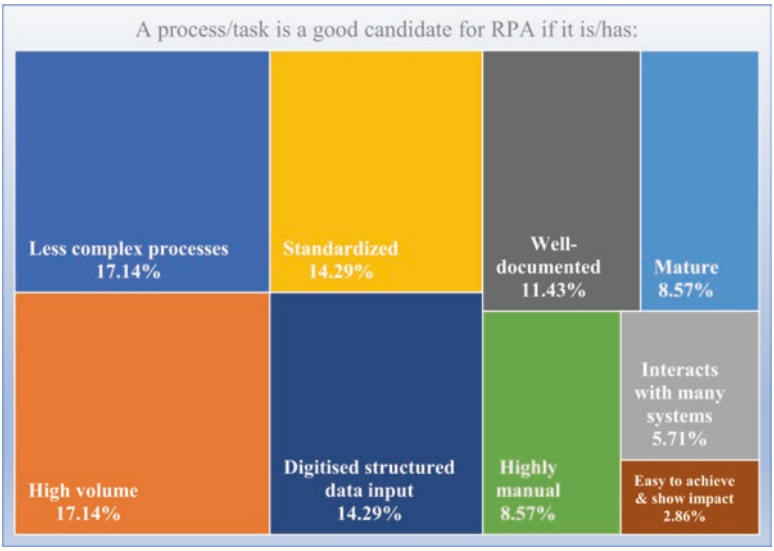

Fig. 9.1 Process properties. Source: authors, based on data collected from interviews

is recommended to use the Agile methodology as a component part of the implementation process, effectively generating an internal cycle throughout the project for the part of process redesign -> process implementation. The Agile methodology is also mentioned by Davenport (2015) and Sobczak (2021) as a potential method considered for the development of RPA robots, especially for large-scale implementations (Fig. 9.2).

Process discovery is an area where the interviewed specialists use the seminar as the main tool to discover process-specific details coupled with unstructured interviews and follow-up of each step and action. The next step for them is the implementation of specialized tools for process mining and automatic detection; but the company has not been prepared so far for such tools, nor have the teams. It is important to note that all interviewees mentioned the seminar as the most important and appropriate tool in the discovery process.

The documentation of processes is mostly done using the following modelling languages: BPMN (Business Process Model Notation), FlowChart, Data Flow Diagrams, Gantt Chart, and Petri Net. Depending on the level of knowledge, skills, and needs of each person, one or more languages are used in the process of documenting the specifications of robots.

Some of the properties and attributes of processes that have a positive impact on the successful implementation of RPA mentioned in the interviews are:

- robotic processes are clear and standardized;
- the implemented robots are scalable automatically;
- error validation and robustness are added in the design phase;
- the ability to solve problems automatically;

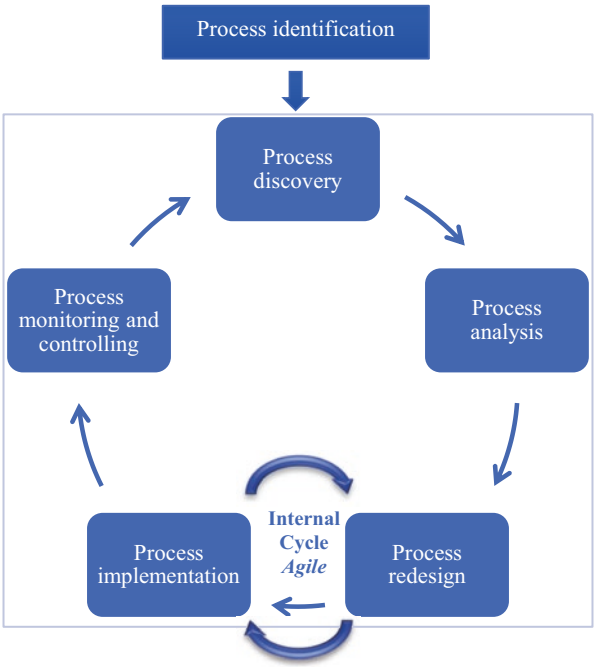

Fig. 9.2 The BPM lifecycle. Source: Adapted from (Dumas et al., 2018, p. 23)

- the execution of robots is always done in the parameters according to the design of the solution, otherwise they are automatically decommissioned;
- using the fastest and simplest methods, with the fewest actions and as few steps as possible;
- stability in operation and continuous measurement of robot performance indicators;
- continuous communication between the client and the analyst in the implementation phase;
- top-quality documentation;
- continuous support after deployment.

Through the interview, we also identified problems in the implementation process and several challenges. The processes where one or more of the aspects mentioned below were observed had problems or RPA could not be implemented:

- the execution of the process depends on the human factor, is not fully automated;
- the process is immature, this generally applies to new processes;
- the request for multiple changes after the design of the process was made on the basis of the initial requirements;
- unstable environments where changes occur constantly (such as web platforms); thus, the maintenance of the solution becomes a necessity after the implementation;

- applications or components in processes are decommissioned without notice, sometimes even during deployment;
- technical limitations such as: sensitive data are not secured and used properly or lack of data confidentiality mechanisms;
- permissions are not obtained in a timely manner for the use of data, platforms, or software in a robotic process;
- the automation or robotic software is not mature enough and certain basic components that should exist in the suite end up being created manually by analysts;
- process managers who do not provide full support to implementation teams.

9.5 Conclusions

From the point of view of an entrepreneur, this study presents a clear and practical approach to implementing process automation within any company. Specific details that help the success of the implementation projects are clearly documented, thus contributing to the increase of the level of critical knowledge in the field and increasing the probability of success of the RPA initiatives. An additional contribution is that other companies that already have an RPA program, that is only in its initial phase, or are experiencing problems, can use the findings of the study to improve and develop their own internal procedures, processes, and tools. They can also introduce a governance platform more easily, helping them monitor the growth of the programme and make changes as quickly as possible.

The information presented in this paper will help the management in making the decision whether to implement robots or not, as an integrative part of the continuous improvement processes taking place in any company. It will also help in choosing a model to follow, if it is concluded that the implementation of robots is feasible and necessary.

For the initial phase of evaluating the implementation possibilities, entrepreneurs should use the dynamic roadmap proposed by Sigurðardóttir (2018) in order to assess which processes would be the ideal candidate for an RPA implementation project.

Once the target processes and the platforms that will be used are identified, the most appropriate cycle that should be used for multiple implementations is the one proposed by Dumas et al. (2018) but with the introduction of a sub-cycle for the part of: process redesign – process implementation in the form of Agile methodology. The use of this methodology brings adaptability to the implementation process and, at the same time, increases quality, making the end process sustainable while allowing for greater control.

In addition to the use of already mentioned concepts, the following aspects must be considered for a successful implementation:

- Processes that have a high volume of repetitive activities, that present a high degree of standardization, that have data inputs in a digitized and structured format, and that have low complexity are the most suitable for RPA.
- Processes discovery or processes mining must be done using software tools due to the capability of these platforms and to the increased return on investment in these cases.
- For a successful implementation, we must use a dedicated project team and, as much as possible, with experience in the field of RPA.
- The project team must consider automatic scalability without intervention when implementing an automation.
- Robots must have the ability to self-repair and must be continuously monitored.
- The use of the Dev-Ops model is highly indicated for the implementation phase.
- Processes that are immature or have a short lifespan should not be automated.
- Technical limitations must be discovered and resolved as quickly as possible during an implementation because they involve high risks that may lead to the impossibility of completing the project.

By following these recommendations in trying to implement process automation in the company, entrepreneurs have the best chance of succeeding with low costs and limited risk.

This study represents a starting point for further research on RPA implementation. The small number of interviews constitutes a limitation of this study. Despite of this limitation, it was confirmed that by using a mature automation platform, complemented by a skilful and dedicated project team, substantial benefits can be brought to companies by detecting, modelling, configuring, and implementing automated processes that can easily complement or replace the old activities, reducing operational costs and increasing the quality of execution.

Via the interviews, we have identified the needs, limitations, skills, and shortcomings of practical activities within a company that has already implemented an RPA governance model. Certain steps such as: choosing the right RPA provider or designing and developing the operational model have already been made and these decisions have been taken based on criteria that we do not know.

On the side of limitations, multiple researchers and authors (Burgess, 2017; Madakam et al., 2019; Burnett et al., 2018; Herm et al., 2022) mentioned in their papers that Machine Learning (ML) and Artificial Intelligence (AI) technologies are the most suitable to be integrated with RPA as the next step in the development of the concept that will help adoption at a broader level, but very few details are presented by them regarding how this integration of the two capabilities can be achieved.

Appendix

Interview questions

1. Interviewee's role/job title?
2. How much experience have you had with RPA?
   i. Can you estimate the number of projects you have worked on?
   ii. What is the extent/period you have focused on RPA projects implementation?
3. What are the typical features that you consider are associated with RPA projects/How would you characterize RPA projects in general?
4. What are the typical properties of the processes you consider for automating? Are there any thresholds for these specific properties? (Some of the properties that will be validated: *Low complexity of tasks, high number of repetitions, multiple systems are involved, the process follows clear business rules, stable environment, limited need for human intervention, structured data)*
5. Please share the typical phases that you go through implementing a robot for an internal client and have you seen that specific domains need a more customized approach like HR versus Finance versus Support?
6. What are the types of process discovery methods do you employ? (*Workshop/Interview structured or unstructured/Keylogging/Process mining/Shadowing*) Which ones have proven to be the most efficient in delivering a clear process understanding?
7. If you use any specialized modelling languages, can you please share what modelling language do you use and why?
8. Please share your own view of what a successful RPA project is like.
   i. What criteria should the project meet to be declared successful?
   ii. Which of the criteria do you think are the most important?
9. If you consider successful RPA projects. What things do you consider important for the success of the project?
   i. What factors have been shown to influence the success of the project?
   ii. In what order of priority would you put the factors you mentioned?
10. If you consider successful RPA projects. What things do you consider important for the success of the project?
    i. What factors have been shown to influence the success of the project?
    ii. In what order of priority would you put the factors you mentioned?

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