Predicting the Profitability of Robotic Process Automation with a Dynamic Business Modeler

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ABSTRACT
Robotic Process Automation (RPA) is an emerging technology that automates well-defined and repetitive tasks, that used to be done by humans. RPA has gained a lot of corporate attention, due to the potential benefits of RPA. However, 30-50 precent of the initial RPA project fail to be profitable. One of the main reasons for these failures is selecting the wrong business process to automate. The goal of this paper is to develop a dynamic model that helps enterprises selecting the right processes for RPA. The paper follows the Design Science Research approach to develop the model. As a result, a System Dynamics model made in Insight maker is presented.

Keywords
Robotic Process Automation, Business model engineering, profitability, dynamic business model

1. INTRODUCTION
To remain market competitive, enterprises aim to improve their operations. Increasing efficiency and productivity or cutting costs are effective strategies to remain market competitive. Nowadays, enterprises want to improve their business operations with the use of technology. Early adopters are experiencing great success with the use of new technologies like Robotic Process Automation (RPA).

RPA is a relatively new technology that aims to automate tasks that are now performed by humans. The RPA realm consists of tools that automate tasks that have clearly defined rules for processing structured data to produce deterministic outcomes[1]. RPA agents also called “bots” mimics the role of a human employee, taking over manual tasks throughout a possible range of different application. Freeing up employees from mindless “swivel chair” tasks[1].

Literature shows that RPA deployment may lead to a variety of benefits. Improved operational efficiency, quality of services, easier and faster implementation and integration with other systems, improved risk management or simply reduction in costs are often talked about[2]–[4].

While research[4] has shown that there are enterprises who are having great success, other enterprises are experiencing difficulties with adopting RPA. According to EY [5] one of the biggest RPA consultancy companies, 30-50 precent of RPA projects fail to return profit. With targeting RPA at the wrong processes being one of the top 10 issues why RPA projects fail. Targeting the wrong business processes will lead to unprofitable business cases.

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1.1 Problem statement
Research has been conducted into the principles and best practices for RPA. However, the literature for selecting the right process is scarce. According to Syed et al.[2] choosing the right activities for automation is one of the main challenges for successful RPA adoption. Existing techniques for task selection are largely developed by RPA vendors, hence, having a higher probability of being biased. Therefore, these tools may not be optimal for selecting business process. Moreover, recently some methods have been developed to help selecting business processes, such as the method developed by Viehhauser[6]. However, these existing methods are time-consuming and require a lot of data[6]. Furthermore, the costs estimate is often one of the most difficult aspects of writing the business case, but without it the case cannot be made[7].This research aims to develop a dynamic business model that shows the financial impact of RPA, thereby helping enterprises building their business case for RPA with selecting the right business process to automate.

1.2 Research Question
The problem statement as defined above leads to the following research questions:

Main RQ: What dynamic business model can be defined to help predicting the profitability of Robotic Process Automation for a business process?

To help answer the main research question two subcomponents have been defined.

First, to predict the profitability of RPA for a given business process, it is important to know what characteristics a business process should have to be suitable for automation with RPA. If a process is not suitable for RPA, it will not be profitable. Therefore, the following sub question has been defined:

SQ1: What are the key characteristics to make a process suitable for Robotic Process Automation?

Secondly, a model will be defined that takes these characteristics into account. This model will be made in the web-based modelling tool Insight Maker. Leading to the next sub question:

SQ2: what are the possibilities within Insight Maker to predict the suitability and profitability of Robotic Process Automation?

2. RESEARCH METHOD
This research can be divided into two separate parts. First, literature has been studied to answer SQ1 and SQ2. The results of SQ1 and SQ2 are used to develop the tool. The development of the tool can be seen as part two of this study and is done following the Design Science Research approach[8].

2.1 Method of research SQ1
To select the key characteristics of a suitable process to automate with RPA, a literature study was performed. The found literature has been analysed to derive the key characteristics.

2.1.1 *Search strategy*

To determine the to be analysed papers a systematic literature search has been performed. The initial search query has been executed in Scopus.

TITLE-ABS-KEY ("robotic process automation " AND (characteristics OR suitability OR feasibility OR profitability))

After reading the title and abstract of the results of the query, a selection has been made of the relevant papers. Relevant papers need to meet the following including criteria:

- Conference or peer reviewed journal
- The characteristics for suitable RPA process need to be a core focus of the paper

The remaining papers have been used for forward and backward searches. New papers found fulfil the including criteria as well.

2.2 Method of Research SQ2

The characteristics formulated in section 3.1, form the basis of the model. To connect the characteristics a modelling tool has been used. The tool used in this research is Insight Maker. To get a greater understanding of the tool the paper of Fortmann[17] has been analysed. This paper gives great insight of the possibilities of the tool. Furthermore, there are a lot of tutorials available on the internet. When parts of the tool were not clear yet, these tutorials helped. With the paper of Fortmann and the tutorials available the possibilities of the tool have been discovered and the right approach to modelling the model can be defined.

2.3 Method of research main RQ

The model has been developed with the use of the Design Science Research Methodology[8]. This methodology consists of 6 steps to successfully design the model. The first step is problem identification. The need for a model has been explained with the use of literature. The second step is to define requirements that the solution must meet.

The third step is to design and develop the model. This has been done by modelling the characteristics defined in section 3.1 in the tool Insight Maker in such a way that there are variables to fill in by the enterprise. When the model is being simulated the results should show whether the process is profitable to automate with RPA.

After development, the fourth step is to demonstrate that the model solves the initial problem. Due to the time constraints on this research, there is no time to empirically test the model with a real process that will be automated after a positive result from the model. However, a demonstration with the data of a case study can still lead to useful information for the evaluation step. The model is demonstrated to various stakeholders of the company where the case study took place. Their feedback will be used to validate that the model solves the initial problem. The final step of the DSR approach[8], is communication. All aspects of the problem and the designed model should be communicated to the relevant stakeholders. This step is very important for the model to be used correctly. However, for the content of this paper, this is not an important step. Therefore, this step is not covered in the paper.

3. RESULTS

3.1 Key characteristics

The search query resulted in a total of 32 papers on Scopus. After the papers were checked on the including criteria, 7 papers remained. Using forward and backward searching 4 highly rated and cited papers were added. Making the total of analysed papers 11. After a full-text screening the most mentioned characteristics of the papers has been derived. The results can be found in Table 1.

Table 1 Results of Literature Review

	Standardization	Volume	Stability and maturity	Complexity	Digital data input	Structured data input	Automation rate
[2]	x	x	x	x	x	x	x
[4]	x	x	x	x			
[6]	x	x	x	x	x	x	x
[9]	x	x	x		x	x	
[10]	x	x	x	x			
[11]	x	x	x	x			x
[12]	x	x	x		x	x	
[13]	x	x	x	x	x	x	
[14]	x	x	x	x	x	x	
[15]	x	x	x				x
[16]	x	x	x	x			x

3.1.1 *Standardization*

All the 11 papers mention standardization as one of the key characteristics for RPA. A higher degree of standardization has a positive effect on the suitability of automation with RPA.

3.1.2 *Volume*

Volume is also mentioned by all the papers. Volume stands for the number of repetitions a task has on average. Intuitively, this seem plausible, RPA is commonly used to automate repetitive tasks. A higher degree of volume has a positive effect on the suitability of automation with RPA.

3.1.3 *Stability and maturity*

All the papers mention stability and maturity as a key characteristic for RPA. A process is stable and mature when the process will not change in the upcoming future and the results of the process are predictable. A higher degree of stability and maturity has a positive effect on the suitability of automation with RPA.

3.1.4 *Complexity*

8 of the 11 papers mention the complexity of a task. The complexity of a tasks is in literature used to describe the amount of time one human takes to complete a task[4]. Therefore, tasks with a higher complexity take longer to be completed.

3.1.5 *Digital data input*

6 of the 11 papers mention digital data input as a requirement for RPA. While some authors[13],[17] mention the fact that RPA bots are getting smarter and technologies like image recognition and optical character recognition are being used complementary to RPA. Digital data input still has a positive effect on the suitability of automation with RPA.

3.1.6 *Structured data input*

6 of 11 papers mention structed data input as a key characteristic for RPA. Structured data helps increasing accuracy and minimizes process costs. Data is structured when the data is stored in

a predefined format. Structured data input has a positive effect on the suitability of automation with RPA.

3.1.7 Automation rate

5 of 11 papers mention automation rate. A process has a high automation rate if the process has little manual interaction with software. A high automation rate has a negative effect on the suitability of RPA.

3.2 Insight Maker

Insight Maker is a web-based modelling and simulation tool. The tool integrates three general modelling approaches: System Dynamics, Agent-Based Modelling, and imperative programming.

Since the time spawn of this research is rather small the System Dynamics approach is the best approach, due to its simplicity. Moreover, the results are generally easy to interpret, which will be a useful asset for mangers in enterprise that are themselves not familiar with RPA, but must make decisions, regarding implementation. System Dynamics is a modelling paradigm developed in the 1950s to study industrial systems. The technique has been applied in a wide range of different systems including the development of urban systems and forecasting worldwide trends[17]. According to the authors of [17] System Dynamics are primarily focused on feedback loops and the roles they play in the evolution of a system.

Insight Maker uses primitives. Each primitive is a building block that has a unique function. Within the System Dynamics approach there are four different primitives. The primitives all have a different shape to distinguish them. The primitives will be explained using the example of a model for a bank account. The primitive stock has the shape of a rectangle. The function of the stock is to store material. A bank account is a stock that stores the material money. The primitive flow has the shape of an arrow. The flow primitive moves material in or out of the stock. In the example of the bank account, you have deposits as inflow and withdrawals as outflow. The primitive variable has the shape of a circle. Variables can be constants or dynamically calculated. E.g., a variable in the bank account model can be the interest rate. This can be a fixed amount (a constant) or change overtime when the money exceeds a certain amount (dynamical). To connect the primitives, links have to be used. A link is a dashed line that shows the transfer of information between primitives. In the bank account example, the stock bank account should be linked to interest rate if the interest rate is dynamical. The information of the stock is being transferred to the interest rate to calculate the interest rate. To make the model easier to understand, different colours are used to distinguish the sorts of primitives. The colours of the final model can be found in Table 2.

Table 2 Used primitives in Insight Maker

Primitive	Colour
Stock	Blue
Variable that needs data input from user	Yellow
Variable	Orange
Positive flow	Green
Negative flow	Red

3.3 Development of the model

3.3.1 Problem identification and motivation

RPA is an emerging technology that can have great benefits when implemented on the right processes. Due to the novelty of the technology not much research has been done in selecting the right processes for RPA. Among others due to selecting the wrong business process 30-50 precent of initial RPA projects fail[5]. The business case of the proposed RPA implementation ended up not being profitable. Existing models[6] need a lot of time and data to be used, with often only pointing out whether the process is suitable for RPA implementation.

3.3.2 Objectives for a solution

The goal of this research is to make an easy understandable model that can be filled in with easy obtainable data. The outcome of the solution should be usable in building or breaking the business case. Thereby, helping in the selection process of RPA implementation. The solution should meet the following requirements.

- The model is easy understandable
- The model has easy obtainable data as input
- The model shows whether the business case is viable

3.3.3 Design and development

The model consists of 3 phases. Throughout the phases the different key characteristics as defined in section 3.1 will play a role. In the end all the characteristics will be taken into account. An overview of the process of calculating the profitability can be found in Figure 1. The complete model can be found in Figure 4.

3.3.3.1 Phase 0: Starting requirements

Phase 0 is essential for the model to give a valid result. In this phase all not quantifiable characteristics are covered. The phase consists of requirements that have to be met in order for the process to be suitable for RPA. The business process should meet the following requirements:

1) The process is well specified and predictable (maturity)
2) All steps are performed in the same way throughout the entire organization (standardization)
3) The data input is digitalised and structured (digital and structured data)
4) The process is stable (stability)

To meet requirement 1, the business process should be written down in all the different steps of the process. Normally the process overview or the work instructions already exists and can be used for this requirement. Furthermore, the process should be predictable, meaning that the same input should lead to the same results. Often, when the work instructions are clearly described the results are also predictable.

To meet requirement 2, all the branches throughout the organization should work in the same way. If all the branches work with the same work instructions, this should be achieved.

To meet requirement 3, the data that is being used in the process should all be digital and structed. The data is structed when the data is always stored in the same predefined format. When this format is an online document, such as an excel file, the data is also digital.

To meet requirement 4, the process should be stable. Meaning that the interactions with the software will not change in the near future. If the software system will be changed in the upcoming months for example, the process is not stable. When the software will be updated in the upcoming months, but the interactions with the software will remain the same, the process can be classified as stable.

When these requirements are not met, the process is not yet suitable for RPA. To proceed the enterprise should first work on these requirements. When the requirements are met the next phase of the model can start.

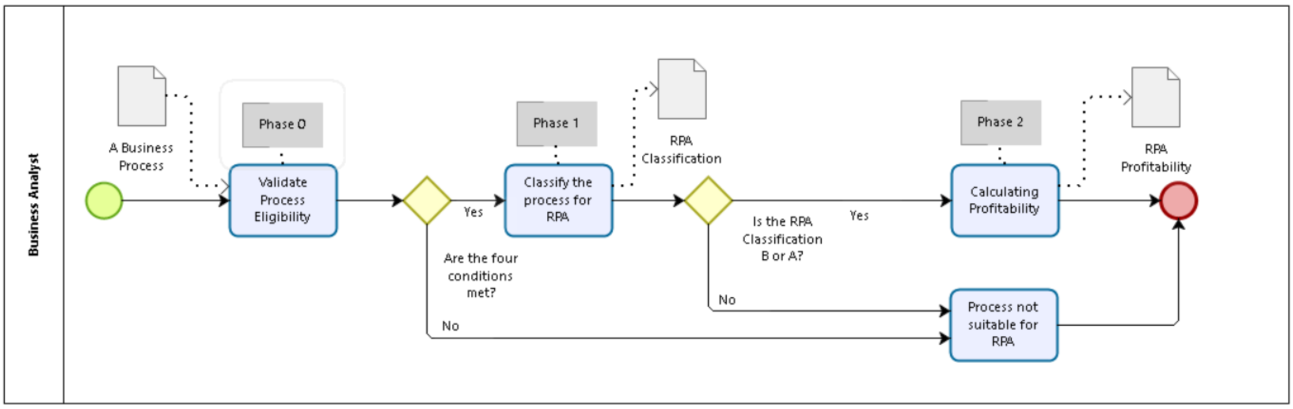


Figure 1 Process of calculating profitability of RPA

3.3.3.2 Phase 1: calculating RPA classification

Phase 1 will calculate the RPA Classification following the approach proposed by Leshob et al. [16] This part of the model classifies whether the business process is suitable for RPA.

The first step is calculating the RPA potential. The outcome is a percentage of the process that can be automated. With 0 being 0 percent of the process is being able to be automated and 1 being 100 percent of the process can be automated. The model needs input for 3 variables to calculate the RPA potential. How the variables need to be calculated can be found in Table 3Table 3. The best practice to calculate these variables is by using the work instruction. Often, the work instructions are clearly described in steps. The model now calculates the RPA potential as shown in

Equation 1.

Table 3 Variables to Calculate RPA Potential

Variable	**Unit**	**How to calculate**
Total Steps	Whole numbers	Adding up all the steps from the work instruction of this process.
Manual steps	Whole numbers	Adding up all steps in the work instruction that require manual interaction with a software application.
Rule based steps	Whole numbers	Adding up all steps in the work instruction that are based on rules that can be clearly defined. (No need for interpretation)

Equation 1

$$\textbf{\textit{RPA Potential}} = \frac{\textbf{\textit{Manual steps}}}{\textbf{\textit{Total steps}}}\, x\, \frac{\textbf{\textit{Rule based steps}}}{\textbf{\textit{Total steps}}}$$

The second step is assigning the RPA relevance. The variables needed for this step can be found in Table 4. The RPA relevance is assigned using the relevance scale as proposed by Leshob et al[16]. The scale can be found in Figure 2.

Table 4 Variables of RPA Relevance

Variable	**Unit**	**How to calculate**
Volume of Transaction	Whole numbers	Average amount the task takes place each day
Complexity of Transaction	Whole numbers	Average amount of time the task takes to be completed, in minutes

The final step of this phase is assigning the RPA Classifcation. For this step, the authors[16] introduce a quadrant as illustraded in Figure 3. A business process can either have a high or a low value for both RPA potential and RPA relevance. With a high value being RPA potential > 0.5 and RPA relevance > 0.5 and other values being labelled as low. A business process with high RPA and high RPA relevance is classified as highly suitable for RPA, quadrant A. A business process with high RPA potential and low RPA relevance is classified as moderately suitable for RPA, quadrant B. A business process with low RPA potential and high RPA relevance is classified as less suitable for RPA, quadrant C. Lastly, a business process with low RPA potential and low RPA relevance is classified as not suitable for RPA, quadrant D. The outcome of RPA Classification will be in numbers instead of text in Insight Maker. The corresponding values can be found in Table 5. It is advised to only proceed to phase 2 of the model, if the outcome of the RPA classification is moderately suitable for RPA (B) or highly suitable for RPA (A).

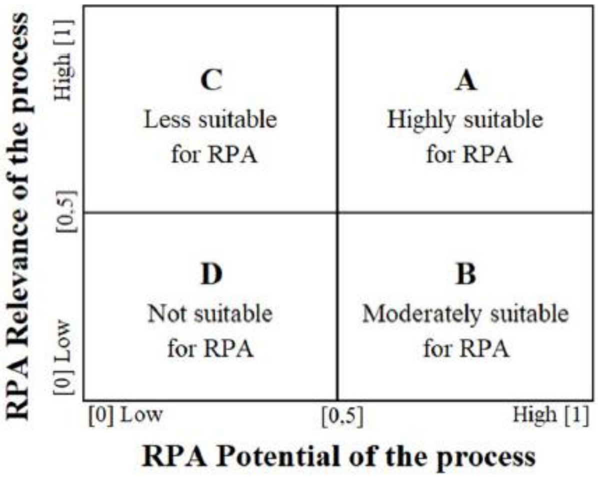


Figure 2 Leshob et al. Relevance Scale

3.3.3.3 Phase 2 calculating potential profit

In phase 2 of the model, the potential profit will be calculated. In this part of the model there are two scenarios possible. The first being the scenario where the user already has an estimate of the costs of the RPA tool and the second scenario where the user has no indication yet what the costs of the RPA tool will be. The first scenario will lead to a prediction of profit when the tool is implemented, while the second scenario gives a prediction on the possible savings. The variables that have to be filled in for this part of the model can be found in Table 6. In the last column of Table 6 the need for the variable is described in 1 of 3 states. The states both scenarios and only scenario 1 are self-explanatory. The state optional means that's the calculation can be executed without the input of this variable. However, including this variable will make the prediction more precise.

With the input the variable possible FTE to save will be calculated. The calculating can be found in appendix A. Since the volume of transaction and complexity of transaction are in times per day and minutes respectively the units need to be converted to hours per workweek to match the variable input of cost of an FTE. To convert minutes into hours, the model divides by 60. To convert from days into workweeks the model multiplies be the number of days in a workweek. This equation is based upon the calculation of Wewerka et al.[19] but improved by adding the possibility to include shrinkage.

The final step is to predict the possible profit or savings. In the case of scenario 2, the variables only used in scenario 1 will have the value of 0. This way they do not influence the outcomes of the model. The stock profit is influenced by 3 flows and has a starting value equal to the onetime costs of the software. The savings in FTE and savings in human errors have a positive influence on the profit while the monthly costs of software have a negative influence on the profit. The calculations of the flow savings in FTE and the flow savings in human errors are included in appendix A. The two flow primitives work in a similar fashion. The savings will start as soon as the RPA tool is implemented, so the model checks whether the number of months to implement the RPA tool have been passed. If that is the case the flow primitives will start influencing the profit stock. The negative flow of monthly costs of software will start influencing the profit stock from the beginning. With the monthly costs being reduced from the profit each month.

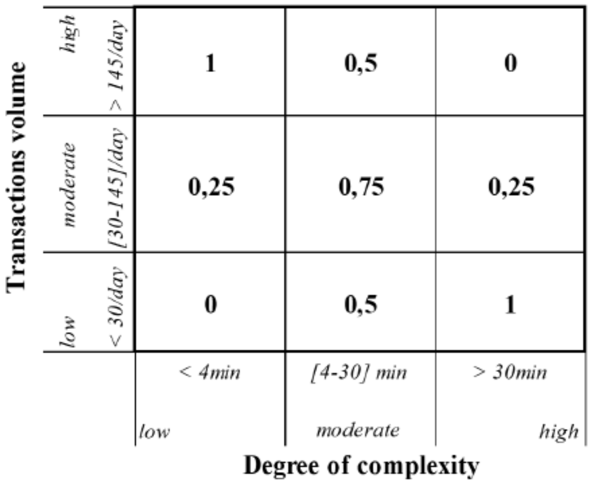


Figure 3 Leshob et al. RPA Classification Quadrant

With all the variables filled in the model can be simulated. Notice that only in scenario 1io 1 the profit stock will stand for profit. If the model is simulated for scenario 2, the primitive will still be called profit, but will actually be the possible savings. The results of the model can be printed in a graph or a table. An example of an outcome is included in the appendix C. Both results are simulations with the same variables. The values of the variables are included in appendix B. An overview of the entire model is showed in Figure 4.

Table 5 Values for classifying RPA suitability

Value in Insight Maker	Value in Quadrant
0	D not suitable for RPA
1/3	C Less suitable for RPA
2/3	B Moderately suitable for RPA
1	A Highly suitable for RPA

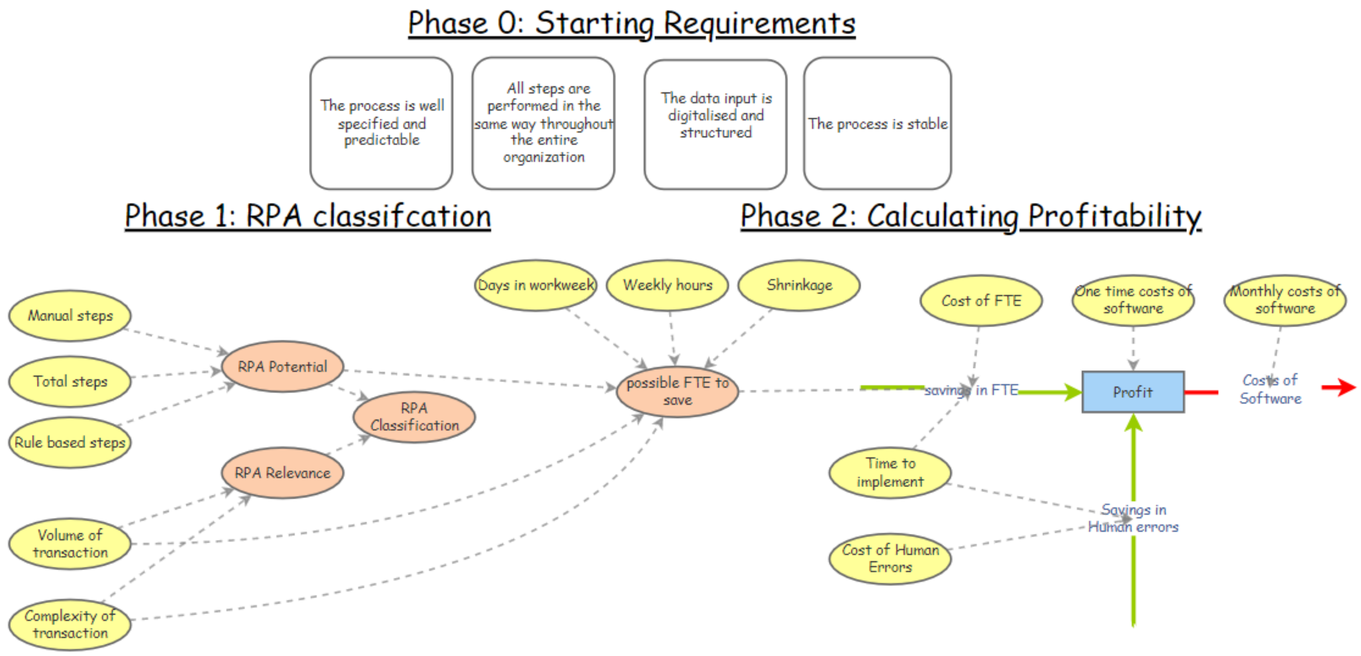


Figure 4 Overview of the entire model build in Insight Maker

Table 6 Variables for profit calculation

Variable	Value	How to calculate	Scenario
Weekly hours	Hours	The number of hours in one standard workweek	Both scenarios
Days in workweek	Days	The number of days in one standard workweek	Both scenarios
Cost of FTE	Currency	the total amount of expenses for one FTE. In currency per month.	Both scenarios
Shrinkage	Percentage	The percentage of hours lost due to shrinkage.	Optional
Cost of Human errors	Currency	the amount of profit lost due two human errors, for this business process. In currency per month	Optional
Time to implement	Months	the estimated time to implement the RPA tool. in months	Only scenario 1
Onetime costs of software	Currency	the total amount of the nonrecurring costs. In currency.	Only scenario 1
Monthly costs of software	Currency	the total amount of recurring costs off the software. In currency per month.	Only scenario 1

3.3.4 Demonstration

To demonstrate that the model solved one or more instances of the problem, a case study has been performed. The case study is performed by the shipping and warehousing department of an enterprise. Mainly focused on their route settlement process.

The goal of the case study is to test the model in a real enterprise to see if the stakeholders are satisfied with the results of the model. The case study was performed on the route settlement process of the enterprise. The values of the route settlement process will be used to demonstrate the model to the stakeholders. Using a real example could lead to more useful feedback from the enterprise.

The model is presented to 2 of the stakeholders of the case study. The manager and the team leader. After the presentation the stakeholders were asked to answer the following questions:

- **Q1** Is the model easy to understand?
- **Q2** Is the model easy to fill in?
- **Q3** Are the results of the model plausible?
- **Q4** Are the other remarks about the model?

Due to the earlier mentioned time restriction, it was not possible to empirically test the correctness of the output. The real data of the case study is used while presenting. However, the results of the model cannot be compared to the possible real results. This will be further discussed in the discussion section. The results of the questions can be found in Table 7. Note that the Team leader did not answer Q3, the team leader did not want to answer the question, due to a lack of expertise in the subject. The manager mentioned that he would have liked to see some qualitatively measurements in the model as well. The amount of value adding work an employee does or employee moral for example. This will be further discussed in section 4.3.

Table 7 Results of questionnaire

	Q1	Q2	Q3	Q4
Manager	Yes	Yes	Yes	Currently not possible to overcome qualitatively measurable benefits in a quantitative model.
Team leader	Yes	Yes	n/a	n/a

3.3.5 Evaluation

For the evaluation, it is important that the model supports a solution to the problem as stated in objectives for a solution. The results from the questionnaire show that the model is user-friendly and easy to fill in. Checking most of the requirements. However, the effectiveness of the model cannot be evaluated yet. Since the model is not empirically tested. This will be further discussed in the discussion section.

4. DISCUSSION

4.1 Literature study

To evaluate what the key characteristics of RPA implementations are only 11 papers were included. This is a rather small number compared to average size literature reviews. This can be explained by the search query. The inclusion of (characteristics OR suitability OR feasibility OR profitability), narrowed down the search results from 411 to 32. From the 32 only 7 papers remained that are actually about the key characteristics. With 4 papers added via backward search the total was only 11. This can be explained by the fact there has not been much research into the feasibility of RPA. Most of the related work is researching the use cases of RPA or the potential general benefits. However, since the included papers are all strongly related to the subject of this research, the literature study still resulted in a list of key characteristics that can be used for this study. Moreover, the authors of [2], [6], [12] included an extensive literature study of their own. Including papers that briefly mentioned characteristics related to RPA. the papers used in those literature studies did not change the outcome of the list of most mentioned key characteristics. Strengthening the choice to define the key characteristics as they are.

Nevertheless, it cannot be guaranteed that all the relevant literature for this topic has been considered throughout the literature review. Increasing the probability that the literature review is biased. Other papers could have been published using other channels, these papers will not appear in this literature study. However, using forward and backward search, the author included papers besides the papers from the literature search. Limiting the probability that relevant literature was missed out.

Moreover, the definition of the key characteristic Complexity is different than the definition of the word complexity. The definition of complexity normally stands for how complicated a task is, while the definition used for the key characteristic focuses on the time consumption of a task. Intuitively, the key characteristic should have gotten another name. However, since the literature called complexity the average time a human takes to complete a task [4], the author of this paper decided to keep the name complexity for the key characteristic of average time consumption.

4.2 Insight Maker

The tool Insight Maker has been a proposed tool by the supervisor of this research. At the start of this research the tool was not yet know by the author. Due to the short time spawn for this research quickly understanding the to be used tool was necessary. Insight Maker has a System Dynamic approach built in its software. The System Dynamics community focuses on easy-to-use graphical tools and numerical analysis of simulation results[17]. Making Insight Maker an excellent tool to use for this research.

Being user-friendly is one of the goals for the model. The graphical user interface of Insight Maker which shows all the relations between variables helps with the usability and transparency of the model. Leading to believe that stakeholders from different industries with little to no expertise in the field of RPA can understand the model.

4.3 The model

The downside of existing models is the use of complex mathematical equations that are difficult to fill in and a lot of data is required for these models[6]. While it is plausible to assume that the existing models will have a higher accuracy in predicting the suitability of RPA than the proposed model. The proposed model gains value by its simplicity. With a bit of preparation, the model is filled in within minutes. Furthermore, the model developed in this research is different than the existing models because the model uses System Dynamics. Using System Dynamics allows the user to see in understandable language what the possible impact could be of RPA implementation. This unique way of predicating the feasibility of RPA helps making a business case for enterprises. Within enterprises it is common to present the business case before making an investment, for the possible implementation of RPA this will be no different. As stated in literature[7] the cost estimate is one of the most difficult aspects of building the business case. It is hard to quantify the effects of an investment, while it is one of the most important aspects of the business case. Moreover, the most common way to present a business case is using a template such as the Business Model

Canvas (BMC) or Business Model Ontology (BMO) as proposed by Osterwalder[20]. While the BMO is a great way to visualize the value proposition, the BMO, is static and does not allow the user to calculate and simulate the costs and incomes over time. System Dynamics are primarily focused on feedback loops and the roles they play in the evolution of the system[17], giving the user the possibility to calculate and simulate the costs and incomes. Due to the feedback loops the user can visualize the possible effects different variables have on the outcome, making System Dynamics and excellent way to model the business case.

Furthermore, Phase 0 and Phase 1 are based upon the approach of Leshob et al.[16] to calculate the suitability of RPA. In their paper the authors state that they already made the first steps into empirical validations, which helps strengthen the believe that the proposed model in this paper can also be empirical validated. One of the next challenges for Leshob et al.[16] is to design and develop a tool that supports to the approach. This research has contributed to building such a tool. The model as proposed in this research is a more extensive tool that supports the approach as proposed by Leshob et al.[16]. Extending the tool to include the simulation of costs and incomes resulted in a tool that can help enterprises not only with selection the right process, but also with visualizing the possible financial effects of the implementation. Therefore, the best use of this model will be at the start of a project where RPA could be the solution.

Nevertheless, it should be stated that the developed model has not been empirically tested. Due to the time constraint of this research, it was not possible to conduct a real case study. The model is only tested on usability and transparency. To strengthen this research the model should be empirically tested with case studies. This can be done by selecting case studies that implemented RPA and have data for the variables available from before and after the implementation. The results from the model should be compared to the actual results in order to test the accuracy of the model.

Furthermore, literature states that the implementation of RPA goes in little steps, "think big but start small"[21]–[23]. Likewise, Lacity et al. [24] argued it is a good thing to start with even the smallest of tasks, learning from your mistakes. At this moment in time the model does not take implementation in little steps into account. In case of scenario 1 the model assumes that the role-out of RPA is all at once and in scenario 2 the model calculates the savings after the full RPA potential has been achieved. To improve the accuracy an extra variable; implementation rate, could be added. This variable makes sure the model takes into account that the implementation will go step by step as stated in the literature.

The manager of the case study proposed to also include non-financial variables like employee satisfaction in the model. Such non-financial variables could also have a financial impact in the end. High employee morale will lead to various benefits for the enterprise. The author agrees with the manager, and this could be done in a future work.

5. CONCLUSION

RPA is an emerging technology that will have an increasing impact on enterprises in different branches. The software robots are automating manual and repetitive tasks that used to be done by humans. RPA implementations offer many benefits including: increased efficiency, reducing human labour, employees can concentrate more on value creation, costs savings, ease of use, increased volume of performed tasks and increased quality of work[2], [3]. However, selecting the right process to automate is still a difficult task and wrong selection will lead to unprofitable business cases[2], [5].

The literature review conducted in this study identified key characteristics for a business process to be suitable for automation with RPA software. The study found out that processes with a high level of standardization, maturity, stability, and digital structured data are essential for RPA implementation. Furthermore, the study found out that processes that are strictly rule based, have a high volume, are prone to human errors and require a lot of manual input tend to be more profitable to automate.

Using the results of the literature study the author proposes a model that helps enterprises to effectively make business cases for RPA implementations. In more detail, the proposed model will help enterprises to select the business processes which have the most potential to be profitable when automated with RPA. This is done by modelling the business process with a System Dynamical approach. The model will show the amount of profit an enterprise can make throughout time if the process is to be automated. In scenario 1 (where the costs of the RPA tool are already known) the tool can be used to predict the possible profit, thereby building, or breaking the business case. In scenario 2 (where the costs of the RPA tool are not yet known) the enterprise can use the outcome to set a maximum amount an RPA tool may cost to breakeven.

This research contributed to helping enterprises quantify the costs and profit of RPA and helping enterprises build profitable business cases. Moreover, this research contributed to the work of Leshob et al [16] by building a tool that supports their approach.

This work is still in an early stage and there are several steps to further improve the model as stated in the discission section. The upcoming challenges are1) the model needs to be empirically tested, 2) the model can be improved by adding the element of step-by-step RPA implementation such as described in literature[21]–[24], 3) the model can be expanded to include non-financial effects, such as employee satisfaction.

6. REFERENCES

[1] M. Lacity and L. Willocks, "Becoming Strategic with Intelligent Automation," *MISQE Research Insights for IT Leaders*, 2021, doi: 10.17705/2msqe.000XX.

[2] R. Syed *et al.*, "Robotic Process Automation: Contemporary themes and challenges," *Computers in Industry*, vol. 115, Feb. 2020, doi: 10.1016/j.compind.2019.103162.

[3] L. Ivančić, D. Suša Vugec, and V. Bosilj Vukšić, "Robotic Process Automation: Systematic Literature Review," *Lecture Notes in Business Information Processing*, vol. 361, pp. 280–295, Sep. 2019, doi: 10.1007/978-3-030-30429-4_19.

[4] M. C. Lacity and L. P. Willcocks, "Robotic process automation at telefónica O2," *MIS Quarterly Executive*, vol. 15, no. 1, pp. 21–35, 2016.

[5] EY, "Get ready for robots Why planning makes the difference between success and disappointment." Accessed: Jan. 23, 2022. [Online]. Available: https://assets.ey.com/content/dam/ey-sites/ey-com/en_gl/topics/emeia-financial-services/ey-get-ready-for-robots.pdf

[6] J. Viehhauser and M. Doerr, "Digging for Gold in RPA Projects – A Quantifiable Method to Identify and Prioritize Suitable RPA Process Candidates," *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, vol. 12751 LNCS, pp. 313–327, 2021, doi: 10.1007/978-3-030-79382-1_19.

[7] I. Gambles, "Making the business case : proposals that succeed for projects that work," p. 183.

[8] J. vom Brocke, A. Hevner, and A. Maedche, "Introduction to Design Science Research," pp. 1–13, 2020, doi: 10.1007/978-3-030-46781-4_1.

[9] A. S. Ermolaeva, V. N. Nemtsev, P. S. Solomatin, and M. A. Selivanova, "The Analysis of Implementation of Robotic Process Automation RPA: The Experience of Russian and Foreign Companies," *Lecture Notes in Networks and Systems*, vol. 198, pp. 1483–1492, 2021, doi: 10.1007/978-3-030-69415-9_164.

[10] K. v. Jeeva Padmini, G. I. U. S. Perera, H. M. N. Dilum Bandara, and R. K. O. H. Silva, "A Decision Support Tool to Select Candidate Business Processes in Robotic Process Automation (RPA): An Empirical Study," *Lecture Notes in Networks and Systems*, vol. 173 LNNS, pp. 567–582, 2021, doi: 10.1007/978-981-33-4305-4_42.

[11] S. Balasundaram and S. Venkatagiri, "A structured approach to implementing Robotic Process Automation in HR," *Journal of Physics: Conference Series*, vol. 1427, no. 1, Jan. 2020, doi: 10.1088/1742-6596/1427/1/012008.

[12] C. Wellmann, M. Stierle, S. Dunzer, and M. Matzner, "A Framework to Evaluate the Viability of Robotic Process Automation for Business Process Activities," *Lecture Notes in Business Information Processing*, vol. 393 LNBIP, pp. 200–214, 2020, doi: 10.1007/978-3-030-58779-6_14.

[13] F. Huang and M. A. Vasarhelyi, "Applying robotic process automation (RPA) in auditing: A framework," *International Journal of Accounting Information Systems*, vol. 35, Dec. 2019, doi: 10.1016/J.ACCINF.2019.100433.

[14] J. Kokina and S. Blanchette, "Early evidence of digital labor in accounting: Innovation with Robotic Process Automation," *International Journal of Accounting Information Systems*, vol. 35, Dec. 2019, doi: 10.1016/J.ACCINF.2019.100431.

[15] J. Wanner, A. Hofmann, M. Fischer, F. Imgrund, C. Janiesch, and Geyer-Klingeberg, "(PDF) Process Selection in RPA Projects – Towards a Quantifiable Method of Decision Making," Nov. 2019. https://www.researchgate.net/publication/337289984_Process_Selection_in_RPA_Projects_-_Towards_a_Quantifiable_Method_of_Decision_Making (accessed Nov. 23, 2021).

[16] A. Leshob, A. Bourgouin, and L. Renard, "Towards a Process Analysis Approach to Adopt Robotic Process Automation," *Proceedings - 2018 IEEE 15th International Conference on e-Business Engineering, ICEBE 2018*, pp. 46–53, Dec. 2018, doi: 10.1109/ICEBE.2018.00018.

[17] S. Fortmann-Roe, "Insight Maker: A general-purpose tool for web-based modeling & simulation," *Simulation Modelling Practice and Theory*, vol. 47, pp. 28–45, 2014, doi: 10.1016/J.SIMPAT.2014.03.013.

[18] H.-C. Grung-Olsen, "A Strategic Look at Robotic Process Automation," 2017, Accessed: Jan. 23, 2022. [Online]. Available: www.bptrends.com

[19] J. Wewerka and M. Reichert, "Towards Quantifying the Effects of Robotic Process Automation," *Proceedings - IEEE International Enterprise Distributed Object Computing Workshop, EDOCW*, vol. 2020-October, pp. 11–19, Oct. 2020, doi: 10.1109/EDOCW49879.2020.00015.

[20] A. Osterwalder, "The business model ontology a proposition in a design science approach," *undefined*, 2004.

[21] Deloitte, "The robots are ready. Are you?," 2017.

[22] Institute for Robotic Process Automation, "Introduction to Robotic Process Automation A Primer," 2015.

[23] Accenture, "Getting Robots Right: How to Avoid the Six Most Damaging Mistakes in Scaling-up Robotic Process Automation," 2016.

[24] M. Lacity, L. P. Willcocks, and A. Craig, "Robotic process automation: mature capabilities in the energy sector," 2015, Accessed: Dec. 08, 2021. [Online]. Available: http://www.lse.ac.uk/management/research/outsourcingunit/

7. APPENDIX

Appendix A.

$$\textit{Possible FTE to save} = [\textit{RPA Potential}] * [\textit{Volume of transaction}] * [\textit{Complexity of transaction}]/60 * [\textit{Days in workweek}] / [\textit{Weekly hours}] * [\textit{Shrinkage}]$$

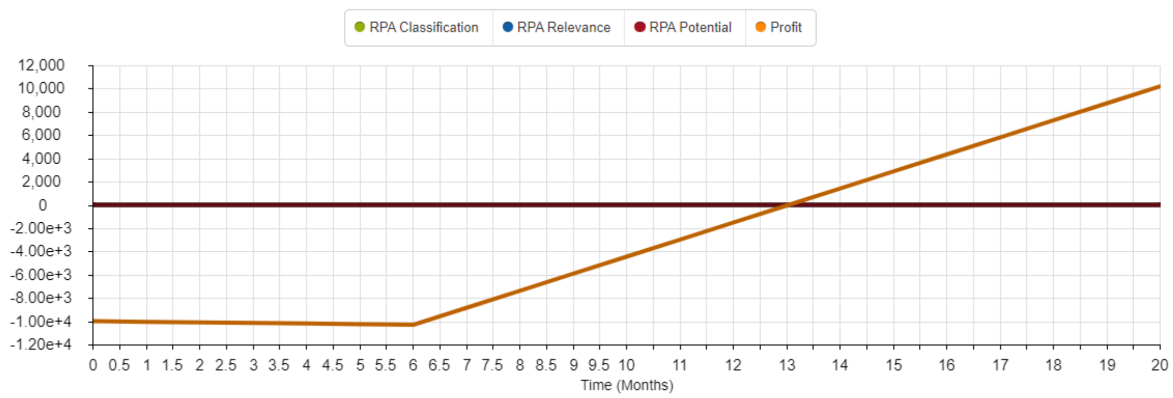
$$\textit{Savings in FTE} = \textit{If Months}() < [\textit{Time to implement}] \textit{Then } 0 \textit{ Else } [\textit{Cost of FTE}] * [\textit{possible FTE to save}] \textit{End If}$$

$$\textit{Savings in Human errors} = \textit{If Months}() < [\textit{Time to implement}] \textit{Then } 0 \textit{ Else } [\textit{Cost of Human Errors}] \textit{End If}$$

Appendix B

Variable	Value
Total steps	42
Manual steps	35
Rule based steps	34
Volume of transaction	50
Complexity of transaction	8
Days in workweek	5
Weekly hours	38
Shrinkage	1.28
Costs of FTE	2000
Cost of Human Errors	0
Time to implement	6
One-time costs of software	10000
Monthly costs of software	50

Appendix C



Time	RPA Classification	RPA Relevance	RPA Potential	Profit
0	1	0.75	0.674603175	-1.00e+4
1	1	0.75	0.674603175	-1.01e+4
2	1	0.75	0.674603175	-1.01e+4
3	1	0.75	0.674603175	-1.02e+4
4	1	0.75	0.674603175	-1.02e+4
5	1	0.75	0.674603175	-1.03e+4
6	1	0.75	0.674603175	-1.03e+4
7	1	0.75	0.674603175	-8.84e+3
8	1	0.75	0.674603175	-7.37e+3
9	1	0.75	0.674603175	-5.91e+3
10	1	0.75	0.674603175	-4.44e+3
11	1	0.75	0.674603175	-2.98e+3
12	1	0.75	0.674603175	-1.51e+3
13	1	0.75	0.674603175	-45.7
14	1	0.75	0.674603175	1,419.18686