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Robotic Process Automation Through Advance Process Analysis Model

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Abstract—Robotics Process Automation is an advanced technology that builds an intelligent software robot that can emulate human interactions with a business process. RPA is an efficient automated method where software agents interact through a graphical user interface in a human-like manner. RPA has various applications in most industries like banking and finance, human resources, healthcare, etc. In this paper, we have proposed our RPA process analysis model and have compared it with a traditional model using various comparison parameters like frequency of change, degree of complexity, time is taken, screen usage and volume of transactions and found out that proposed method gave efficient results over the traditional method.

Keywords—Robotic Process Automation (RPA), Business Process Analysis, Software Agent, Process Model, Automation Model, Software Process Automation

I. INTRODUCTION

This Robotic process automation (RPA) is the practice of automating routine business process with 'software robots' that perform various tasks automatically. These tasks include transaction processing, IT management and automated online assistants. Robotic process automation is software robots that could effectively emulate human beings by using artificial intelligence methods [1]. The robotic process automation (RPA) represents neither physical nor mechanical robot, even if it envisions some electromechanical machine. In the term of robotic process automation, robot refers to a software-based solution, programmed to carry out procedures, processes or tasks on the repetitive way that are usually done by humans [2][3]. RPA can be applied in various functions like finance and accounting (F&A), procurement, human resources, contact centres, etc. Branches of RPA extends from sectors like banking to healthcare. In the banking and financial services industry [4], the RPA potential for F&A, card activation, and fraudulent claims discovery is high whereas the RPA potential for human resource (like payrolls, hiring candidates) is low. While in the healthcare industry [5], functions like report automation, system reconciliation has a higher RPA potential as compared to procurement (i.e. invoice processing, requisition-to-purchase). The benefits of RPA include rapid return on investment, enhanced processes, better customer experience, elimination of repetitive work, improved service delivery, enhanced ability to manage, cost reduction, insights and analytics, non-invasive technology, increased compliance, scalability, and flexibility. Another feature that RPA provides is recording manual tasks and then imitate the whole process [6]. There are many organisations that provide a platform and tools to implement RPA, such as UiPath [7], BluePrism [8] or Automation Anywhere [9]. The flow of the paper can be described as follows. Section II compiles the literature survey conducted. Section III gives some examples of RPA being used in daily life. Section IV defines process analysis and process model. Section V explains the proposed process model in the form of a case study. Section VI summarises and compares the existing process model and the proposed process model. Section VII is the final conclusion of our study.

II. LITERATURE REVIEW

In this study, we will be addressing the model described by Leshob, Bourgouin, and Renard [10] as 'traditional model'. This model decides whether the process under consideration is to be automated or not by considering three main factors, namely, eligibility, potential and relevance. The final decision is the combination of the results of the above-mentioned factors. For example, if a given process is eligible, with a potential=1 and relevance=0.3, then that process is *moderately suitable* for automation.

A case study, analysing the application of RPA inside a BPO unit, was conducted by Aguirre and Rodriguez [11]. Their study yields that, when RPA was applied for some of the organisation's back-office tasks, an increase in productivity was observed with a reduced amount of processing time.

A method that could be used for modelling of processes is called the Integrate Definition (IDEF) group of modelling methods. For business modelling, IDEF0 (Function Modelling) and IDEF3 (Process Description Capture Method) are proven to be the best choice. The IDEF0 serves as a modelling language for analysis, development and integration of processes and IDEF3 describes how a particular sub-processor a system works. [12][13].

As stated by S. Al-Fedaghi [14], a process model is a method of representation of the reality of a process through

diagrams that depict the flow of the process, its interaction with databases and other entities. The most common way to represent a process is by designing a Business Process Model and Notation (BPMN) diagram [15]. The major benefit of using such a standardised model is the terminologies used, which can be easily applied to any and all kinds of business processes, of any complexity. Some other benefits include improved efficiency, agility and clear insight.

To better understand BPMN, we take an example mentioned in the study done by Muehlen and Ho [16]. First, the received complaint is analysed and then decided whether to proceed for warranty verification or job assignment. For warranty verification, it is directly sent to warranty claim, but for the job assignment, the required type of service is selected. After the service is completed, a quality assurance test is conducted and upon satisfaction, proceeded to collect the necessary funds.

III. Real-World Applications

RPA can be used on a day-to-day basis, some of the proposed processes are mentioned below:

A. Procure-to-Pay

The procure-to-pay process involves a Purchase Order (PO), then the goods received and the final step is the payment step, involving creating invoices and logging all the details to a database. Currently, this process is done by systems like Enterprise Resource Planning (ERP) and someone to enter all the necessary information. The manual intervention in this process can be automated using an RPA robot on the front-end [17].

B. Automated Testing

Testing of new software is a very crucial but time-consuming process. But, the most common test scenarios can be easily automated using RPA and the process is completed in no time, without any manual intervention [18].

C. Daily Profit & Loss Preparation

Many large trading companies need to track their P&L and risk exposures daily. Currently, the process is done manually using MS Excel or other legacy tools. UiPath [19] claims that the handling time can be reduced by roughly 66% with 100% accuracy.

D. Process Mining

Process mining is a method used to analyse business processes and extract relevant information from logs that will help to detect undesired patterns, bottlenecks, etc. With the help of automation, this process would be faster and can be performed for large amounts of data, continuously [20].

IV. What are the RPA process analysis and process model?

There are numerous important processes that take place in a company but repetitive maybe daily or weekly basis or a couple of days a week. These tasks can be automated using the RPA approach. For example, the process of downloading of a bank statement, finding any errors and correcting them takes time, whereas a robot made by RPA can do the same job in one-third of the time without the need of any human intervention. In this way, the employees can do more productive tasks in the time that was spent on those repetitive processes. Also, the time spent on those processes can be greatly reduced by automating them.

A. Process Analysis

Process Analysis is a method to determine whether RPA can be applied to a particular process or not. It helps in reaching to a conclusion for the most crucial decision for a company, i.e. on which processes to invest money on its automation. The selection of a process for RPA can be determined by various eligibility criteria like Potential, Complexity, FTE (Full Time Employ) savings, etc. Based on these selected parameters and the arbitrary values assigned with them, the eligibility is calculated. The main role of process analysis is to choose a process in such a way that on automation, there is long term, fruitful outcome bearing the ease of the company and increasing the efficiency of the firm/company.

B. Process Model

Process Model is a platform on which the implementation or execution of any process analysis can be done. A process model can only be formed when all the criteria of the process analysis are fulfilled. It provides a meticulous and comprehensive diagnosis that acts as a platform on which the process analysis for a process can be executed.

V. Purchase Requisition Analysis: A Case Study

In this study, we consider a software robot (developed via an automation software) that will read an e-mail with a pre-defined subject and download its attachments. Then, it reads the attached document via a pdf viewer and copies all its data into a Microsoft Excel file and saves the file. Then, it analyses each row and searches for that product on the e-commerce website. This process is repeated for each item in the attached document and a final excel sheet is prepared.

The main flow of our proposed model can be summarised as shown in Fig. 2.

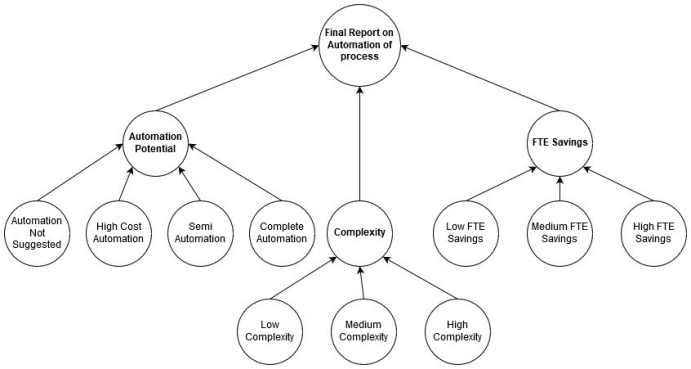

Fig. 1. The basic flow of the model

A. Automation Potential

Automation potential is the capacity of the process that has the necessary abilities or qualities to become successful or useful in the future. It is also a possibility of a process to develop in a particular way. So, to determine the type of automation for a process, the different tasks of the process need to be analysed. Based on these criteria, some parameters have been selected to determine the type of automation to be implemented, as mentioned below.

1) Rules and Assumptions:

If, there are frequent changes expected in the system in the next 6 months, or

the requirements can be handled through minor changes in existing systems, or

the requirement be handled effectively by only making a business process change,

Then, **Automation Is Not Suggested**

Else if, the process requires complex cognitive capabilities,

Then, **High-Cost Automation Is Suggested**

Else if, Process involves manual decision making or process includes the use of physical-equipment/ security-token/ SMS-authentication, or process involves unknown exceptions or process involves uncertain triggers,

Then, **Semi-Automation Is Suggested**

Else, **Complete Automation Is Suggested**

The above-mentioned tasks are compiled into a generalized tabular form, as shown in Fig. 4, so that different processes can be easily categorized.

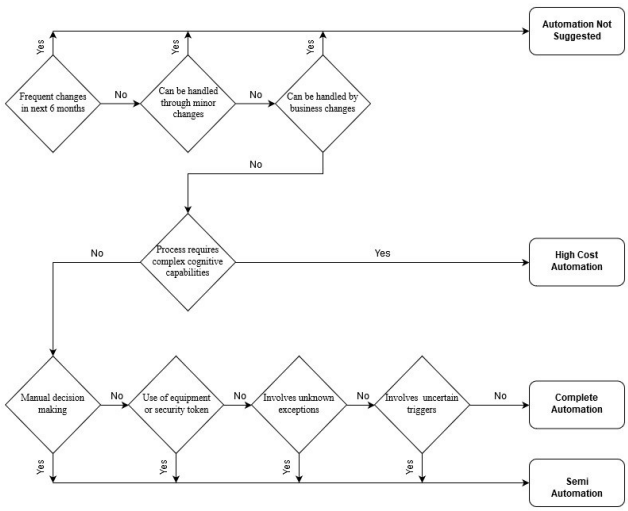

Fig. 2. Flowchart to Determine the Type of Automation Potential

2) Decision Making Process For Automation Potential

This process involves manual decision making, whether to purchase the product or not. It involves unknown exceptions such as network errors, product out of stock or purchase amount exceeds the budget. Also, it involves uncertain triggers like a new browser window is opened for each product request. So, here the automation potential is *Semi-Automation*.

Automation Potential		Semi Automation
Sr. No.	Questions	
1	Are Frequent changes expected in the system/process in next 6 months?	No
2	Does the process require complex cognitive capabilities e.g. (handwriting, recognition, text understanding, reasoning & skills)?	No
3	Does the process involve manual decision making (Non standard steps)?	No
4	Does the process include use of physical equipment/security token/SMS authentication?	No
5	Are there any unknown exceptions?	Yes
6	Are the processes triggered on certain date/dependent on a particular activity completion?	Yes
7	Can this requirement be handled through minor changes in existing systems?	No
8	Can this requirement be handled effectively by only making a business process change?	No

Fig. 3. Evaluating Automation Potential for the Process

B. Complexity

Complexity in simple terms is an assessment of the tasks or events that make up the process and through which activity or a decision flow is decided before reaching the output stage. Complexity characterises the behaviour of a system or model whose components interact in multiple ways and follow local rules, meaning there is no reasonable higher instruction to define the various possible interactions. Considering the type of interaction of the automated process, the allocation of points is done as mentioned below and then the level of complexity is determined, as shown in Fig. 6.

1) Rules and Assumptions:

For Each Application used, add 10 points to the complexity score.

Each Screen used in the process, add 2 points to the complexity score.

For Each If-else condition used in the process, adds 2 points to the complexity score.

If, the net complexity score is less than 30,

Then, it is categorized as **Low Complexity**

If, the net complexity score is between 30 to 60,

Then, it is categorized as **Medium Complexity**

If, the net complexity score is greater than 60, Then, it is categorized as **High Complexity**.

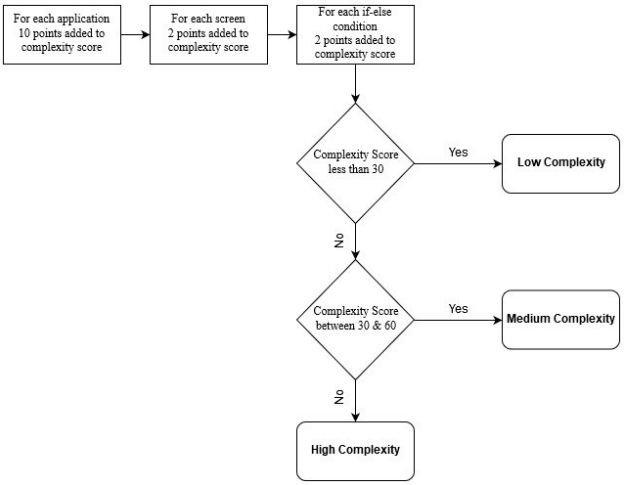

Fig. 4. Flowchart to Determine the Type of Complexity

2) Decision Making Process For Complexity

This process is a manual and repetitive process that requires about 4 Java/web-based applications. The number of screens used is 16 per process with about 25 if-else scenarios each of standard input type. There is a 31% chance of exception scenarios. It requires image reading skills but no reasoning/cognitive skills or remote access required. Based on the above data, the complexity of this process is 30 or low.

Complexity				
		Complexity Score	Low	30
Sr. No.	Questions	Weightage	Input	Score
1	Process type	10%	Manual & Repetitive	30
2	Input Method - Free text (%)	10%	0%	0
3	Applications Used	20%		35
3a	Number of application	50%	4	40
3b	Type of application	50%	Java/ Microsoft/ Web based	30
4	Number of Steps	20%		34
4a	Number of screens used	30%	16	32
4b	Number of If else scenarios	40%	25	50
4c	Input Type	30%	Standard	15
5	% Exception/ Non Standard scenarios	10%	31%	31
6	Image/ handwriting reading required	10%	Yes	100
7	Reasoning/understanding/cognitive skills needed?	10%	No	0
8	VDI/ Remote desktop/ citrix required	10%	No	0

Fig. 5. Evaluating Complexity for the Process

C. FTE Savings

FTE Savings stands for Full-Time Employee Savings. It gives us information about the full-time employees hours saved to execute the process. It also helps to budget, economize and save money for the future. In the view of time taken by a process or the amount of data it handles, the FTE savings is calculated as shown in Fig. 8.

1) Rules and Assumptions:

Assuming that a single bot is used to automate at least 5 processes and the minimum FTE expected from a bot is 0.2.

If, automation saves less than 0.2 FTE,

Then, it is categorized as Low FTE Saving

If, automation saves between 0.2 to 0.6 FTE,

Then, it is categorized as Medium FTE Saving

If, automation saves more than 0.6 FTE,

Then, it is categorized as High FTE Saving

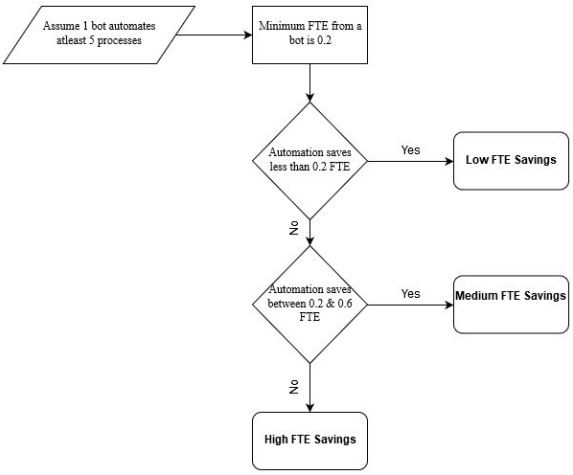

Fig. 6. Flowchart to Determine the Type of FTE Savings

2) Decision Making Process For FTE Savings

The process involves 10,000 volumes of data per process run, which takes about 1 hour of time. It is run on a daily basis daily and engaging 2 employees in the process, which sums up as about 720 hours yearly. Based on the above data, the FTE savings for this process is 0.341 or medium.

FTE Savings		Medium
Sr. No.	Questions	
1	Average volume of data handled during a process run	10000
2	Process turnaround time (in Hrs)	24
3	Frequency of run	Daily
4	Average time taken per run (in Hrs)	1
5	AHT per month (in Hrs)	30.00
6	Number of FTEs engaged	2
7	Total efforts per month (in Hrs)	60.00
8	Total Efforts per year ((in Hrs)	720
9	Number of FTE Savings	0.341

Fig. 7. Calculating Full-Time Employment Savings for the Process

To put the process in a nutshell, we can say that the automation potential of the given process is Semi-Automation, the complexity of the process has a collective score of 30 due to which the process has Low complexity and finally the FTE savings for the given process after considering all the conditions are set to Medium. In the end, the process, on the whole, falls in the Quick Win Quadrant which acquaints us that the process is suitable for Automation as shown in Fig. 9.

Summary	
Process	
Process Description	
Process Owners	
Department	
Automation Potential	Semi Automation
FTE Savings	Medium
Complexity	Low

Complexity	FTE Savings	Quadrant
Low	High	Quick win
Low	Medium	Quick win
Low	Low	Low Hanging Fruit
Medium	Medium	Low Hanging Fruit
Medium	High	Quick win
Medium	Low	Long Term Improvement
High	Low	Long Term Improvement
High	High	Must do Improvement
High	Medium	Must do Improvement

Fig. 8. Summary Report

VI. Results and Discussion

To analyse the efficiency of the proposed model, we have compared it with the traditional model.

A. Traditional Process Model

According to [10], this model comprises of four-steps to analyse a business process. The first step checks for the eligibility by considering the maturity and standardization of the process. The next step analyses the potential of the business process by the percentage of manual and software interaction with respect to the whole process. The third step assesses the relevance of automating a business process with the RPA approach. The fourth and final step classifies the process and provides the suitability of the process for RPA, based on the result of the previous steps.

After a thorough examination of all the parameters, some key parameters were selected and their weightage on the entire process model is plotted in the form of a graph, Fig. 10.

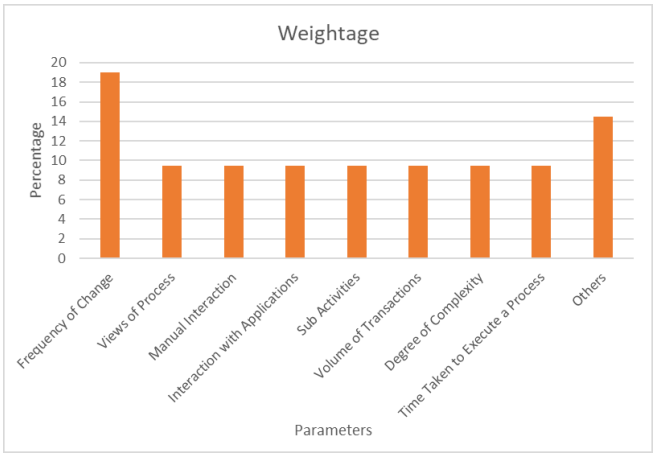

Fig. 9. Parameters' Weightage of Traditional Model

1) Assessment of Traditional Model:

As per the method described in [10], we have,

Step I: As the given process can be used for a long period of time and the software, it is mature. As the process has some defined views, like functional view, dynamic, organisational view and information view, the process is standard. Thus, the process is eligible for RPA.

Step II: The given process reduces human interaction with the software as well as it follows the pre-defined business rules. So, the process has potential = 1.

Step III: In this case study, the transaction volume is high and the degree of complexity is moderate. So, the process has relevance = 0.5.

Step IV: Considering the high value of relevance and the potential of the process, it is highly suitable for automation.

B. Proposed Model

The proposed model primarily takes three factors into consideration.

- The first factor, *Automation Potential* evaluates and tell the user what type of automation is suggested.
- Second, *Complexity* analyses criteria like cognitive skills required or exception possibility, etc and gives the complexity of the given process.
- Third, *FTE Savings* takes into account the amount of data, man-hours and the processing time required to give the analysis from a business point of view.

After analysing the parameters, some key parameters were taken into consideration and plotted according to their significance on the process model, shown in Fig. 11.

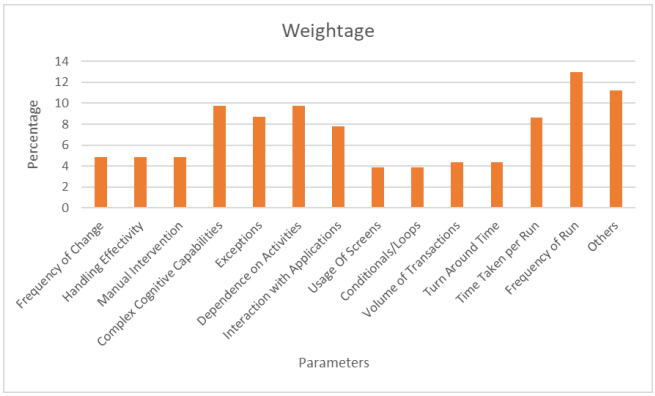

Fig. 10. Parameters' Weightage of Proposed Model

1) Assessment of Proposed Model:

Step I: The given process involves decision making, unknown exceptions and uncertain triggers hence the automation potential is semi-automation.

Step II: For the given process there are 4 Java/web-based applications, 25 if-else conditions,16 screens used per process and 31% chance of exceptions which altogether makes complexity score low.

Step III: Volume of data for the given process is 10,000 which takes 1 hr of time to be processed with 2 employees working daily which sums up to 720 hrs and based on this data the FTE savings is medium.

Step IV: Since the complexity of the given process is low and FTE savings is high, the process falls in the quick win quadrant

C. *Comparison of the traditional and proposed model*

For better understanding the difference between traditional and proposed process models, their common parameters are being taken into consideration and their weightage (i.e. the influence of a particular parameter over the whole process model) is as mentioned below.

TABLE I. WEIGHTAGE COMPARISON OF COMMON PARAMETERS BETWEEN THE TWO MODELS

Comparison Parameters	Traditional Model (%)	Proposed Model (%)
Frequency of Change	19	4.875
Degree of Complexity	9.5	9.75
Volume of Transactions	9.5	4.33
Time Taken	9.5	8.667
Screen Usage	9.5	3.9
Total	**57**	**31.522**

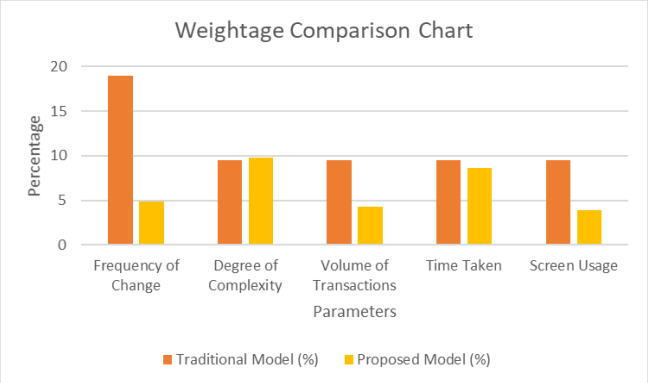

Fig. 11. Weightage Comparison Chart of Common Parameters between the two models

After comparison of the common parameters of both models, it is observed that the traditional model considers 19% weightage for the frequency of change, whereas for the proposed model its just 4.875%. Similarly, the weightage of the parameters, degree of complexity, transaction volume, time is taken and screen usage is 9.5% each in the traditional model, but for the proposed model they are 9.75%, 4.33%, 8.667%, 3.9% respectively.

VII. CONCLUSION

Robotic Process Automation (RPA) is a targeted solution for optimizing human usage on mundane tasks, unlike the unpopular notion of "workforce reduction". A process automation project needs process modelling as a pre-requisite because it acts as a blueprint for the project. The Proposed Model provides a complete analysis of the business process, which helps to calculate factors such as automation potential, complexity, and FTE savings of a given process. Various parameters such as frequency of change, complex cognitive capabilities, etc. are taken into consideration. Using these factors and parameters, we decide if it is suitable for automation or not. The proposed model is comparatively better than the traditional model because it deals with more number of parameters where each parameter has its own specifications. The proposed model also analyses the process from almost every conceivable angle to give a detailed description with improved accuracy whereas the analysis made by the traditional model is imperfect and one-dimensional.

Although this work is at an early stage, we wish to continue working on the same. Our next challenges are: (i) improving the model by considering more parameters and factors like cost estimation, paybacks, and benefits (ii) extend this model to support more business patterns (iii) expand the empirical base of the process model.

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