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A MODEL FOR SELECTION OF BUSINESS PROCESSES FOR ROBOTIC PROCESS AUTOMATION

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ABSTRACT

In recent times Robotic Process Automation (RPA) has been used to transform low performing back-office operations like finance, HR, procurement to high performance centers. Robotic process automation (RPA) has evolved as an emerging technology focused on automation of rule-based, routine, repetitive processes, or tasks, with the aim to streamline operations in a hybrid environment where person and machine work side by side. In back-office operations a well-defined and executed automation can lead to enhanced productivity and significant returns on investment. However not all processes are suitable for automation. For successful RPA adoption and high return on investment it is important to select the right process which can be automated. This paper aims to investigate, using systematic literature review, the common fundamental characteristics that are used to select a business process suitable for automation. This paper aims to help academicians, researchers, students, and practitioners to effectively analyze their business processes to identify the most appropriate process for automation.

KEY WORDS: *Digital Transformation, Robotic Process Automation; RPA; Systematic Evaluation; Digital Workforce*

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1. INTRODUCTION

Digitalization is no longer a peripheral trend or a catchphrase but has become mainstream. Today, businesses encounter an environment that is driven by continuous transformation. This leads to an ever-changing multifaceted information systems (IS) topography[51]. Robotic process automation (RPA) is an important component of digital transformation. The last few years have seen a lot of attention to robotic process automation (RPA) from companies. Some of the main drivers for the large-scale adoption of RPA is to accomplish non-value adding activities in a cost efficiently and in a scalable manner as well as reducing turnaround times[43].. Companies that follow an operational excellence strategy are driven to disciplines like Business Process Management (BPM), Total Quality Management, Lean Six Sigma, Process Mining and Robotic Process Automation among others. As organizations chart their Robotic Process Automation journey, they will have varied levels of success in automation and operational gains. However, as companies mature their RPA journey, they will look to expand the complexity and scale of their automation adoption.

Some of the most important reasons for organisations to adopt Robotics Process Automation are ***Insourcing*** and ***Efficiency.***

- ***Insourcing*** refers to the work that an organization can bring back in house. This is typically the work that the company may have previously outsourced for economic reasons – typically referred to as economies of scale.[41]. The work can be automated with RPA because the costs of RPA are usually lower than the expenses of outsourcing. RPA can still be used alongside and together with the future technologies of artificial intelligence, which makes it a versatile tool for automation also in the long term.

- ***Efficiency*** is realized when a simple manual task is performed fast and accurate. In RPA parlance it is a Robot that does this automation of the work. A robot, or a bot, is not bound to certain working hours. However, it is important to note that this is not a physical robot but rather a series of codes that are used to automate a task. Bots can be run as per the needs of the organization, and the bot performs the tasks just as it is programmed to perform them, without discretionary errors. In case the bot runs into an error then there is error handling mechanism to determine the next course of action.

One of the key tasks for an organisation to commence on their Robotics Process Automation journey is to determine which process they should automate. This is a challenging area since there are many different rules that the company needs to determine if automating a process can give them the right benefits like agility, scalability, or an economic cost advantage over others. There is a lot of scope in amalgamation of these rules so that there can be a standard set of few rules that an organisation needs to check to determine the best fit process for automation. There is a need to determine the most suitable process for automation. A complicated process cannot be efficiently automated. While it might be the best option in terms of return on investment a process that involves many applications with changing interfaces can be deemed as unstable for automation because of the complexity or efforts in maintenance. While selecting a process for automation the current effort in automation and the effort required in maintaining the automation needs to be taken into consideration.

Today we see that bots are working alongside people. This is referred to as a hybrid workforce. There are some processes that can be more efficient when it is fully automated with the aid of Robotics Process Automation. But we see that many a times Robotics Process Automation plays a more assistive role - enabling the process. An example is a process that requires to amalgamate reports for a certain month across different applications and then merge them together in a defined template. In such a case a bot can be used to login to the different applications and pass the required parameters to draw the required reports. These downloaded reports can then be merged by the bot to create the final report in the desired template. There are also many tasks that require human decision making, which means that they cannot be automated. There are no uniform set of rules to determine the best suited process for automation. The aim of this study is to look at the different methods suggested by academia & industry and based on that determine if there is a common method to answer the question: How to select a business process for automation? The Literature review was produced by browsing through publicly available internet sources using search engines for scientific publications on the subject and prominent industry sources to determine the process identification selection criteria.

2. MATERIALS AND METHODS

This section aims to describe and justify the way the study was carried out. To answer the research question set in the above section this study will follow the Systematic Literature Review (SLR). An SLR is conducted to analyse both the body of knowledge and relevant publications in the RPA field to determine the existing methodologies to determine the choice of the process being selected for automation. An SLR is ‘a means of identifying, evaluating and interpreting all

available research relevant to a particular research question (RQ), or topic area, or phenomenon of interest' [57].

Since we need to identify the factors that influence the choice of the business *process* being selected for automation, we would need to define a business process first. Organisations define a process as a fixed set of activities, with a defined input and fixed output data parameters that is expected. The process uses a set of steps to transform one or more inputs parameters to convert it into the expected output result. A generic term for any sub-process is called as an activity. The smallest process that can be chosen to a model by using the same process diagram symbols is called as an atomic activity or task [14]. Every process or activity should have a responsible person for a process. For a defined process there must be a defined process manager who is responsible for accomplishing the end results of the process[14].The first task to define the process is to specify the purpose of the models as well as and the situation for which the modelling is carried out[33]. The process can be illustrated when we chalk out the defined input and output parameters with the set of rules that need to be used for the transformation. This process will also have the required exception handling situations.

3. LITERATURE REVIEW

The business description of a process along with the details of how it performs in the system and it displays clarity on the steps that need reforming is called as the visual blueprint of a process[42], [46]. This can be augmented with the details of process mining which can give a different viewpoint on the operations of a process. A resource perspective or other departmental constructs, such as alliance partners, channel partners or departments collaborations [23]. This can also be used to uncover the data that exists in the systems /applications. In addition, this viewpoint provides the intelligence to determine the inefficiencies and bottlenecks in a process. It thus determines the root cause of failure of any in a particular the business process. The process mining exercise can thus reveal how a process has been employed, the level of intricacy it involves, the exceptions that it has and the thus the maturity of that process for automation. The evaluation of compound or multi faced business processes, which involve multiple applications or multiple handshakes require manual mapping, observation, and elucidation [46].

The idea is to define a process and then critically examine all the steps involved in it. This includes the input criteria's, determine the different applications or systems that are involved, apply rules that are common cross different units within an organisation. During this examination we also establish if it is conceivable to advance or improve the process, identify bottlenecks or other problematic areas as well as whether it can be strengthened and augmented. Decisions about parallel processing i.e. if certain operations that have been done in sequence can be done in parallel can be examined. Every operation is timed, and we need to determine the upper- and lower-time limits for the operation time before the operation is deemed as timed-out. This part of the analysis determines the changes in the current process and the parts of the process that can be automated [32].A detailed click by click breakdown of the process is chalked out. All this visualisation of details is laid out in the form of a smaller steps and using interactive plans / illustrations that give a visual representation of the levels and layers of sub-steps involved in a process or task.[31].

With the purpose of attaining an in-depth understanding of the published methods for the selection of processes for Robotics Process Automation many previous research studies and articles were identified and reviewed. Articles were searched from the electronic database of EBSCO, Science Direct, Emerald, International Journals on economics, finance, science, and technology and also Google Scholar. The analysis of all the studies were performed in stages to extract the appropriate studies to interpret relevant information and data that can facilitate valuable conclusions. In the 1st stage, over 200 studies were found that were related to Robotic Process Automation research area. After the 2nd stage, around 75

studies were selected that were found appropriate in relation to Robotics Process Automation and also related to keywords of this study like process selection. Further on we classified the sources of the literature in the 2 categories of Academia & Industry. The academia sources are: Willcocks (2015)[53], Willcocks (Xchanging) (2015)[52], Lacity, Wilcocks (2016)[25], Asatiani, Penttinen (2016)[2], Lacity (2015)[27] & Ayehu (2015)[3]. Among the Academia papers it was found that of significant importance was Asatiani, Penttinen (2016)[2] because it was detailed and the Process selection method for RPA had a practical implementation plan with a case study for an organization Opus Capita Group.

The industry sources are the service providers who aid organisations for the implementation of RPA tools. This is in their capacity as business advisory firms, consulting firms, technology partners, implementation partners to their client – i.e. organisation which is implementing RPA. The industry sources are: Accenture[1], Deloitte (2017)[7], Deloitte UK[8], Cutter Consortium (2017)[6], Kryon Systems (2015)[24],Sutherland (2016)[44], Cap Gemini (2016)[5], PWC (2017)[40], EY (2015)[9], TCS (2017)[45], HfS (2013)[17], UiPath (2014)[48], Genpact (2017)[19], Virtual Operations (2014)[55], IRPAAI[21], Infosys (2017)[22] & Minit (2018)[37]. For our research we have analysed how these industry sources recommend the selection of processes for selection for RPA. For this we went to the websites to check the details of the methodologies that are published and publicly available on their websites or via case studies.

Processes Suitable for RPA: A Perspective from Academia

Currently different methods are used by organizations to decide if a process is applicable for RPA or not [25], [2]. Asatiani and Penttinen [2] uses a model adopted, that is based on a dual criteria selection method to determine a process suitability for automation. These 2 are:

- How routine is a process?
- What is the amount of cognitive reasoning that is required?

Hence as per this model, a process that is routine with minimal or no cognitive reasoning is most suitable for selection as a process for automation. The full list of criteria from Asatiani and Penttinen [2]–"Turning robotic process automation into commercial success-case OpusCapita". OpusCapita Group is a Finnish company offering financial processes and outsourcing services to medium-sized companies and large corporations. This organisation focuses on end-to-end Purchase-to-Pay (P2P) and Order-to-Cash (O2C) processes. To remain competitive in financial process operations, OpusCapita used Robotic Process Automation (RPA). This case is particularly relevant to our research since it showcases the challenges faced by OpusCapita Group during its implementation and lifecycle of RPA. Some of the common selection criteria's selected are listed below:

- Processes that are regular or routine in nature
- Processes that have low reasoning requirements
- Processes that are definable with definite starting and ending point
- Processes that are high transaction volume
- Processes that leverage multiple applications or systems
- Processes that leverage stable underlying applications or systems
- Processes that are rule based

- Processes that are less error prone or have failures.
- Processes that have less exception handling scenarios
- Processes that have clear cost definitions

Some academia sources do not produce a definite list of criteria but rather converse on characteristics of process that are important [52]. Such discussions comprise of detailing of similarities in the processes but also differs from the list presented by Asatiani and Penttinen [2]. The characteristics that Will cocks et al.[52] discuss can be seen below:

- Processes that have clear business value
- Processes that have definite and easily explainable costs
- Processes that have demonstrated stability.
- Processes that have high transaction volume
- Process that leverages multiple systems
- Processes that are rule based
- Processes that are standardized

Processes Suitable for RPA: A perspective from Industry

The technology industry has taken a more hands on approach to identify processes suitable for automation. This would stem from the fact that every technology company wants their process to be agile & scalable so that more technology service companies can implement them for customers. In our research we have seen that there are more recommendations available from industry sources, both for:

- Criteria checklists
- Preferred characteristics.

Industry source Accenture proposed a 5 criteria checklist for determining the process suitability for Robotics Process Automation. This comprises of:

- Rule based process.
- Process initiation by digital trigger. Rules based process where all inputs are based on digital data.
- Stable process with well-defined rule. Well defined rules for exception handling.
- High volume of run of the process for higher ROI.
- Ability to demonstrate successfull proof of concept / pilot project by selecting a [process that leverages major / key IT systems or applications within an organisation.

Another industry source Delloite [7] has a similar approach. Deloitte [7]have refined the criteria for the selection of a process by adding a criterion that a process involving multiple applications are good targets for RPA implementations. Such points are very practical since it is easy to analyse the number of applications that are involved in a process. We also see that within an industry source we have differences in the way a process is selected. For example, we have a division

within Deloitte UK [8]which describes the criteria for the processes suitable for automation as:

- Process that is repetitive
- Process that is less error prone
- Process based on definite rules.
- Process that runs on digital data
- Process that is time critical and seasonal

The full list of criteria per source can be found below:

Table 1: Consolidated Criteria from 23 Sources from Academia & Industry

	Source	Willcocks (2015)[53]	Willcocks (Changing) (2015)[52]	Lacity, Willcocks (2016)[25]	Asatiani, Penttinen (2016)[2]	Lacity (2015)[27]	Accenture[1]	Deloitte (2017)[7]	Deloitte UK[8]	Cutter Consortium (2017)[6]	Kryon Systems (2015)[24]	Sutherland (2016)[44]	Cap Gemini (2016)[5]	PWC (2017)[40]	EY (2015)[9]	TCS (2017)[45]	HfS (2013)[17]	UiPath (2014)[48]	Genpact (2017)[19]	Ayehu (2015)[3]	Virtual Operations (2014)[55]	IRPAAI[21]	Infosys (2017)[22]	Minit (2018)[47]
1	Clear business value	x																						
2	Clear costs	x			x												x							
3	Complex										x													
4	Computer based																				x			
5	Contains bottlenecks																		x					
6	Critical in day-to-day operations										x													
7	Data driven										x													
8	Definable				x						x													
9	Deterministic outcome			x																				
10	Digital data						x		x			x												
11	Digital trigger						x																	
12	Error prone				x				x				x	x		x	x	x		x			x	x
13	Few exceptions				x								x				x	x		x			x	x
14	Fixed procedures													x										
15	Fluctuating demand								x				x						x		x			
16	High risk																					x		
17	High transaction volume	x	x		x	x	x	x				x	x	x									x	
18	High transaction volumes or high value of transactions																x							
19	Highly regulated																				x			
20	Involve searching, collating or updating information											x									x			

21	Limited human intervention						x						x				x	x		x				x
22	Low cognitive requirements				x																			
23	Low complexity		x																					
24	Low risk							x																
25	Manual													x									x	
26	Manual interaction with computer interface							x																
27	Multiple systems	x			x	x						x	x	x		x	x	x		x	x			
28	No change due to regulations									x														
29	No strategic fit												x											
30	Performed at all hours															x								
31	Performing simple or complex decisions and algorithms																				x			
32	Potential for savings							x																
33	Redeployable personel																				x			
34	Redundant																					x		
35	Repetitive		x						x	x	x				x	x					x	x	x	x
36	Routine			x	x																			
37	Rules based	x	x	x	x	x	x	x	x		x	x	x	x	x		x	x	x	x	x		x	x
38	Simple											x							x					
39	Stable	x	x			x	x			x	x			x										
40	Stable underlying systems				x									x										
41	Standardised data input																							x
42	Standardized	x	x			x								x	x									
43	Strategic value																							x
44	Structured									x					x						x			
45	Structured data			x															x					
46	Structured sequence of sub-processes											x												
47	Tedious										x													
48	Time consuming							x			x								x					
49	Time critical								x					x										

We have analysed the commonalities in the selection of the process criteria as per academia & industry referred in Table 1 below. In this research we have tried to identify what are the baseline or similar characteristics that make a process suitable for automation. In the next section we shall share the details of the systematic literature review that we have conducted on the above 23 sources for the selection of process for automation.

4. RESULTS AND DISCUSSION

The results from the study are presented in this chapter. Based on the above analysis we can clearly see that there is no one fixed way to identify the common characteristics when it comes to identifying / selecting a process for automation. In fact, often we see that different schools of thought are applied to select the right process. This is not just a distinction between academia versus industry but also between firms within the industry. In this section we have identified the different ways that are recommended by the academia &industry.

4.1 Challenges Faced by Organizations in Process Slection for RPA

The aim of this section is to elicit the challenge which any organisation will face when it is trying to select processes to automate using RPA because of the various methods & criterias mentioned across multiple sources

4.1.1 Different Sources have Different Criteria

In our study we have seen that from the 23 sources across both academia & industry, there were a total of 49 exclusive criteria which were unique after the first round of merging. The identical criteria were grouped. After this we noticed that some criteria were mentioned by almost all sources whereas some were unique and stood alone. However, we did not see a marked difference in the academia versus the industry approach. In the above Table 1, we have listed the most common criteria with a frequency of more than 5. We also discovered that a net of 27 criteria were unique and were only found in a single source. This depicts the variety or multiplicity found in the sources. The level of definition or abstraction level of the criteria also varied. While we see the industry, focus is more on technical aspects of the process the academia is more focussed on the strategy of the company and the role of the process in the business case. We can clearly see that there is a spread in the criteria's being defined and being adopted. We believe that different methods should be studied to determine the best set of criteria to be used. We understand that different methods will lead to different processes being selected and as a result when assessing business processes, we should be cognizant of the method being used.

4.1.2 Different Categories of Criteria

In our study of the 23 processes, we also saw that not all criteria are equal. That means that not all process selection methods can be directly pitted or compared against each other. Some criteria were at different detail levels that did not only focus on processes but also on other aspects like return on investment or business value gained by automation. Using a mix of different types of criteria without ascribing a well-defined thought process can often lead to selecting a process that is unsuitable for automation. For example, if an organisation selects processes that are "Not Error" prone (i.e. a process with very well documented and laid out rules), the organisation may miss out selecting a process that could probably bring in more savings for the organisation i.e. a process that is currently very cumbersome and using a lot of resources. Even though the more complex process is not all rule based it might be more beneficial to the organisation in the longer run-in terms of the savings that it brings for the organisation. However, we also encounter certain cases where the criteria like "Rules based" are compulsory / required for all process definition as it relates to a fundamental characteristic needed for RPA to be implemented.

4.1.3 Criteria with Similar Meaning

In our systematic literature review of the 23 sources of literature that provide means to identify the most suitable process for automation we also discovered that some criteria were hard to distinguish from each other but also hard to combine straight away as there are very minor differences between them. While it is possible that these differences are due to the specific / industry related words chosen by the sources to describe the criteria. However,it is also plausible that the differences in definition of the criteria are intentional and should therefore should not be discarded.

4.1.4 Conflicting Criteria

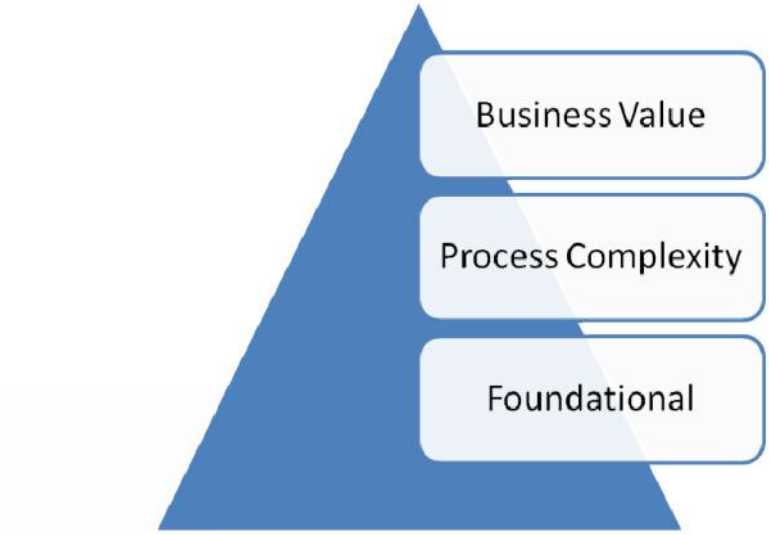
While researching the 23 sources we also discovered that while there were cases of criteria's that are very similar to each other, there was also the opposite. Criteria's that are seemed to be opposites or are conflicting in nature. We cannot attribute this conflicting nature to academia vs industry. In many cases we have come across diametrically opposite viewpoints on the criteria to be applied for the selection of a process for automation. Such instances create confusion about the process that is to be used for automation since the methodology used for process selection will lead to different, and perhaps process at two ends óf the spectrum for automation.

4.1.5 Unimportant or Minor Criteria

In our systematic literature review we also came across methodology for process selection that provided irrelevant criteria that do not aid in process selection. These are basically selection criteria that make no impact in process selection and are deemed to be inconsequential. Most process would fall in this category. These are unlikely to cast any light on the selection of a process since almost all processes would score high for these criteria's thus making them unsuitable for evaluation purposes. A case in point here is that "computer based" is not a criterion for the selection of a process for automation. We will select only process that are computer based and hence while the criteria are important, these criteria will score equally for all the processes being evaluated. Hence, we believe the above set of criteria will not move the needle while selecting a process.

4. 2 Our Proposed Process Selection Model for RPA

Our proposed model is based on the shortcomings in the above analysis we are proposing a revised methodology to identify the process that is ideal for Robotic Process Automation. This new framework comprises of a 3 broad criteria:



Figue 1: Framework for Selection of Business Processes for Robotic Process Automation.

4.2.1 Foundational Criteria

Even before we commence on the selection of a process for automation, there are some important criteria that has to be true for a process. This is a gatekeeper to ensure that only the valid processes are selected for further investigation for automation. Sometimes we also see that some organisations re-engineer processes to fit the below criteria.

4.2.1.1 Digital and Structured Data

A bot can only automate processes that are digital in nature and have a structured digital data. In the absence of structure, the robot might need human assistance to interpret data. While there are bots that can use OCI to convert human handwriting to digital format the overall accuracy for these are very low.

4.2.1.2 Few Exceptions

The ideal process for automation should have few business / technical exceptions for the bot to deal with. With many exception handling situations that bot will require more programming and over its lifetime more maintenance cost too.

4.2.1.3 Repetitive

From a business point of view it's imperative to select only processes that need to be run on a regular basis to ensure maximum utilisation of a bot and hence increase its return on investment.

4.2.1.4. Rules Based

A process that is based on definite rules are best suited for automation. A process should have fixed input parameters and fixed steps to run the process from start to end, with a definite format of output at the end. Also a process should have as few decision points as possible and the decisions that exist should be able to be resolved by founding rules.

4.2.1.5 Stable Process and Environment

A selected process should be run on a stable environment / use stable systems or applications that is not prone to major changes.

4.2.1.6 Easy Data Access

Since every bot needs a definite starting point it is expected that the bot should have well established and access to the data that is used to start and run the process.

4.2.2 Process Complexity

This is probably the single most important criteria that needs to be studied to determine if a process is fit for automation. By design we have built the first step of the process selection as something that is objective & extensive. The points are self-explanatory and are used to define the process which is being sought for automation. At this juncture we are not looking at any business process reengineering. While process complexity can be simplified by reducing the number of target systems and the number of individual process steps, there is a range of additional parameters which can occur in any combination and ultimately increase the level of risk present or resource investment required to automate a process. Based on this exercise we can categorise the business process as Simple, Medium or Complex to automate. The easy to pick / first targets should be applications that are in the Simple category.

Estimation Model	Simple	Medium	Complex
# of Applications	1 2	3 4	4 6
# of Process Steps	< 20	20 - 40	60-80*
Types of Host Platforms	< 2	< 3	< 5
# of Data Fields involved	< 5	5 – 10	10 – 20
# of Business Logic Involved	3 – 4	5 - 7	8 – 10
# of Business Rules involved	Simple Rules, Conditional Statements	Conditional Rules & Calculations	Complex logic, multilevel validations and calculations
Type of Apps	Mainframe | Web and No Citrix/ Desktop, No OCR	Desktop Apps and No OCR	Max 1 Citrix Template based structured PDF
Implementation Time	4 - 6 Weeks	/ - 10 Weeks	10 – 12 Weeks

Figure 2: Process Complexity Estimation Model to Determine for Selection of Business Processes for Robotic Process Automation.

Additional variables include factors such as the presence of relatively higher levels of business rules, logic or validation, RPA being new to the business or the absence of process maturity before automation can all have varying degrees of impact on process automation. The determinants for this step are:

4.2.2.1 # of Applications

Total number of IT applications that the BOT has to access / login to complete the end to end operation. This will include applications that are used for communication -like email.

4.2.2.2 # of Process Steps

This is the break down of the number of steps that are to be performed by the bot for the completion of the process. This has to be broken down into single units of work. (ideally on a click basis)

4.2.2.3 Types of Hosted Platforms

This is the number of platforms that are involved in the operation.

4.2.2.4 # of Data Fields Involved

This portrays the starting data set points, that are needed for the Bot to complete the operation. This could be considered as a subset of the 4.2.1.2 (# of process Steps). This signifies the number of fields that the Bot will use for the end to end operation.

4.2.2.5 # of Business Logic Involved

This signifies the number of exceptions / rules that the Bot has to follow. This is usually depicted as a decision box in the process flow diagram (if -else logic).

4.2.2.6 # of Business Rules Involved- This depicts the number of rules that the bot needs to follow for the completion of a business process flow. This will be routing, calculations etc.

4.2.2.7 Types of Applications

This is the nature of the applications that are being used by the process. Ideally we would want an applications with a definite GUI. This way its easier for the bot to pick values / fields / click on buttons on the screen based on pixel location.

4.2.2.8. Implementation Time

Businesses have some expectation about the implementation of certain processes. This input field captures how quickly the process needs to be automated as per business.

4.2.3 Business Value

After the first cut of investigation for the processes, it is key to determine the business value for selecting a process for automation. The aim is to select processes that elicit a clear value for the organisation. The benefit realisation can be categorised in one of the following categories:

4.3.2.1 Time Saved

One of the key advantages of employing BOTS is that it increases speed of process execution.. One the keys is that a bot can work 24x7. This aspect comes in handy when the bot can complete processes that take a lot of time to perform during non-peak / non office hours. Such prep work can help the business to be ready when there is peak load.

4.3.2.2 Quality & Accuracy

Bots operate without any error or at least have error handling scenarios thereby reducing rework, rejections and delays & improving quality and there by client satisfaction. A process that is susceptible to manual errors is usually a good fit for automation provided that the rules of the process are well defined / rule based.

4.3.2.3 Employee Buy-In

We are looking at a scenario where bots and humans will work side by side - a hybrid environment. While bots do not replace humans completely there is fear in people about the same. It is important to ensure that the hours saved by the bot are utilised by employees on value adding and meaningful work.

4.3.2.4 Availability & Flexibility

The ability of business to scale up or down based on seasonality of the business is key to its success. Bots can help to automated processes and run them – 24x7 or if need be use multiple bots to run processes round the clock, which can have certain benefits. Also, a bot can be used to run processes without any employee intervention and there by speeding up processes.

The above framework was designed with the goal to make it as practical as possible so that organisations can adopt this in a pragmatic way. Many conditions and criteria were expunged before finalising the framework. This was to ensure that only value adding / essential criteria are used for the selection of a process for automation. In our proposed model, we considered only a total of 18 criteria as compared to the 49 that we uncovered during our research based on available 23 published papers / research. This was because we came across many selection criteria's that we redundant, duplicates, repetitions or ambiguous in nature. The 18 conditions that we have proposed are easily definable and can be practically used to determine the best process fitment for RPA. These selection criteria are also easily measurable (e.g. # Process Steps, # Data Fields Involved, # Business Rules Involved, # Business Logic Involved, Types of Host Platforms etc). This would make the method of Process selection less ambiguous and contentious.

5. Research Gap

From the above systematic literature review we can see that some existing methods have shown deficiencies / redundancies in various ways. From our analysis we see that the most significant issue with prevailing methods is that they demonstrate a diversity in criteria's for determining which process characteristics are deemed critical.Multiple sources suggest diverse criteria when assessing process suitability for automation. In addition to this issue, we also see other inadequacies in the methodologies for process selection, for e.g. Conflicting Criteria or Unimportant or Minor Criteria, makes any singular method insufficient to be used on their own. This paper has proposed a revised methodology for Business Process selection in Robotic Process Automation. An empirical study needs to be conducted to test the efficacy of this methodology.

A possible way forward for an empirical study is to

- Identify organizations that have adopted RPA
- Select business function / functions e.g. finance, human resources & procurement.
- Apply our proposed model to various business processes within function(s)
- Assess the results for each business process
- Compare with actual results from the identified organizations

6. CONCLUSION

The use of Robotic Process Automation does not mean that the entire work is done by bots. Bots have the capability to perform certain repetitive and rule-based tasks. These are tasks that have a definite start and end point with a set of defined rules that define the process. However, bots cannot handle all types of tasks. In such a scenario organisation will look at a hybrid digital workforce where humans are augmented with bots. However, to effectively leverage Robotic Process Automation organizations need to have rule-based workflows or processes. Effective process selection for automation is the cornerstone for a successful Robotics Process Automation adoption.

Selecting the right process for automation is a complex process with no definite rules defined. Industry & academia have set some guidelines to determine which process is best suited for automation. However, a lot of the decisions are determined by the RPA tool choice, the team which is executing the process automation and perhaps the single most important criteria is the process being selected for automation. In the absence of such guides for selection of process for automation, we undertook an exercise to analyse the different ways in which processes are analysed. In this paper we have reviewed 23 existing methods for selecting processes to automate using RPA. We see that there is a difference in ways academia &industry adopt to assess which processes should be automated. There are many shortcomings in various ways in the existing methods employed by academia and industry. The list of different criteria suggested by multiple sources for the assessment of process suitability for Robotics Process Automation is perhaps the single most confusion creating problem. Adding to the confusion are other deficiencies, e.g. unclear and not well-defined types of criteria used to define the selection criteria. All this makes the methods insufficient to be used on their own. To tackle these issues this paper has proposed a new framework.

REFERENCES

1. *Accenture, Robotic Process Automation: The Future of Technology in Financial Services. [Online]. Available: www. accenture. com / no - en / insight -financial-services-robotic-process-automation (visited on 01/15/2018).*
2. *Asatiani, A., & Penttinen, E. (2016). Turning robotic process automation into commercial success-case OpusCapita. Journal of Information Technology Teaching Cases, 6, 67–74.*
3. *Ayehu, 5 Business Processes that are Ideal for Robotic Process Automation, 2015. [Online]. Available: ayehu.com/5-business-processes-that-areideal-for-robotic-process-automation/ (visited on 02/19/2018).*
4. *C. B. Frey and M. A. Osborne, "The future of employment: How susceptible are jobs to computerisation?", Technological Forecasting and Social Change, vol. 114, pp. 254–280, 2017.*
5. *Capgemini, "Robotic Process Automation - Robots conquer business processes in back offices", Tech. Rep., 2016. [Online]. Available: www.capgemini.com/consulting - de / wp - content / uploads / sites / 32 / 2017 / 08 / robotic -process-automation-study.pdf.*
6. *Cutter Consortium, Robotic Process Automation: The 4 Critical Stages of Implementation, 2017. [Online]. Available: www. cutter. com / article / 4 -critical-stages-rpa-implementation-496651 (visited on 01/29/2018).*
7. *Deloitte, "Automate this: The business leader's guide to robotic and intelligent automation", Tech. Rep., 2017. [Online]. Available: www2. deloitte. com /us / en / pages / operations / articles / a - guide - to - robotic - process - automation-and-intelligent-automation.html#.*

8. *Deloitte UK, Robotic Process Automation. [Online]. Available: www2.deloitte.com/uk/en/pages/innovation/solutions/robotic-process-automation.html (visited on 01/15/2018).*
9. *EY, "Robotic process automation White paper", Tech. Rep., 2015. [Online].Available:www.ey.com/Publication/vwLUAssets/ey-robotic-processautomation-white-paper/\$FILE/ey-robotic-process-automation.pdf.*
10. *Forrester Research. (2014). Building a center of expertise to support robotic automation: Preparing for the life cycle of business change. Forrester Research. (2017). The new frontier of automation: Enterprise RPA.*
11. *Fung, H. P. (2013). Criteria, use cases and effects of information technology process automation (ITPA). Advances in Robotics & Automation, 3(3). https://doi.org/10.4172/2168-9695.1000124.*
12. *Hallikainen, P., Bekkhus, R., & Pan, S. L. (2018). How OpusCapita used internal RPA capabilities to offer services to clients. MIS Quarterly Executive, 17, 41–52.*
13. *Harmon, P. 2014. Business Process Change: A Business Process Management Guide for Managers and Process Professionals. 3rd Edition. Morgan Kaufman Publishers.*
14. *Helpsystems. How to Build and Scale a Digital Workforce. 2017. Blog. Accessed 7 June 2018. https://www.helpsystems.com/blog/how-build-and-scale-digital- workforce*
15. *Heikkinen, M. 2017. Taloushallinnon lyhyt historia – innovaatioiden ja työn tuottavuuden näkökulma. Intito. Accessed 10 November 2017. http://www.intito.fi/taloushallinnon-lyhyt-historia-innovaatioiden-ja-tyon-tuottavuuden-nakokulma/*
16. *HfS, "Framing a Constitution for Robotistan - Racing with the Machine ofRobotic Automation", HfS Research, pp. 1–23, 2013.*
17. *Hfs Research, "The 2016 RPA Premier League Table - Transformation comesto the fore", Tech. Rep., 2016. [Online]. Available: www.hfsresearch.comwww.horsesforsources.com.*
18. *Genpact, "The Evolution from Robotic Process Automation to Intelligent Automation",Tech. Rep., 2017. [Online]. Available: www.genpact.com/downloadablecontent/insight/the-evolution-from-robotic-process-automationto-intelligent-automation.pdf.*
19. *Information Services Group. (2018). RPA in Europe: Enterprise plans, budgets and organizational impact.*
20. *IRPAAI, Robotic Process Automation 101: (Part 2: Where and When). [Online].Available: irpaai.com/robotic-process-automation-101-part-2/(visited on 02/15/2018).*
21. *Infosys, "Robotic Process Automation (RPA) in AML and KYC", Tech. Rep.,2017, p. 8. [Online]. Available: www.infosys.com/industries/financialservices/white-papers/Documents/robotic-process-automation-amlkyc.pdf.*
22. *Kerremans, M. 2018. Market Guide for Process Mining. Gartner. Accessed 13 June 2018. https://www.gartner.com/doc/reprints?id=1-4VX2Z7N&ct=180412&st=sb*
23. *Kryon Systems, 3 Criteria to Choosing the Right Process to Automate, 2015.[Online]. Available: blog.kryonsystems.com/rpa/3-criteria-to-choosingthe-right-process-to-automate (visited on 01/29/2018).*

24. *Lacity, M., & Willcocks, L. (2016a). Robotic process automation: The next transformation lever for shared services. The Outsourcing Unit Working Research Paper Series.*
25. *Lacity, M., & Willcocks, L. (2016b). A new approach to automating services. MIT Sloan Management Review, Fall.*
26. *Lacity, M., Willcocks, L., & Craig, A. (2015). Robotic process automation at Telefónica O2. The Outsourcing Unit Working Research Paper Series.*
27. *Lacity, M., Willcocks, L., & Craig, A. (2017). Service automations: Cognitive virtual agents at SEB Bank. The Outsourcing Unit Working Research Paper Series.*
28. *Leopold, H., van der Aa, H., & Reijers, H. A. (2018). Identifying candi- date tasks for robotic process automation in textual process descrip- tions. In J. Gulden, I. Reinhartz-Berger, R. Schmidt, S. Guerreiro, W. Guédria, & P. Bera (Eds.), Enterprise, business-process and infor- mation systems modeling, Lecture notes in business information processing (Vol. 318, pp. 67–81). Cham: Springer International Publishing.*
29. *Linderman, K., Schroeder, R. G., Zaheer, S., & Choo, A. S. (2003). Six sigma: A goal-theoretic perspective. Journal of Operations Management, 21(2), 193–203. https://doi.org/10.1016/S0272-6963(02)00087-6.*
30. *Lowes, P., Cannata, F., Chitre, S. & Barkham, J. 2017. Automate this. The business leader's guide to robotic and intelligent automation. Deloitte. Accessed 3 May 2018. https://www2.deloitte.com/content/dam/Deloitte/us/Documents/process-and- operations/us-sdt-process-automation.pdf*
31. *Luukka, E. 2016. Lyhyt opas RPA:n maailmaan: Automatisoitavien prosessien tunnistaminen työpaikalla. Digital Workforce. Accessed 29 May 2018. https://digitalworkforce.fi/lyhyt-opas-rpan-maailmaan-automatisoitavien-prosessien-tunnistaminen-tyopaikalla/*
32. *Luukkonen, I., Mykkänen, J., Itälä, T., Savolainen, S., Tamminen, M. 2012. Toiminnan ja prosessien mallintaminen. Tasot, näkökulmat ja esimerkit. Itä-Suomen yliopisto ja Aaltoyliopisto. Accessed 30 May 2018. http://epublications.uef.fi/pub/urn_isbn_978- 952-61-0697-7/urn_isbn_978-952-61-0697-7.pdf*
33. *L. Willcocks, M. Lacity, and A. Craig, "Robotic Process Automation at Xchanging", 2015, [Online]. Available: eprints.lse.ac.uk/64518/1/OUWRPS_15_03_published.pdf.*
34. *Martinsuo, M., Blomqvist, M. 2010. Prosessien mallintaminen osana toiminnan kehittämistä. Tampere: Tampereen teknillinen yliopisto. 6-15.*
35. *M. C. Lacity and L. P. Willcocks, "A New Approach to Automating Services.",MIT Sloan Management Review, vol. 58, no. 1, pp. 40–49, 2016. [Online].Available: mitsmr.com/2cUzK69.*
36. *Minit, "How to get Robotic Process Automation right in 2018", 2018.*
37. *Nakayama, I. 2017. The New Work Style Innovation Enabled by AI and RPA. Fujitsu Insight 2017 Work Style Innovation Keynote Report. Fujitsu Journal. Accessed 3 May 2018.http://journal.jp.fujitsu.com/en/2017/12/27/01/*
38. *Ostdick, N. 2016. The Evolution of RPA: Past, Present, and Future. Accesse 4 May 2018. https://www.uipath.com/blog/the-evolution-of-rpa-past-present-and-future*

39. *PWC, "Successful implementation of RPA takes time - Lessons learnt by 18 ofthe largest Danish enterprises", Tech. Rep. October, 2017. [Online]. Available:www.pwc.dk/da/publikationer/2017/rpa-danish-market-survey-2017-uk-pwc.pdf.*

40. *Schniederjans, M.J., Schniederjans, D.G. 2005. Outsourcing and Insourcing in an International Context. New York: M.E.Sharpe.*

41. *Shelke, M. 2018. RPA with Process Mining. vElement. Accessed 12 June 2018. https://velement.io/rpa-with-process-mining/*

42. *Sutherland, C. (2013). Framing a Constitution for Robotistan: Racing with the Machine of Robotic Automation : Hfs Research.*

43. *Sutherland, How to Identify Select Processes for RPA, 2016. [Online]. Available:clarity.sutherlandglobal.com/blog/accounting-minute/how-toidentify-select-processes-for-rpa/ (visited on 01/29/2018).*

44. *TCS, How to achieve early ROI in robotic process automation?, 2017. [Online].Available: sites.tcs.com/blogs/enterpriseinsights/how-to-achieveearly-roi-in-robotic-process-automation (visited on 02/15/2018).*

45. *UiPath. 2017a. Accelerate Digital Transformation with RPA & Process Mining. White paper. Accessed 12 June 2018. https://cdn2.hubspot.net/hubfs/416323/Whitepapers/RPA%20and%20Process%20Mining.pdf?t=1517336069668*

46. *UiPath 2017b. Unattended & Attended Automation: RPA Glossary #1. Blog. Accessed 19 June 2018. https://www.uipath.com/blog/unattended-attended-automation*

47. *UiPath, Five Characteristics of Business Processes That Are Perfect for RPA,2014. [Online]. Available: www.uipath.com/blog/five-characteristicsof-business-processes-that-are-perfect-for-rpa (visited on 02/15/2018).*

48. *Van der Aalst, W. M. P., Bichler, M., & Heinzl, A. (2018). Robotic process automation. Business & Information Systems Engineering, 60(4), 269–272. https://doi.org/10.1007/s12599-018-0542-4.*

49. *Vedder, R., & Guynes, C. S. (2016). The challenge of botsourcing. Review of Business Information Systems (RBIS), 20(1). https://doi. org/10.19030/rbis.v20i1.9677.*

50. *Vom Brocke, J., Maaß, W., Buxmann, P., Maedche, A., Leimeister, J. M., & Pecht, G. (2018). Future work and enterprise systems. Business & Information Systems Engineering, 60(4), 357–366. https://doi.org/ 10.1007/s12599-018-0544-2.*

51. *Willcocks, L., Lacity, M., & Craig, A. (2015a). Robotic process automation at X changing. The Outsourcing Unit Working Research Paper Series.*

52. *Willcocks, L., Lacity, M., & Craig, A. (2015b). The IT function and robotic process automation. The Outsourcing Unit Working Research Paper Series.*

53. *Willcocks, L.P., Lacity, M. 2016. Service Automation – Robots and The Future of Work. Stratford-upon-Avon: Steve Brookes Publishing.*

54. *Virtual Operations, "Robotic Process Automation Assesment to Implementation", Tech. Rep., 2014. [Online]. Available: www. everestgrp. com / wp -content/uploads/2014/10/Discovery-Assessment-Overview_VO-2014.pdf.*

55. *——, "The IT Function and Robotic Process Automation", 15th ser., pp. 1–38, 2015. [Online]. Available: eprints.lse.ac.uk/64519/1/OUWRPS_15_05_published.pdf.*

56. *Kitchenham, Barbara. 2004. "Procedures for performing systematic reviews." Keele, UK, Keele University 33 (2004): 1–26.*

57. *Arja Leivonen. 2019. "Utilizing Robotic Process Automation for Hybrid Workforce in Finance and Accounting Operations",jamk.fi. https://core.ac.uk/download/pdf/237130329.pdf*