Utility-based Robotic Process Automation Candidate Projects Ranking

NIKOLAOS SPANOUDAKIS[1,a], NIKOLAOS BATAKIS[2], NIKOLAOS MATSATSINIS[3]

[1]*Applied Mathematics and Computers Laboratory, School of Production Engineering and Management, Technical University of Crete, Chania, Greece*

[2]*MSc Program on Technology & Innovation Management, Technical University of Crete, Chania, Greece*

[3]*Decision Support Systems Laboratory, School of Production Engineering and Management, Technical University of Crete, Chania, Greece*

[a]*Corresponding author: nikos@amcl.tuc.gr*

Abstract: Robotic Process Automation is a modern field of Information Technology that enables the automation of mechanically repeated tasks by humans when they use their computer. It is a field that is currently trending, but many RPA projects fail. This paper aims to aid decision makers who want to select one or more Robotic Process Automation projects for implementation among several candidates. To achieve our goal we developed two tools, one for filtering proposals, leaving out those that are not good candidates, and another for ranking the remaining proposals to aid the decision maker in deciding which ones to implement. To develop the tools, firstly we discovered the criteria required for a successful Robotic Process Automation project proposal assessment by interviewing six experts in the field using the Coding method. Our findings led to the development of a first tool, i.e. the Process Assessment Model tool, which filters the proposals. Then, we asked two of the experts to rank sample RPA project proposals - many of which were real-world proposals. Subsequently we applied the UTA* multi-criteria method that provided weights for the criteria. Using them, we developed the Process Assessment Formula, a tool which calculates the complexity of the process as well as the expected value it will provide and shows this information in a priority table. Our tools can assist organizations in deciding effectively which processes can be automated, and in ranking them, so that the best candidates among them can be selected for automation.

Keywords: **Multiple-Criteria Decision Analysis, Robotic Process Automation, Decision Support Systems, UTA* method.**

Introduction

The origin of Robotic Process Automation (RPA) can be found back in the 1990s when screen scraping software was introduced [2]. Since then, RPA quietly evolved until around 2015, when it became mainstream [10]. Today, new RPA software is released regularly with Automation Anywhere[1], Blue Prism[2], and

[1] Automation Anywhere was founded in 2003 and has evolved from desktop integration solutions. Website: https://www.automationanywhere.com/

UiPath[3] being the leaders in the market. RPA, as defined by the Institute for Robotic Process Automation & Artificial Intelligence [4], is the application of technology that allows to configure computer software to capture and interpret existing applications for processing a transaction, manipulating data, triggering responses, and communicating with other applications or systems, as a robot would do if given strict instructions. This is not about robotics, but about software robots that automate work by imitating tasks executed by humans when they use their computers. As the robots are made to behave just like a human would, RPA is often referred as a non-invasive technology and therefore there is no need to change anything on the software that RPA is interacting with.

With the assistance of RPA technologies, the combined use of diverse (legacy) systems in the corporate environment that are difficult to integrate can now be automated. RPA can provide multiple benefits if used correctly, e.g., free valuable time from staff, decrease operational costs, reduce the cost of consumables by forcing digitisation, raise staff satisfaction, provide faster processing times, reduce errors and create more reliable analyses [2].

While all this sounds promising, RPA comes with some risks, like every automation technology. RPA helps complete routine tasks faster and at a higher quality, but it can also make mistakes faster. Insufficient definition of business rules and poor data quality can result in failing to achieve the expected benefits. Furthermore, RPA can be seen as a threat to the labour market as employees working on tasks that can be automated could face job loss. An inaccurate assessment of the processes could lead to increased development costs that could also result in the termination of a project. A study conducted by Ernst & Young [3] reveals that 30% to 50% of initial RPA projects fail due to poor choice of process. Thus, it is crucial to conduct a process assessment before development. Wrongly defined assessment criteria might lead to selecting a process for automation that might not be a good match for RPA.

In our work, we conducted six interviews that discuss different parts of the RPA process evaluation and that assisted us in finding the criteria that should be considered when evaluating a process for RPA. With the use of the coding method [11], the most important criteria were discovered and, with the use of UTA* [13], the weights of the criteria were determined and used in the Process Assessment Formula tool. We developed two tools: a) the Process Assessment Model, which is a simple flowchart with technical and business-related criteria the project and the candidate process must satisfy to move to the next phase, and, b) the Process As-

---

[2] A group of process automation experts formed Blue Prism in 2001. Their first commercial product, Automate, was launched in 2003 and since then they have been automating manual processes in customer services. Website: https://www.blueprism.com/

[3] UiPath was founded in 2005 in Romania and is one of the fastest-growing RPA vendors. UiPath has multiple partners that use technologies like NLP, OCR, ML, and chatbots. Website: https://www.uipath.com/

sessment Formula (PAF), which is a tool developed in Excel that allows the user to evaluate a candidate process's performance on each of the selected criteria and then get the value each process is expected to provide, and its complexity.

In the following, we provide an overview of the criteria elicitation process, then we present the developed tools and we conclude with a summary of our findings.

Criteria Elicitation Methodology

The method used in this research is qualitative and the followed process is based on the proposal of Kothari [6]. The research begins by defining the research problem; in our case this was done by talking to experts in the field and by examining the available literature (case studies). The data collected through interviews and unstructured questionnaires was then analysed through Coding. Coding is an analytical process, where data is categorized to facilitate analysis [11]. Our criteria assessment was completed based on the analysed data and on the comparison with our findings based on the literature review. To get results from a qualitative analysis, a step-by-step process must be followed [9]. First, the researcher reads the transcripts and takes notes. After that, relevant information is labelled. Labels (or *codes*) can be used for any concept that the researcher thinks is relevant to the research. Then, the researcher decides which codes are the most important and creates categories by combining several codes. In this step, many of the initial codes can be dropped since more essential and relevant codes are created. The categories are labelled, and the researcher can now decide which are the most relevant and how they are connected. Finally, before writing the results, the researcher can decide if there is a hierarchy among the categories and draw a figure to summarise the results. In the following paragraphs we outline the literature review and the findings from the interviews. For more information the interested reader can consult the thesis of Batakis [1], who conducted the interviews, an MSc student in the our interdepartmental Program on Technology & Innovation Management and also an RPA Projects Lead Developer in a private consultancy/company.

We selected three case study reports, one for each of the most successful RPA tools (i.e. Automation Anywhere, Blue Prism, and UiPath) aiming to find the different key criteria that each company uses to select the processes to automate as well as the benefits acquired from the success of their RPA implementation. All three papers are part of a research project conducted by Lacity, Willcocks, and Craig [7], [8], [14]. We found that automating processes delivers benefits such as:

- Full Time Equivalent (FTE) employee labour time saving (cost reduction)
- Reduced errors, improved service quality
- Increased Staff satisfaction, FTE redeployment, focus on critical tasks
- Return of Investment (ROI) in a few months or a multiple in a few years
- Re-investment in RPA, scale RPA team, increase automation

To try to automate a process that is not a right candidate will not only get someone further away from those benefits but can also be a negative experience that will push a company away from RPA. From the case studies, we derived the following characteristics of suitable candidate processes for automation:

- Highly manual and repetitive processes (i.e. running frequently and involve much manual work)
- Rule-based processes where decision making is based on standardised and predictive rules)
- Stable and mature processes (i.e. that are stable, predictable, and mature)
- High volume processes (with high transaction volumes)
- Processes whose input is in a standard electronic format (e.g. emails or Excel/Word/PDF files), not reliant to Optical Character Recognition (OCR) technologies
- No human intervention required after automation (removing human intervention reduces errors and the time required to complete the process)

After the literature review we proceeded to the interviews. Four categories were developed during the coding of the interviews: a) RPA and Automation, b) Business Goals and RPA Benefits, c) Project and Process Issues, d) Process Selection and Process Characteristics.

By analyzing the replies of the interviewees, the following criteria were derived: a) multiple FTEs can be saved, b) high volume of transactions, c) highly manual process, d) low number of exceptions, e) low to zero human intervention after the application, f) no change expected in the near future, g) no human judgement involved, h) reliant to one individual, i) repetitive, j) rules-based decision making, k) systems the robot interacts with are stable with no disconnects, glitches or crashes, l) standard electronic input, m) structured data involved, n) process uses multiple systems/applications, o) time saved is greater than the time required to automate the process, p) time-consuming task. Some of these criteria are not conclusive, and some play a more significant role in the decision of whether the process can be automated or not.

The Assessment Process Using the Developed Tools

Two mechanisms were created to assist an organisation in determining whether a process is suitable for automation: Firstly, the Process Assessment Model, a simplified flowchart, which determines if a process can be automated. Secondly, the Process Assessment Formula, which determines whether a process is suitable for automation and assists organisations in ranking the suitable processes.

The Process Assessment Model that we propose in this paper was created based on the ten main criteria that were derived from the interviews and the research made on RPA and the case studies. The flowchart is presented in Figure 1. The flow starts from the *Start* node and continues with yes/no questions leading either to the *Automate with RPA* node that indicates a good candidate project or to suggestions for improving it before considering it again.

The Process Assessment Formula (PAF) is a tool which can rank all the processes that passed through the previous tool as good candidates for automating with RPA. The PAF has been developed in Excel. After the process selection criteria were identified, the criteria that influence the Value and the Complexity were derived with the assistance of Interviewees 3 and 6. The next step was to calculate the weights of the criteria with the use of UTA* [13].

The UTA methods refer to the philosophy of assessing a set of value or utility functions, assuming the axiomatic basis of multiattribute utility theory and adopting the preference disaggregation principle [12]. The UTA* method uses linear programming techniques to optimally infer additive value/utility functions so that these functions are as consistent as possible with the global decision-maker's preferences (inference principle). For UTA* to calculate the weights for the criteria that influence the Value and Complexity of each interviewee, two tables with numerical values were created for each interviewee, one for Value and one for Complexity. In Table 1 the reader can see the first five rows of the Multi-criteria Matrix for calculating the weights of the criteria influencing the Value each *alternative* process can provide if automated. The following criteria are used and in parenthesis we provide their properties (qualitative/quantitative, worst value, best value):

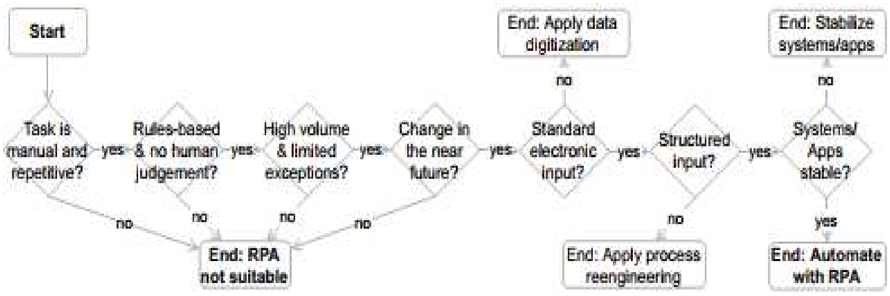

Fig 1. Process Assessment Model.

Table 1. Multi-criteria Matrix. Each row shows the performance of the alternative in the criteria and its rank as given by Interviewee 3.

Alternative	Criteria						
	VCR1	VCR2	VCR3	VCR4	VCR5	VCR6	Ranking
J1	5	0	0	0	1	5	1
J2	6	15	0	1	0	2	2
J3	2	0	0	1	1	5	2
J4	1	0	1	1	1	3	2
J5	6	20	0	1	0	2	3

VCR1: The volume of the process counted in FTEs (quantitative, 0.1, 10)
VCR2: Possibility (in percentage format) of the process changing in the near future (quantitative, 33, 0)
VCR3: Reliant to one individual, as being reliant to more than one individual brings risk (qualitative, 0, 1)
VCR4: Time Consuming, i.e. the process requires a lot of human effort (qualitative, 0, 1)
VCR5: Strategic Importance, a business might want a process automated even though it is not the best candidate, e.g. the business wants to reduce the number of human errors currently made (qualitative, 0, 1)
VCR6: Number of Systems the robot is interacting with (quantitative, 1, 10)

For each table, we used UTA* to derive the criteria weights for Value and Complexity. As the effort of filling the tables was time consuming, only two Interviewees, #3 and #6, responded. Rows I1 and I2 of Table 2 shows the interviewees calculated weights for Value, while the third row shows the average weights. The mean value of the weights on each criteria was taken and then used in the Processes Assessment Formula. As seen on Table 2 below, VCR1 (no. of FTEs) is the most important criterion when calculating the Value the process provides. As an interviewee suggested, 2 FTEs can be considered a financial break-even threshold if the headcount is removed, however, headcount reduction is usually only possible when over 5 FTEs are working the process. That means that an organization will receive the best ROI when the number of FTEs is high.

Table 2. The criteria weights for Value for both decision makers (dm) and their average values

Decision Maker	Criteria					
	VCR1	VCR2	VCR3	VCR4	VCR5	VCR6
I1	0.446	0.189	0.085	0.117	0.108	0.055
I2	0.367	0.161	0.173	0.063	0.160	0.077
Average	0.406	0.175	0.129	0.090	0.134	0.066

Exactly the same process took place for the Complexity computation and ranking of the projects. In this case, we had five criteria:

CCR1: Number of systems the robot interacts with (quantitative, 10, 1, 0.142)
CCR2: Standard Electronic Input, input received is in an electronic format (qualitative, 2, 0, 0.108)
CCR3: Structured Input, the data received are in a predictable form or table (qualitative, 0, 1, 0.123)
CCR4: % of Exceptions, % of the process that is not following the happy (standard) path (quantitative, 33, 0, 0.099)
CCR5: No. of steps the robot requires to complete the process, each click is considered a step (quantitative, 100, 5, 0.527)

Notice that here there is a criterion, i.e. CCR5, that is by far the most important. The other four are all weighted around 0.1, however CCR5 is more than 0.5. Multiple interviewees stated that the number of steps plays an important role in the complexity of a process being automated which also results in more time required for development. More steps in a process means more work for the development team, higher possibility for mistakes in the process documents as well as higher number of exception paths that need to be developed.

To summarise, in order for the Process Assessment Formula tool to provide results, the user fills the necessary cells, Excel makes calculations in the background based on the weights obtained by UTA* and the calculations created on Excel for each criteria. Finally, the tool provides information on whether the process can be automated and its Complexity, Value and Priority (see Table 3).

Table 3. Priority Table: First priority have processes that have low complexity (<30%) and high value (>60%), see number 1 in the top-right cell. Second are those processes that have low complexity and average value (30-60%), etc.

Complexity	Low (<30%)	5	2	1
	Med (>=30%)	7	4	3
	High (>=60%)	9	8	6
		Low (<30%)	Med (>=30%)	High (>=60%)
			Value	

Conclusion

Robotic Process Automation tools are software robots that are used on information systems to complete tasks the same way as humans. There are more than 30 different RPA tools in the market, which, when used correctly, can help an organization achieve multiple benefits such as cost savings, raise of staff and customer satisfaction, and error reduction. The three different case studies were examined, analysed, and the following characteristics were determined as essential for a process to be considered for automation with RPA: A process should be highly manual and repetitive, rules-based, stable, have high volume, and be provided standard electronic input. By conducting interviews with six experts in the field of RPA it was determined that organizations use RPA technology to provide efficiency. Furthermore, it was found that a process should be highly manual and repetitive, have high process volumes, be rules-based, have standard electronic inputs and should have structured data, a low number of exceptions, should not change radically in the near future, and should not require human judgment.

To conclude, RPA tools, when used correctly, can provide multiple benefits to an organization. For an organization to implement its projects successfully, a thorough evaluation of each of the processes for automation must be done. This procedure can be done either by following the criteria found during the interviews or by using the Process Assessment tools created by the work presented in this paper.

In the future, we plan to explore the possibility of the tools to expanded using computational argumentation, as on one hand it allows for explaining the Artificial Intelligence derived solution to the decision maker, and, on the other hand it allows to take decisions when information is lacking using abduction [5].

References

[1] Batakis, N. (2020). *Exploring Robotic Process Automation*. Master thesis, Technical University of Crete.

[2] Doguc, O. (2020). Robot process automation (RPA) and its future. In: *Handbook of Research on Strategic Fit and Design in Business Ecosystems*). IGI Global, pp. 469-492

[3] Ernst & Young, (2016). *Get ready for robots*. [online]. Available at: https://eyfinancialservicesthoughtgallery.ie [Accessed 28 June 2021].

[4] Institute for Robotic Process Automation & Artificial Intelligence. *What is Robotic Process Automation*. [online]. Available at: https://irpaai.com/what-is-robotic-process-automation/ [Accessed 28 June 2021].

[5] Kakas, A.C., Moraitis, P. and Spanoudakis, N.I. (2019). GORGIAS: Applying argumentation. *Argument & Computation*, 10(1), pp. 55-81.

[6] Kothari, C. (2004). *Research Methodology: Methods & Techniques*. 2nd ed. New Delhi : New Age International.

[7] Lacity, M. and Willcocks, L. (2016). Robotic Process Automation at Telefonica O2. *MIS Quarterly Executive*, 15(1)

[8] Lacity, M., Willcocks, L. and Craig, A. (2017). Robotizing Global Financial Shared Services at Royal DSM. *Automation*, 46. Henley Business School : Capco Institute Paper Series in Financial Services, pp. 62-75.

[9] Löfgren, K. (2013). Qualitative Analysis of Interview Data: A step-by-step guide. [online] https://youtu.be/DRL4PF2u9XA [Accessed 28 June 2021]

[10] Madakam, S., Holmukhe, R. M. and Jaiswal, D. K. (2019). The future digital work force: robotic process automation (RPA). *Journal of Information Systems and Technology Management*, 16.

[11] Sharp, E. (2018). *An invitation to Qualitative Fieldwork – A Multilogical Approach*. ED-Tech Press.

[12] Siskos, Y., Grigoroudis, E. and Matsatsinis, N.F. (2016). UTA Methods. In: S. Greco, M. Ehrgott, J. Figueira ed(s). *Multiple Criteria Decision Analysis*. New York: Springer, pp. 315 - 362.

[13] Siskos, J. and Yannacopoulos, D. (1985). UTASTAR: An ordinal regression method for building additive value functions. *Investigação Operacional*, 5(1), pp. 39–53.

[14] Willcocks, L., Lacity, M. and Craig, A. (2015). Robotic Process Automation at Xchanging. *The Outsourcing Unit Working Research Paper Series*, (15/03). London : The London School of Economics and Political Science.