Available online at www.ijournalse.org

Emerging Science Journal

(ISSN: 2610-9182)

Vol. 9, No. 3, June, 2025

Methodology for Business Process Automation in SMEs: From Requirements Analysis to Practical Demonstration

Sílvia Moreira [1, 2], Henrique S. Mamede [1, 3*], Arnaldo Santos [1, 3]

[1] *INESC TEC—Institute for Systems and Computer Engineering, Technology and Science, 4200-465 Porto, Portugal.*

[2] *University of Trás-os-Montes and Alto Douro, Quinta de Prados, 5000-801 Vila Real, Portugal.*

[3] *Department of Science and Technology, Universidade Aberta, Rua da Escola Politécnica, no. 147, 1269-001 Lisbon, Portugal.*

Abstract

This study aims to develop a methodology to assist Small and Medium Enterprises (SMEs) in effectively adopting Business Process Automation (BPA). Despite its growing importance in streamlining routine tasks and enabling employees to focus on more creative activities, numerous organizations face challenges in implementing BPA due to unclear procedures, insufficient knowledge of eligible processes, and uncertainty regarding the necessary technology. In response to these challenges, we introduce the Methodology for Business Process Automation (M4BPA), an artifact designed to guide SMEs through a structured BPA implementation process. The research follows the Design Science Research Methodology (DSRM). The requirements for the artifact came from the results of a previous Systematic Literature Review (SLR). M4BPA was demonstrated within real SME environments, providing solid evidence of its efficacy. The findings suggest that M4BPA significantly enhances SMEs' ability to implement BPA efficiently, offering a practical toolkit that facilitates the process. The novelty of this work lies in the development of a BPA methodology specifically tailored for SMEs, addressing existing gaps in current frameworks and providing a best-practice model for similar organizations. This research contributes to the intermediate results of a doctoral project, offering valuable insights for both practitioners and researchers in the field of BPA.

Keywords:

Business Process Automation; Framework; Methodology; Business Process Management; Digital Transformation; SME.

Article History:

Received:	23	December	2024
Revised:	11	April	2025
Accepted:	19	April	2025
Published:	01	June	2025

1- Introduction

According to Zaoui and Souissi [1], digital transformation is a current and highly significant topic for companies across all sectors, as it reshapes the relationships with customers, suppliers, and human resources, and alters the value creation process. Gartner [2] noted that the use of process automation technologies will be a critical issue. Statista [3] reports that, out of the 22.6 million SMEs in the European Union, 34% have already adopted digital technologies, 24% acknowledge the need for a digital tool, 10% are considering adopting advanced digital technologies, and 8% share the same outlook as the previous group. These process automation technologies are set to automate essential business processes, relieving employees from manual tasks and allowing them to focus on other activities [2].

Business Process Automation (BPA) can be adopted in numerous areas in the organizational structure [4] using only one technology or various simultaneously. Given the general benefits of adopting BPA (reducing execution times and costs and increasing productivity), applying this technology is not always successful [5]. According to Stravinskienė and Serafinas [6], 30% to 50% of RPA initiatives fail. This failure can involve numerous reasons, like not knowing about the procedure, not knowing what kind of processes are eligible for automation, how to do the procedure, what kind of technology is mandatory for the organization, and others [7].

* **CONTACT**: jose.mamede@uab.pt

DOI: http://dx.doi.org/10.28991/ESJ-2025-09-03-022

From a previous work, a Systematic Literature Review (SLR) [7], we found that there are still gaps in the area of BPA: tested guidelines/roadmaps for RPA adoption [8-18], the definition of formal techniques for choosing target processes for automation [8, 9, 13, 17, 19-21], the definition of metrics for measuring the benefits achieved with RPA [6, 10, 11, 12, 17, 22]; and definition of critical factors for success in automating and their implications ([9, 12, 15, 17, 22], among others gaps in the literature (please see Table 1 in the section 2). On the SME side, they do not know how to implement BPA due to a lack of digital literacy or funding [3]. From the existence of the cited gaps and the factors that contribute to the failure of the procedure of BPA from the previous SLR, a set of guidelines and tools that guide SMEs in the entire BPA procedure is necessary.

The objective to be carried out within the scope of this work is: "*What methodological support can be given to SMEs for successfully adopting process automation?*". The search for an answer to this question follows the Design Science Research Methodology. Our team has already carried out a SLR in the first quarter of 2023 [7]. The results of this SLR (critical factors (negative – Table 4 in section 2 – and positive – Table 5 in section 2) for the successful application of automation; most commonly used technologies; what types of processes are best suited to automation; what types of artifacts already exist to help SMEs – Table 2 in section 2) have been included as requirements in our artifact (Table 7 in section 4.2). After its design and development, it was tested on a group of 16 SMEs, and outputs and lessons were learned from the application of the M4BPA in a real environment. After these phases, we intend to validate the results of the artifact itself and the feedback from SMEs through focus groups in the future. However, at the moment we believe that it is already a tested methodology and that SMEs can use it to implement BPA in their businesses.

At the end of this work, SMEs will have a method for adopting BPA developed and tested. This artifact is different from other ones in the way that it joins a set of phases and tasks, the identification of the stakeholders, and a set of tools that support the execution of the tasks. It covers the preparation, implementation, and post-implementation phases of the procedure. M4BPA, materializing guidelines, is the support that guides SMEs in their successful BPA procedure.

This paper is part of a set of publications that aims to document the various stages of the artifact's development, and is structured as follows: Section II presents the background research used to fulfill the purpose mentioned above; Section III describes the methodology of this investigation; Section IV describes and presents the artifact M4BPA. Section V illustrates the procedure for demonstrating the artifact and its results. Section VI is the conclusion, where the main lines in this paper and some limitations and obstacles are mentioned. This paper ends with announcing the future research by the authors.

2- Background Research

This chapter mentions the research gaps in the area of BPA, the comparison of 28 artifacts, as well as the positive and negative factors that can influence a BPA procedure found in the work by Moreira et al. [7] (previous SLR made by the authors of this paper). All of these items will be inputs for our artifact.

Table 1 summarizes the gaps for improvement regarding this procedure. Additionally, Moreira et al. [7] mentioned the necessity of studying the social impact that RPA can cause [8] and the study of ethical complications in data handling in systems with RPA features [23]. These two concerns are not included in Table 1, as they were only addressed once in the literature.

Table 1. Open gaps in the BPA area

Gap	References
Guidelines/Roadmaps for RPA Adoption	[8-18]
Definition of formal techniques for choosing target processes for automation	[8, 9, 13, 17, 19-21]
Definition of metrics for measuring the benefits achieved with RPA	[6, 10-12, 17, 22]
Implementing methodology for automation procedure (Agile, management tools, among others)	[6, 8, 12, 17]
Definition of critical factors for success in automating and their implications	[9, 12, 15, 17, 22]
Impact of the use of automation on the organization's business model	[6, 9-13, 16, 17, 24]
Evolution of RPA technology	[6, 8, 10-12, 16-18, 25]
RPA Literature	[14, 18, 26, 27]
Studies related to the security and performance of RPA solutions	[21, 25, 28]
Comparative empirical studies of before and after RPA	[6, 10, 11, 16-18, 22, 26, 29]

The lack of methodology for automation is the top concern [7]. As we already mentioned the SLR [7] was performed in 2023 Q1, however, the results concerning the gaps continue to be a cause of concern as we can see in Abidemi [30], Pardesi [31], and Rani et al. [32]. Moreira et al. [7] analyzed 28 models to support the procedure of BPA in organizations (Table 2). About 39% are frameworks, 29% are guidelines, 18% are roadmaps, and 14% are methodologies. There is a focus on a wide spectrum of types of technology [7].

Table 2. List of artifacts for automation (adapted from [7])

Paper	Type	Technology
Hull & Nezhad [33]	Framework	Cognitive BPM
Nurhayati & Fitrisari [34]	Guidelines	Workflow System
Athanasopoulos et al. [35]	Roadmap	BPM/BPR/BPA
Alves et al. [36]	Methodology	BPM
Denner et al. [37]	Methodology	BPM Process Improvement
Torkhani et al. [38]	Framework	IPA/IRPA
Ahmad & Van Looy [39]	Framework	BPM
Dumčius & Skersys [40]	Guidelines	BPM
Huang & Vasarhelyi [41]	Framework	RPA
Hartley & Sawaya [42]	Roadmap	RPA/AI/ML/BCK
Ludacka et al. [43]	Guidelines	Workflow System
Mishra et al. [8]	Guidelines	RPA
Enríquez et al. [10]	Guidelines	RPA
König et al. [44]	Methodology	Integration RPA in BPM
Leon [45]	Framework	–
Noppen et al. [46]	Guidelines	RPA
Flechsig et al. [11]	Roadmap	RPA
Sobczak [24]	Guidelines	RPA
Susilo et al. [47]	Roadmap	RPA
Wewerka & Reichert [18]	Methodology	RPA
Costa et al. [48]	Guidelines	RPA
Feio & dos Santos [49]	Framework	IPA/RPA
Herm et al. [50]	Framework	RPA
Lazareva et al. [51]	Framework	RPA
Liutkevičienė et al. [52]	Framework	ERP
Neto et al. [53]	Framework	Workflow System
Smirnov et al. [54]	Roadmap	Workflow System
Moreira et al. [55]	Framework	-

We have analyzed all 28 listed references, their stages, guidelines, and topics of interest; the procedure for implementing automation in SMEs must include the aspects marked in Table 3. The column *#papers* marks the number of papers found in the literature review from [7] that exposed the item.

Table 3. List of the automation aspects that were found in the 28 studies (adapted from [7])

Item	Symbol	#papers
Roles in procedure	ROLL	13
Strategy for procedure	STR	8
Methodology for project	MET	6
Study process to automate	PROC	26
Technology for automation	TECH	12
Integration TIS	INTG	9
Development of automation	DEV	24
Test of automation	TEST	17
Assessment of the automation	ASSE	12
Deployment of the process	DEPL	18
Monitoring the process	MONI	16
Change management	CHGM	3
Upscaling of automation	UPSA	4

Five works have been selected as the more complete ones [7]: Flechsig et al. [11], Herm et al. [50], Noppen et al. [46], in König et al. [44] and Ludacka et al. [43]. Ludacka et al. [43] failed in the post-implementation of automation. König et al. [44] neglect aspects like the involvement of the human resources (roles), methodology for implementation, approach for the project, change management, and plan to upscale. Flechsig et al. [11] failed in not considering the problem of choosing the technology or tool for automation. Herm et al. [50] did not have considered monitoring the solution achieved. Integration with other information systems, the assessment of automation, and change management were not noted by Noppen et al. [46]. With the literature as a base, it can affirmed that the elements from Table 3 must be included in the design of our artifact.

Besides the comparison of the 28 models, Moreira et al. [7] provided a set of factors that can influence BPA (Table 4 and Table 5). In each table, the *#papers* column reflects the weight of each factor in the [7] results.

Table 4. Negative factors to BPA procedures (adapted from [7])

Negative factors	#papers
Not having a methodology for automation.	57
Lack of knowledge about technology/automation	53
Cost of the solution	32
Inertia and resistance of employees	29
Lack of solution governance	26
Ethical and moral issues	25
Lack of digitalization in process/organization	22
Lack of knowledge about organizational processes	21
Lack of skilled human resources	21
Lack of strategic alignment (business goals and IT)	19
Poor management/overcentralized decision-making/rigid hierarchical structure	17
Lack of innovation in the organization	11
Concerns in cybersecurity and data privacy	9
Lack of transparency of the process or change	7
Low flexibility/agility in the process	7

Table 5. Positive factors to BPA procedures (adapted from [7])

Positive factors	#papers
Plans of communication	15
Change management	14
Staff training	14
Culture/Politics/Organizational Structure that supports changes	13
Knowledge about digital technologies	11
Existence of BPM	10
Process management	9
Low cost of automation solution	7
Communication about job disruption	5
Low time of implementation	5
Orchestration of various kinds of BPA approaches	4

Besides the SLR [7], Schlegel et al. [5] list the prerequisites for an organization to implement with success BPA and factors that contribute to the failure or success of an RPA project. The authors noted the human factors (training, knowledge about the technologies, involvement of stakeholders), organizational factors (strategy, roles, center of excellence, project management, and process management), and technical factors (integration, pilot processes or Proof-of-Concept, maintenance management). Gandía et al. [56] concluded that process automation provides benefits but requires employee training and attitude change for successful implementation.

There are still gaps in the automation implementation process, and there is an urgent need for a roadmap guiding the entire process, from the as-is study to the as-be study, adoption, and follow-up (*Guidelines/Roadmaps for automation adoption*). This will be a priority problem to solve, given the number of references found (*Guidelines/Roadmaps for RPA Adoption* in Table 1; *Not having a methodology for automation* in Table 4).

In addition to this non-existent framework, it is worth investing more resources in defining formal, systematic, and proven techniques for choosing target processes for automation (*Definition of formal techniques for choosing target processes for automation* in Table 1). The SLR by Moreira et al. [7] also identified a possible gap in research on the application of models to guide the overall procedure of BPA, particularly in SMEs. Only six papers explicitly referred to SMEs [7].

Our artifact, the Methodology for Business Process Automation (M4BPA), aims to address at least the concerns mentioned in the previous paragraph. It identifies the tasks and phases involved in the BPA procedure; outlines their workflow; determines the roles of who should be involved; assists in selecting candidate processes for automation; evaluates their suitability for automation; helps to understand which of the candidate processes the SME should start its BPA journey with; helps decide whether AI-supported technology is needed and emphasizes the importance of documentation to support the procedure, involving the entire organizational structure.

3- Research Methodology

To create an artifact capable of guiding SMEs in their BPA procedure, we can divide the research path described in this article into 3 steps (Figure 1): the collection of existing information related to the problem - Background Research -; then, with their results, we set out to design the solution - Solution Proposal -; finally, we demonstrated the artifact in SMEs - Demonstration. The output of background research is in section 2; our solution proposal is in section 4, and the demonstration is explained in section 5.

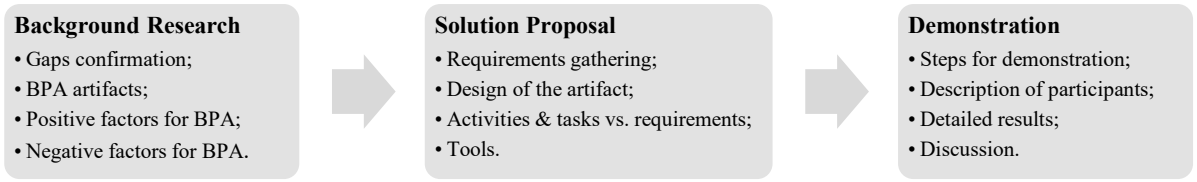

Figure 1. Research steps in this paper

4- Solution Proposal

This chapter presents our proposal. It mentions the requirements and constituents of the artifact, including plans, phases, activities, tasks, tools, and the profiles of those involved.

4-1- Requirements of the Artifact

The items from the comparison of the models (13 from the revisiting Table 3) are important to the BPA procedure, as all were supported by evidence in multiple analyzed publications. Therefore, all of these items must be considered requirements in the design of our new artifact. Table 6 presents the list of requirements derived from the influencing factors (negative – Table 4 and positive – Table 5) and the analysis of existing BPA-guiding artifacts, which will be considered in the design of the artifact.

Table 6. Requirements and their origins

Requirement	Origins
Roles in procedure (ROLL)	Influencing factors & analysis of artifacts
Strategy and methodology for the project (STR and MET)	Influencing factors & analysis of artifacts
Change management (CHGM)	Influencing factors & analysis of artifacts
Plan of Communication (COM)	Influencing factors
Governance Plan (GOV)	Influencing factors
Study process to automate (PROC)	Influencing factors & analysis of artifacts
Technology for automation (TECH)	Influencing factors & analysis of artifacts
Implementation of the automation (with INTG, DEV, TEST, ASSE, and DEPL)	Analysis of artifacts
Monitoring the process automated (MONI)	Analysis of artifacts
Upscaling of automation (UPSA)	Analysis of artifacts

4-2- Design of the Artifact

Next, we present the list of requirements and sub-requirements (Table 7) that formed the basis for the design of the artifact. Table 7 also indicates the stage of the BPA implementation process where each requirement is applicable.

Table 7. List of requirements and sub-requirements for artifact design

	Requirement	Sub-Requirements	Stage
R01	Roles in procedure (ROLL)		ALL
R02	Strategy and methodology for the project (SRT and MET)		ALL
R03	Change management (CHGM)		ALL
R04	Plan of Communication (COM)		ALL
R05	Governance Plan (GOV)		ALL
R06	Study process to automate (PROC)		PRE
R07	Technology for automation (TECH)		IMP
R08a	Implementation of the automation	Integration TIS (INT)	IMP
R08b		Development of automation (DEV)	IMP
R08c		Test of automation (TEST)	IMP
R08d		Assessment of the automation (ASSE)	IMP
R08e		Deployment of the process (DEPL)	IMP
R09	Monitoring the process automated (MONI)		POST
R10	Upscaling of automation (UPSA)		POST

In the design of the artifact, we have considered the Business Process Management (BPM) and BPA cycle retrieved from the SLR [7]. We noted automation in the stage of execution from the BPM lifecycle (Figure 2). BPM lifecycle was inspired mostly by Chakraborti et al. [57] and Wewerka and Reichert [18]: (1) Design, (2) Modeling, (3) Execution, (4) Monitoring, and (5) Optimization. The BPM lifecycle proposed by van der Aalst [58] was implemented in three phases: design or redesign of the process, its implementation, and its execution and adjustment. In the *execution* phase of the BPM lifecycle integration and automation are mentioned. *Integration* with other systems or processes related to the study process [55]. *Automation* of the process with technology or tools [55]. In this stage, our artifact can be used as a valid support for SMEs.

The automation life cycle includes six steps [10, 11, 18, 34, 36-38, 41, 42, 44, 45, 47-51] (as can be seen in Figure 2): 1. *identify processes for automation*; 2. *design and optimization of the process*; 3. *verification of the digital readiness*; 4. *selection of the automation technology*; 5. *automation implementation*, and 6. *solution governance*. Step 2 is a cycle task since the optimization and design of the process must be a concern, with the goal of high automation performance.

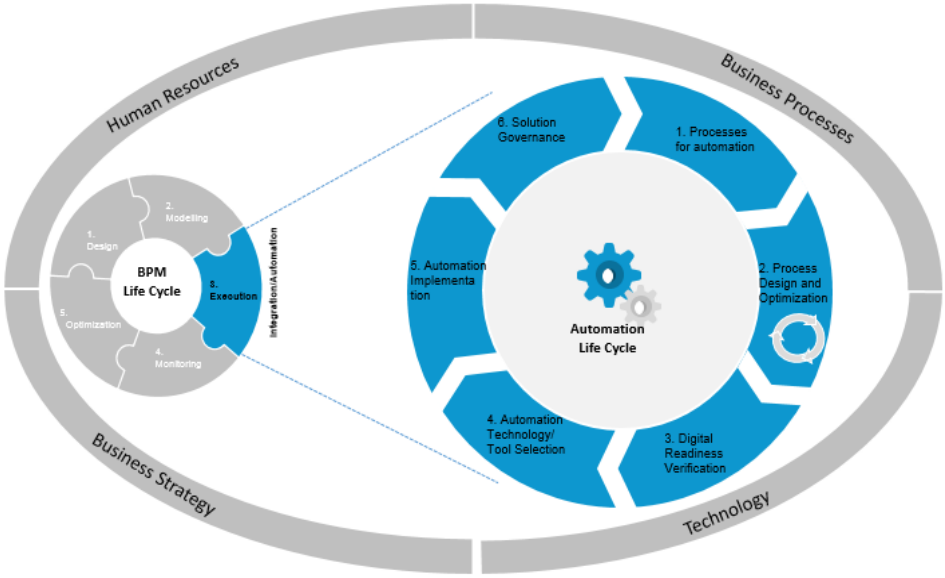

Figure 2. Details of BPM and BPA Cycles

The designed artifact aggregates stages, activities, stakeholders, tools/methods for performing tasks, inputs, outputs, and flows between tasks. Because of their complexity, it was produced from two points of view, one from the perspective of stages, activities, and stakeholders (roles) (Figure 3), and the other from activities, tasks, tools/methods, and input and outputs (explained in each activity section). These points of view will be explained in different schemes and sections.

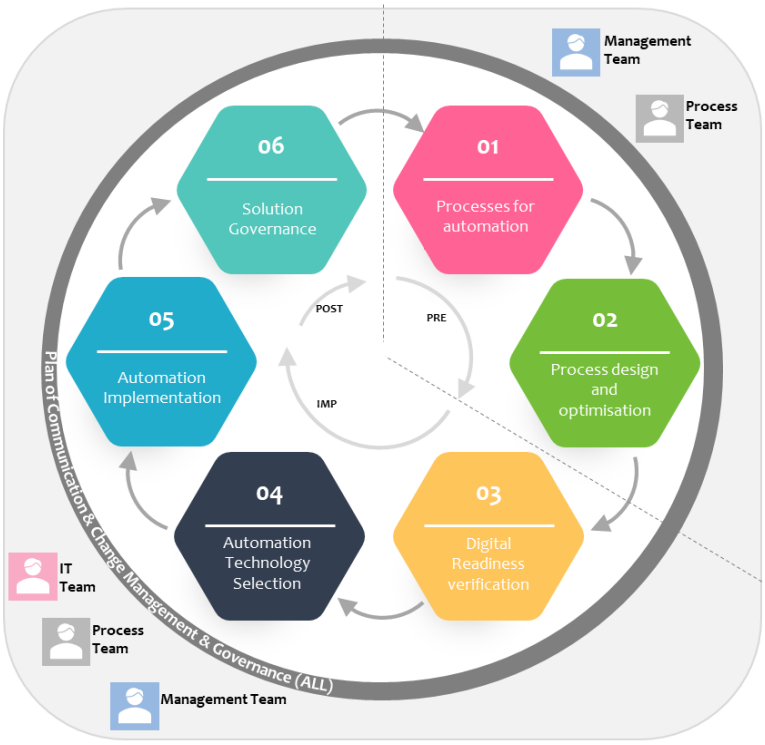

Figure 3. Stages, activities, and stakeholders (roles) from the artifact

We grouped activities (1) *processes for automation* and (2) *process design and optimization* in the *Pre-Implementation* stage. The second stage, *Implementation*, grouped (3) *digital readiness*, (4) *automation technology selection*, and (5) *automation implementation*. The last stage, *Post-Implementation*, is about the (6) *solution governance* (Figure 3). Supporting all steps, the artifact advises the existence of a *communication plan*, a *change management plan*, a *governance plan*, and a *definition of the roles* (Figure 3).

4-3-Artifact Activities and Tasks

Based on the requirements (Table 7) and design of the artifact (Figure 3), we now explain each activity and its components, including tasks, inputs, outputs, interactions, and tools. Table 8 shows how the artifact components align with the design requirements (Table 7).

Table 8. Correspondence between requirements and activities from the artifact

	(Sub) Requirement	Artifact activity or concern
R01	Roles in procedure	Present in all activities
R02	Strategy and methodology for the project	Strategy and methodology for the project
R03	Change management	Change management
R04	Plan of Communication	Communication Plan
R05	Governance Plan	Governance Plan
R06	Study process to automate	01. Processes for automation 02. Process design and optimization
R07	Technology for automation	04. Automation technology selection
R08a	Integration TIS	05. Automation Implementation
R08b	Development of automation	05. Automation Implementation
R08c	Test of automation	05. Automation Implementation
R08d	Assessment of the automation	05. Automation Implementation
R08e	Deployment of the process	05. Automation Implementation
R09	Monitoring the process automated	06. Solution governance
R10	Upscaling of automation	06. Solution governance

4-3-1- Processes for Automation

In activity *01,* the as-is and to-be scenarios are assessed, processes for automation are selected and prioritized, and processes for a proof-of-concept (PoC) are chosen (Figure 4). It is essential to include stakeholders, such as process and organizational management teams, to support process mining. A key feature of this artifact is the proposed *checklist*

with the characteristics of candidates for automation and a *method to choose PoC* (explained in a different section). With these tools and techniques from BPM, the goal of this step is to help with the correct identification of processes for automation and PoC. The outputs of Activity 01 include the as-is and to-be scenarios, a ranked list of processes to automate, and the selected PoC processes (Figure 4).

Revisiting Table 8, the requirement R06 is, in part, performed in this activity. In this activity, the concern of artifacts is only choosing the process to begin the process of business process automation. The study of the process is the goal of the next activity – *02: Process design and optimization*.

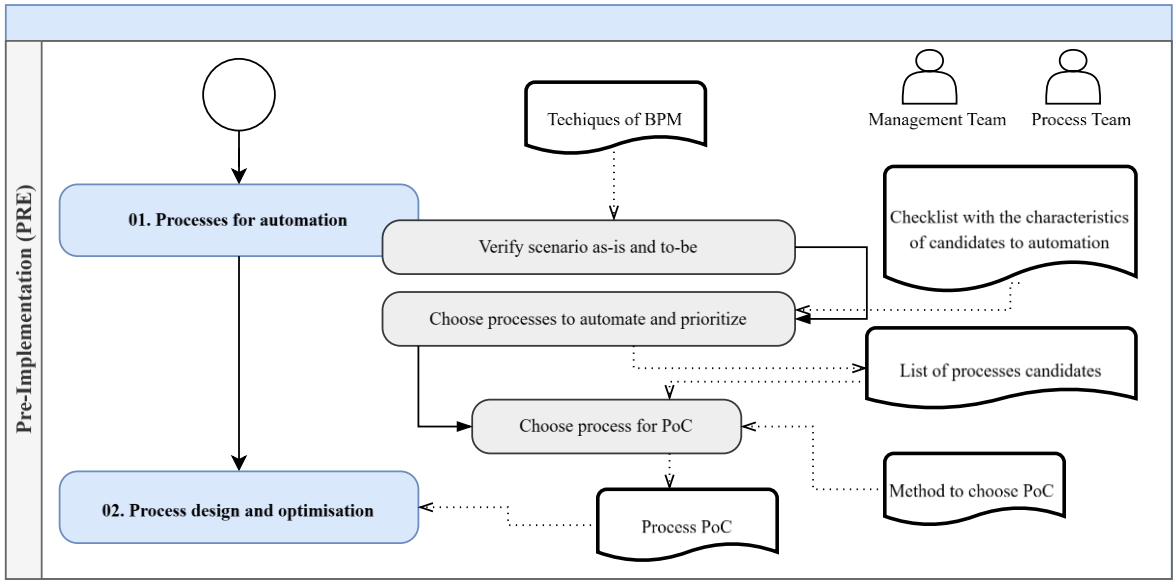

Figure 4. Detail of activity: 01. Processes for automation

4-3-2- Process Design and Optimization

One of the most critical and time-consuming tasks in step *02* is to analyze the process and optimize (cycle characteristic and its goal) (Figure 5). Besides this task, the organization also has to perform a detailed breakdown of the process and design it. Through Business Process Model and Notation (BPMN) and flowcharts (for example) is achieve the description of the process is achieved (RH, tasks, inputs, outputs, integrations), and the design of the process is optimized. Activity *02*, like activity *01*, needs the support of the stakeholders from management and the process team.

It is essential to define the list of KPIs (Key Performance Indicators) with more sense for the area of business of the SME because the organization must know how automation affects the process (compared to as-is scenarios and KPIs before automation) (Figure 5).

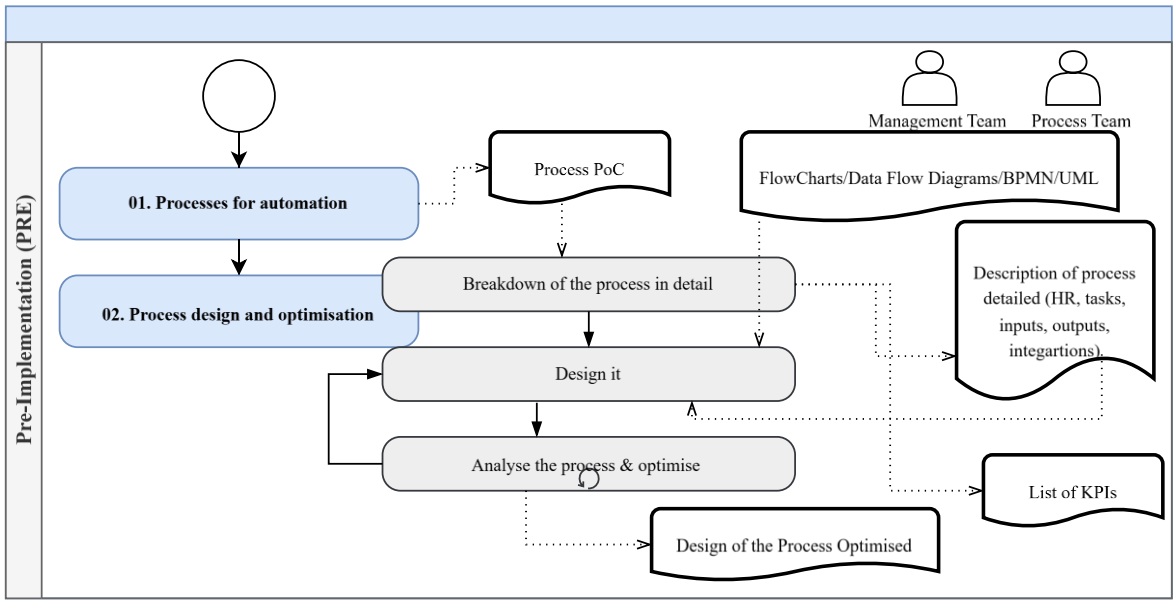

Figure 5. Detail of activity: 02. Process design and optimization

Revisiting Table 8, the requirement R06 is partly performed in this activity. In this activity, the concern is to document, optimize, and design with a recognized notation of all the existent data flows. The outputs of this activity are the input to the activity *03. Digital Readiness*, *05. Automation implementation*, and *06. Solution Governance*.

4-3-3- Digital Readiness

The implementation phase begins with the assessment in Activity *03* (Figure 3). The implementation phase needs to achieve success and needs to involve the process, the organization's management, and the IT team (Figure 6). One more novelty of this work is the *checklist with digital characteristics for automation.* If the process is ready for automation, the organization can select the appropriate automation technology (activity 04) from the artifact (Figure 3).

Revisiting Table 8, this activity is not exposed; however, it is important to check if the process PoC has some necessary digital characteristics to be automated by the next activity.

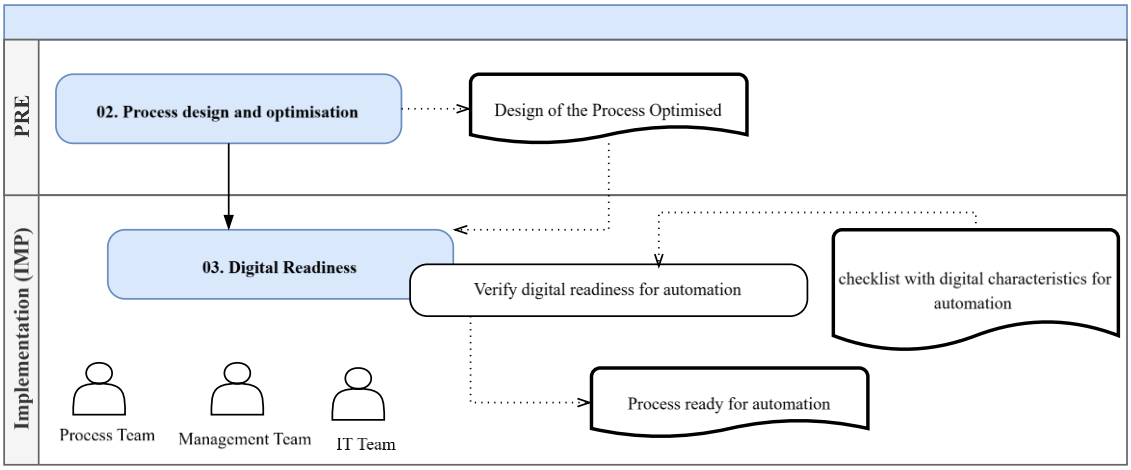

Figure 6. Detail of activity: 03. Digital readiness

4-3-4- Automation Technology Selection

To perform activity *04,* the organization has to fulfill the definition of the *process requirements* and then *choose the necessary automation technology* (Figure 7). This artifact defines a *matrix that relates process automation requirements versus technology characteristics* to help organizations in this choice. Activity *04* delivers a *list of process requirements* and the *technology for automation*.

Revisiting Table 8, the requirement R07 is performed in this activity. In this activity, the concern of the artifact is the documented choice of the fittest automation technology. At this point, the organization is ready to begin the practical implementation (Information Technology) of automation. The outputs of this activity are the input to the activity *05. Automation implementation*, and *06. Solution Governance.*

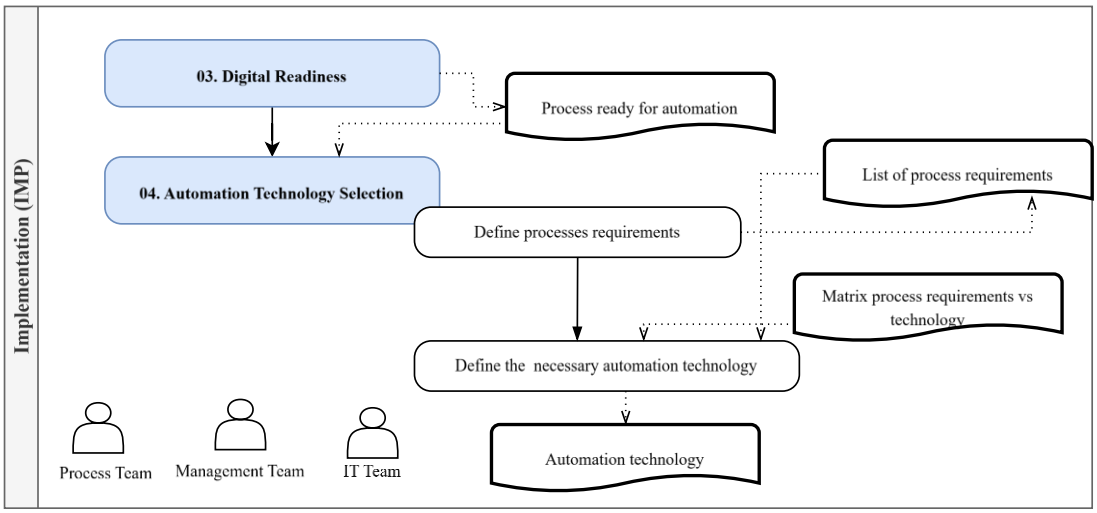

Figure 7. Detail of activity: 04. Automation technology selection

4-3-5- Automation Implementation

The last activity of the implementation phase is the *05* (Figure 3). This activity is the materialization of all the choices made in the previous steps. Six tasks are in the body of this activity (Figure 8): *focus on the Human Resources Team (responsibilities and training)*; *installation and configuration of the technology*; *automation process design in the tool*; *implementation of the solution* (including development, testing, and deployment), *integration with other information systems* (if needed), and *evaluation of the solution* (with the list of KPIs). These last four tasks can be repeated until the evaluation reveals some success. At the end of activity *05,* the SME will have the *solution implemented, tested, and evaluated*, and the *process participants trained*.

Revisiting Table 8, the requirements R08a, R08b, R08c, R08d, and R08e are performed in this activity. In this activity, the concern is the practical implementation of BPA using technology. The output of this activity is the input to activity *06. Solution Governance*.

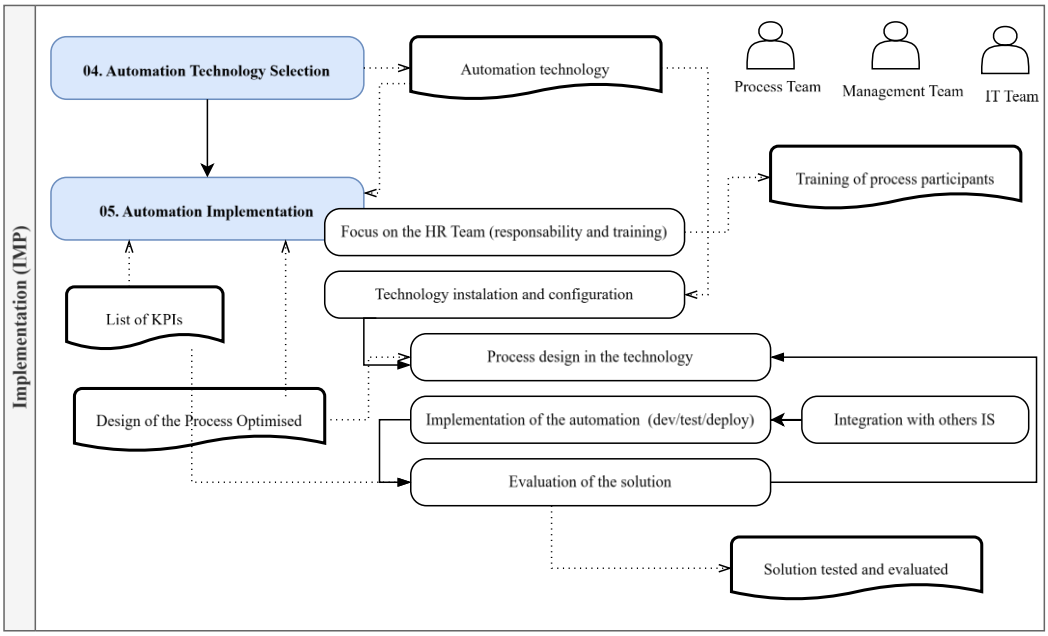

Figure 8. Detail of activity: 05. Automation implementation

4-3-6- Solution Governance

The last stage, post-implementation, is *06* (Figure 3). Activity *06* aims to *monitor and analyze the effectiveness of the solution*, *deal with errors and exceptions*, concerns about the *security/privacy and General Data Protection Regulation of the solution*, and *scalability and balance resources* (Figure 9). These tasks will deliver a *dashboard with KPIs* (before and after automation) *for evaluation*, a *report of continuous monitoring*, a *report of security/general data protection regulation compliance and privacy*, and a *plan for upscaling* the solution for more automated processes.

Revisiting Table 8, the requirements R09 and R10 are performed in this activity. At this point, the organization has the PoC automated, analyzed, and validated and knows how to scale the solution to more processes from the *list of business process candidates* (output from activity 01. Processes for automation).

4-3-7- Change Management, Communication, and Governance Plan

Preparing all the sectors and human resources from the organization for the change of paradigm in the way that processes are performed is important to achieve success in the procedure of business process automation. With this change management, together with a communication plan, all workers will feel an integral part of the procedure, and part of their fears and resistance to change can be nullified, contributing to the success of this journey (as seen in [7]). The governance plan will be controlled after validating the success of automating a business process and upscaling the tool for the implemented solution.

There is not any activity in the artifact, which directly cites these plans. However, they are the basis of this artifact. These three documents were considered important to the success of automation in an organization for the reasons already explained. Revisiting Table 8, the requirements R03, R04, and R05 are considered in this artifact.

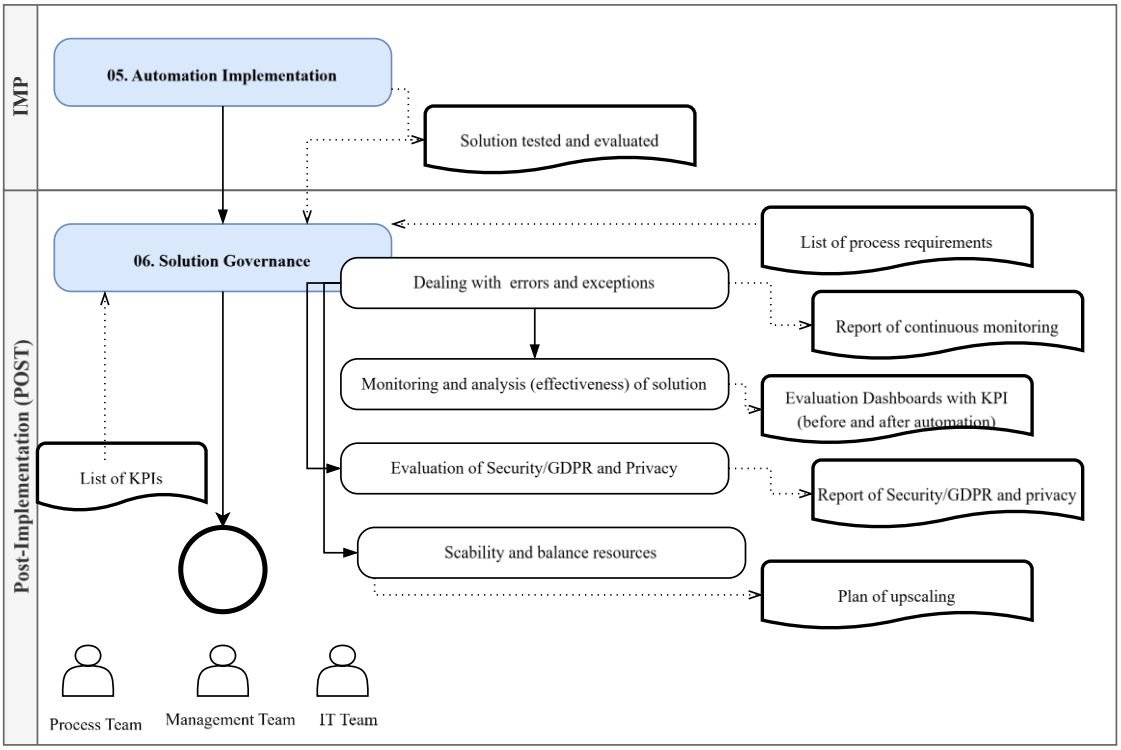

Figure 9. Detail of activity: 06. Solution governance

4-4- Tools

In the last session, all activities and documents/concerns that make up the artifact were explained in detail. In the explanation of activity 01, the tool *checklist with the characteristics of candidates to automation* (Figure 4) and a *method to choose PoC* (Figure 4) were cited. The third tool that merges in activity 03 is the *checklist with digital characteristics for automation* (Figure 6). The last one, *matrix processes requirements versus technology*, is performed in activity 04 (Figure 7). These four tools will be explained in the next four sections.

4-4-1- Checklist with the Characteristics of Candidates for Automation

With this tool, the output-ranking list of the processes to automate and process for PoC will be less complex. From the key findings from the SLR [7], it is possible to define a list of the characteristics that a business process must have to be a candidate for the procedure of automation. Table 9 lists the attributes with the number of occurrences in Moreira et al. [7].

Table 9. Attributes of the processes candidates for automation (retrieved from [7])

Attribute	#
Very repetitive (increases ROI)	57
Rule-based (for mapping without ambiguity)	42
Normalized/structured/standardized/matured (no changes in the future, or minimal. Easy configuration of the bot)	41
Low complexity (tech without AI) (process simple for quick implementation)	30
High number of occurrences (increases ROI)	29
Interacts with multiple systems (probability of error increases since the human has to perform access to several systems inconsistently)	23
Structured data (tech without AI) (data must be structured and in a digital format)	22
Error-prone (processes that tend to errors)	15
Medium-high complexity (tech with AI) (complex process to automation)	9
Low level of exception (exceptions can limit the automation)	9
Limited human intervention (processes that can be performed without human intervention are ideal for automation)	7
Unstructured data (tech with AI) (processes with unstructured data, like text in an email	6

So, this tool (Figure 10) describes the process by considering the features mentioned in Table 9 (without the characteristics related to technology) with one more item: the *duration of task execution* [18].

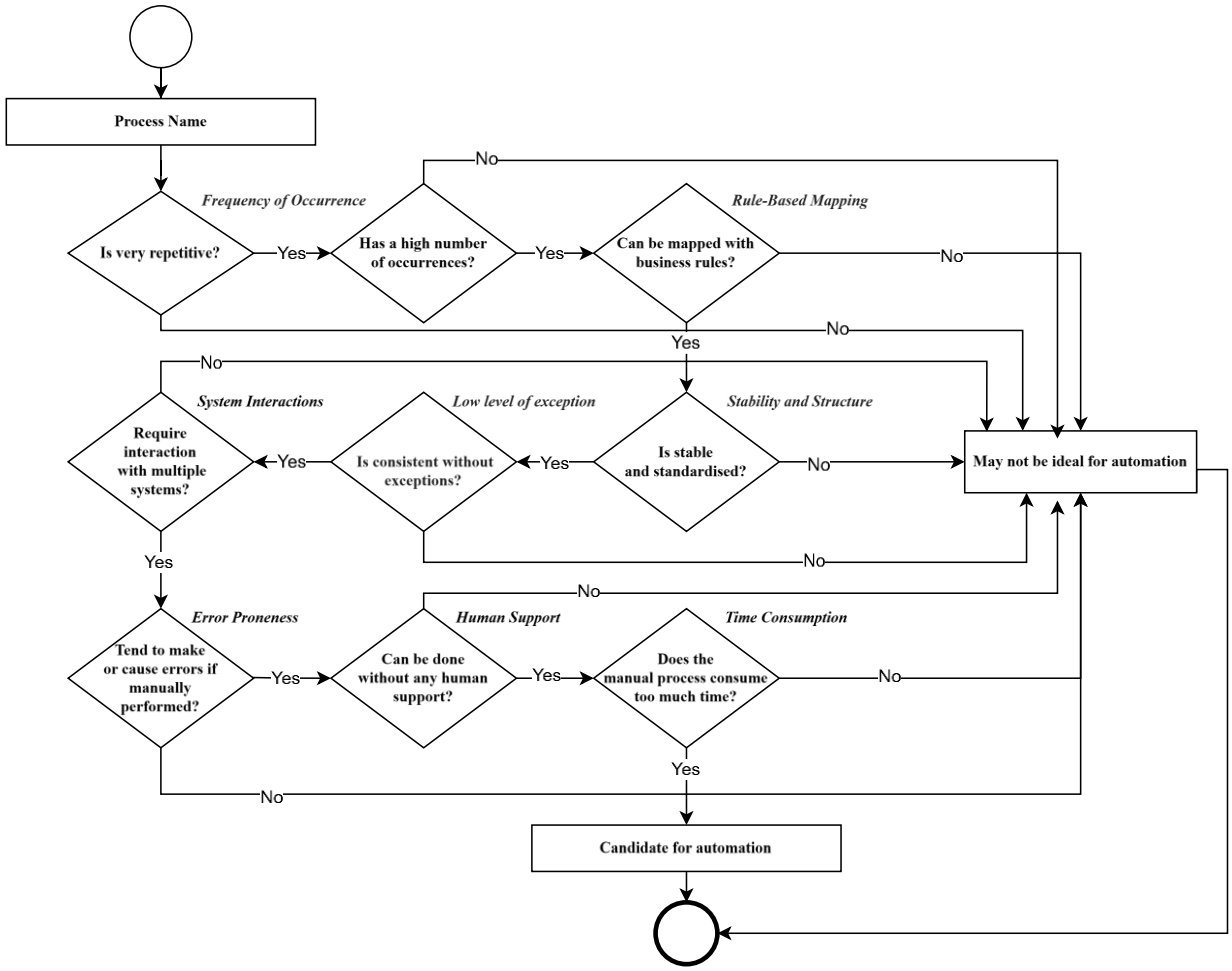

Figure 10. Checklist with the characteristics of candidates for automation

4-4-2- Method to Choose PoC

After analyzing the characteristics mentioned in Figure 10, the organization knows which processes can be automated (without concern for the type of technology). The next step is to decide which process can be promoted to the PoC (where the BPA procedure can begin).

In [7], various authors referred to this "problem"; however, the resolution always involved the automation technology of RPA, like Eulerich et al. [59] and Flechsig et al. [11]. For the development of this tool, the framework "*a three-step evaluation framework to assist auditors as they decide what activities to automate"* [59] was an inspiration concerning the identification of the *benefits* that automation can bring to SMEs and the *feasibility* of the procedure. The authors classify each process's technical feasibility (1 lower feasibility to 5 higher feasibility), considering various characteristics and benefits of the bot (1 fewer benefit to 5 more benefits) and various related items.

Flechsig et al. [11] and Eulerich et al. [59], through their matrix (Figure 11), recommend where to start automation: bots that are in Quadrant 2 should be prioritized for immediate development (*Quick wins*); followed by Quadrant 1 (*Initial test cases*), then Quadrant 4 (*Digital transformation*) bots should be developed only once technical feasibility improves. Bots in Quadrant 3 (*Deprioritized processes*) should not be developed.

Eulerich et al. [59] demonstrate that a successful PoC in simple use cases makes the implementation procedure of automation easier. Feasibility is related to whether the process is suitable for the RPA characteristics and whether the value is all about the ROI (return-of-investment) of the automation [11].

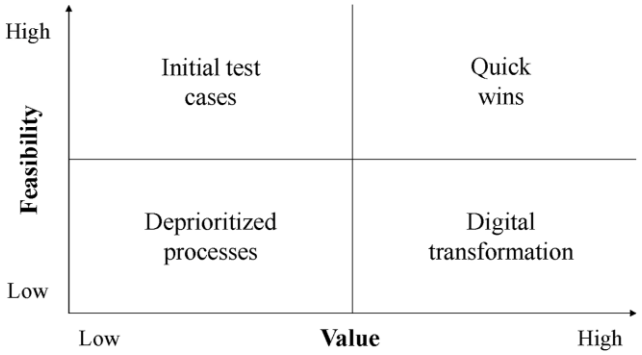

Figure 11. Matrix feasibility vs value [11]

Considering the inputs of [11] and [59], the artifact tool method to choose PoC is represented in Figure 12 and its interpretation in Figure 13. In this investigation, this tool is technologically not related.

After collecting the answers to the 8 considerations represented in Figure 12, the tool finds the average of the values for each group and determines the level of each dimension. If the value is above or equal to 2.5, the dimension level is high (high feasibility or high benefits). If the value is below 2.5, the dimension level is low (low feasibility or low benefits). Then, the processes are distributed in the next matrix (Figure 13).

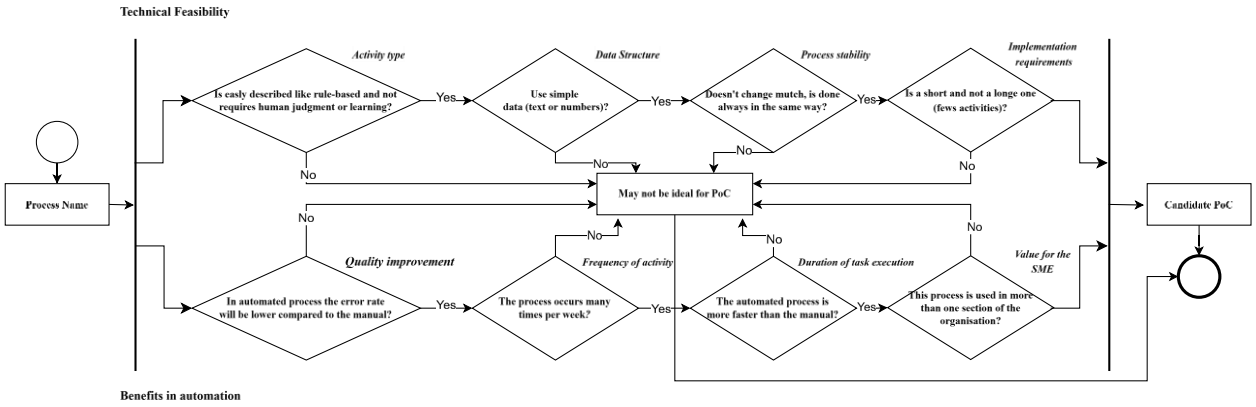

Figure 12. Checklist for the method to choose PoC

The artifact tool *method to choose PoC* follows the recommendations of cited authors and identifies quadrant 2 as the pool where the organizations must choose the PoC. Quadrant 3 is the last pool for consideration for automation. After PoC, an organization can evolve automation to the pool of quadrant 1 and then quadrant 4.

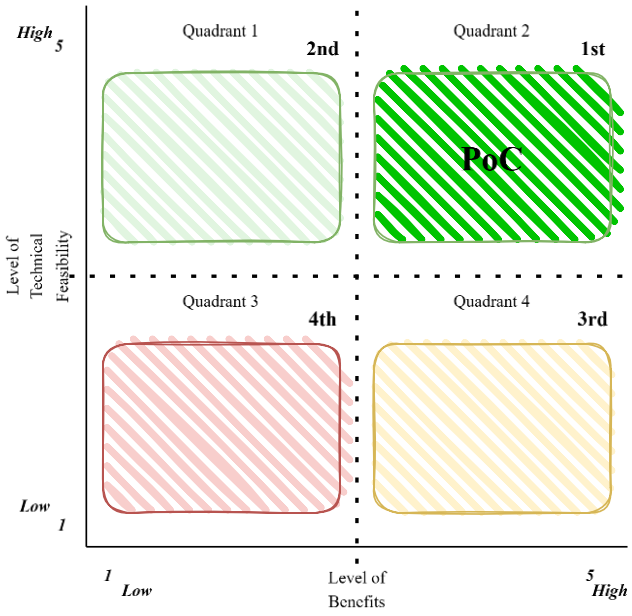

Figure 13. Matrix level of technical feasibility vs benefits

4-4-3- Checklist with Digital Characteristics for Automation

Checking if the process is ready to be input into an automation tool is the goal of activity *03* of this artifact (Figure 6). This activity includes the tool *checklist with the digital characteristics for automation* (Figure 14) to help in this verification. This tool, unlike the other two, is only a checklist, with responses of *Yes* or *No*.

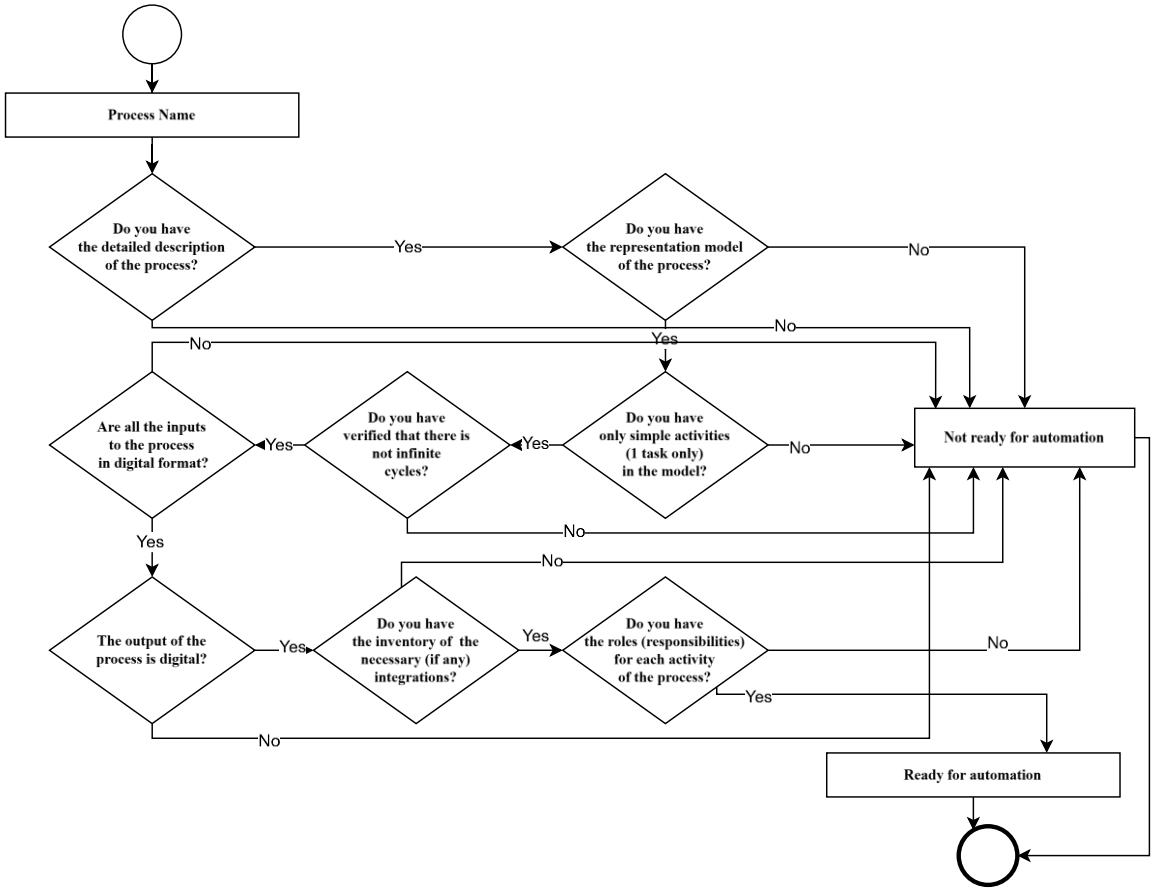

Figure 14. Checklist with digital characteristics for automation

The procedure of business automation goes to step *04. Automation Technology/Tool Selection* (Figure 3) if all 8 items have affirmative answers.

4-4-4- Matrix Processes Requirements vs. Technology

Believing that the organization has at least the PoC process ready to automate, the BPA procedure goes to step *04* (Figure 7). The outputs of this step are a list of process requirements and the automation technology.

According to the SLR from Moreira et al. [7], BPA can be implemented using a wide variety of technologies, depending on the process complexity and the organization's objectives. Automation can be done with a simple macro from Microsoft Excel. If the task requires interaction with Excel, Enterprise Resource Planning (ERP), and a website, for example, Robotic Process Automation (RPA) is the best choice [59]. The top three technologies for process automation are RPA, Intelligent or Cognitive Process Automation (IPA or CPA), and Workflow Manager/Business Process Management System (WfMS/BPMS), as listed in [7].

So, the tool *matrix processes requirements vs technology* will help SMEs decide if they need to adopt a tool with Artificial Intelligence (AI) features or not. Now, the imperative question: how do you choose the technology? According to [7], there is no direct response; however, there are important considerations that must be considered by authors like Costa et al. [48], Hofmann et al. [12], Martinek-Jaguszewska and Rogowski [60], Šperka & Halaška [61], Szelągowski [62], Wellmann et al. [63], Wewerka & Reichert [18].

There are at least four requirements of business processes that can help to decide if the organization needs AI features or not for their automation procedure: the *type of process*, the *level of standardization*, the *type of data*, and the *level of complexity*. The first step of the *matrix processes requirements vs technology* is to analyze the process by answering the following 4 questions (Figure 15), considering the requirements mentioned.

The second step is matching each answer in the matrix (Figure 16). If any response requires AI features, the organization has to adopt an automation tool with AI capabilities.

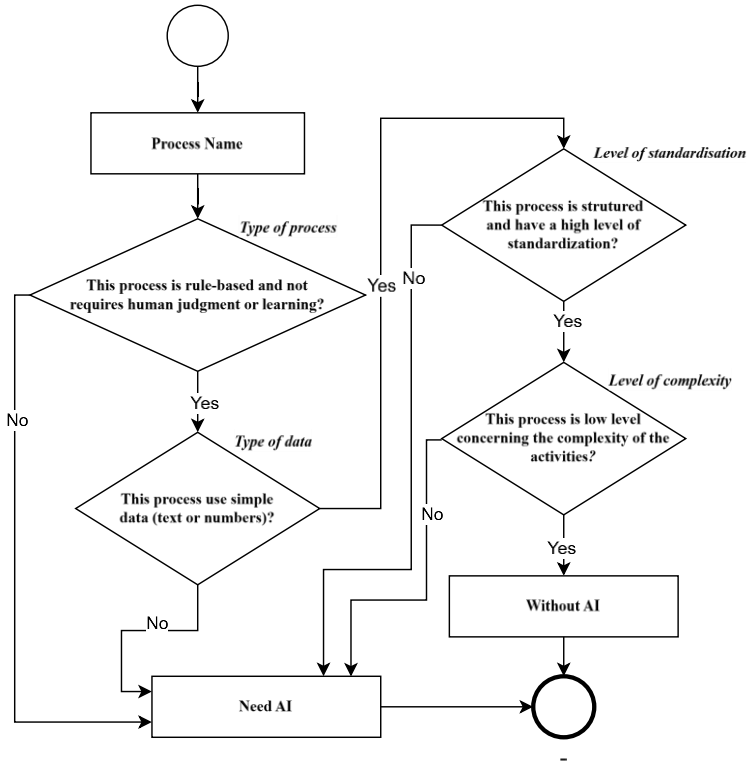

Figure 15. Checklist for choosing the type of technology

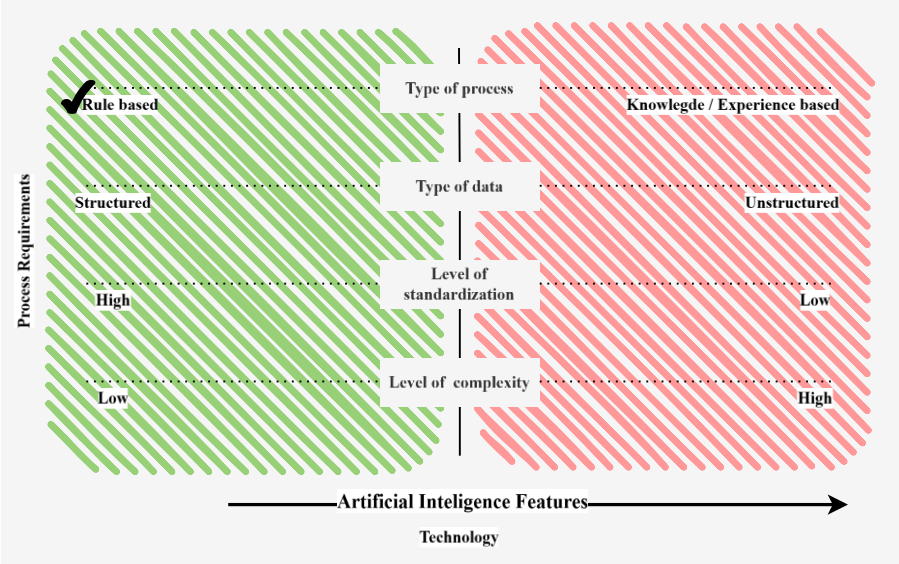

Figure 16. Matrix processes requirements vs technology

5- Demonstration of the Artifact

This chapter explains all the activities carried out in the demonstration. For the demonstration to the SMEs, a web page was developed with a client-server architecture and different profiles. Its development involved MySQL, PHP, HTML, and CSS. Each SME has its user area where it can interact with the artifact. We called M4BPA – Methodology for Business Process Automation to the artifact.

We also created a list of pre-requirements for SME selection: the organization has to be an SME (with 10 employees is a Micro, between 10 and 49 is a Small, and upper 50 to 250 is a medium-sized enterprise); SMEs must identify roles like Manager, Process Owner, and IT human resources (internal or external), because the artifact needed role; and the SME must have some implemented software that supports, at least, the financial area processes.

To perform the artifact's demonstration, we performed 7 activities that can be explained as listed above:

1. We sent an official email to an initial set of 25 SMEs, ***inviting*** them to participate in this study. In the e-mail, we informed that all the data will be anonymized and will involve 1 or 2 hours and the study of more than 2 administrative processes.
2. For those accepting the invitation, we arranged an ***introductory meeting*** where it was explained:
   - Introduction/awareness to the subject of business process automation;
   - The artifact (M4BPA) guidelines, tools, and goals;
   - Next demonstration steps.
3. Suppose the SME's management is still interested in taking part in the study. In that case, a longer meeting is then arranged to collect the characteristics of at least two administrative processes and to characterize the organization's environment (HR, use of digital tools, digital knowledge).
4. In the ***exploratory meeting***, the SME interlocutor ***uses the artifact (M4BPA)*** for each process.
5. Then, suppose the process is considered a candidate for automation. In that case, the SME considers automating it, and if it decides to go ahead, it collects at least one KPI for comparison after automation. If it cannot automate, the SME is left with a set of relevant information to put into practice in the future.
6. At the end of the process, there is a ***closing meeting*** where the artifact M4BPA output report is left, accompanied by some considerations for the procedure. The SME also comments on the study.
7. ***Feedback*** from the SME on the use of the artifact M4BPA is also collected.

5-1- Global results

The explained process was executed in all 25 invited SMEs, and the results are presented in this subchapter. We have divided it into two subsections: description of participants and artifact outputs.

5-1-1- Description of participants

Of 25 SMEs, 16 have accepted the challenge, which represents a rate of 64%. The final list of SMEs is summarized in Table 10. About 50 % of the SMEs are Small, 25% are Medium, and 25% are Micro. The participating SMEs belong to 11 different sectors of activity. Each of them has contributed to this demonstration with the number of processes that are listed in column *#processes*.

Table 10. List of participant SME

ID	Designation	Activity Sector	Employees	Type	#processes
01	SME A	Study Center	15	Small	4
02	SME B	IT Services	12	Small	4
03	SME C	Physiotherapy Center	8	Micro	3
04	SME D	Fitness Center	36	Small	5
05	SME E	IT Services	14	Small	4
06	SME F	IT Services	80	Medium	3
07	SME G	Optical Services	80	Medium	6
08	SME H	Decoration Services	6	Micro	3
09	SME I	Insurance Services	10	Small	7
10	SME J	Insurance Services	4	Micro	5
11	SME K	IT Services	60	Medium	3
12	SME L	Tattoo Supplies Retail	28	Small	3
13	SME M	Health Services	35	Small	5
14	SME N	Consulting/IT Services	122	Medium	3
15	SME O	Network Services	36	Small	2
16	SME P	IT Services	6	Micro	3

5-1-2- Artifacts Outputs

M4BPA was demonstrated in 16 SMEs involving a total of 63 processes studied, 22 of which were automated (Figure 17). Table 11 shows some of the numbers that this phase involved in terms of processes that are automatable, which still need attention before automation, and the type of technology the SME needs.

Table 11. Summary of the number of processes involved in the demonstration of the M4BPA

SME id	#processes	#candidates	#poc	#ready	#need ai	#no ai	#automated
SME A	4	4	3	3	1	2	1
SME B	4	4	4	4	2	2	1
SME C	3	2	2	0			
SME D	5	5	4	5		5	2
SME E	4	4	3	4	1	3	2
SME F	3	3	2	1		1	1
SME G	6	5	5	3		3	3
SME H	3	3	3	1	1		
SME I	7	7	6	6	1	5	3
SME J	5	5	4	4	1	3	3
SME K	3	3	1	1		1	1
SME L	3	3	2	0			
SME M	5	5	5	5		5	2
SME N	3	3	3	3	1	2	
SME O	2	2	2	1		1	1
SME P	3	2	2	2		2	2
Totals	**63**	**60**	**51**	**43**	**8**	**35**	**22**

Analyzing this summary of the total processes involved in the demonstration of the artifact, we can see that 4 SMEs did not automate any process: SME C, SME H, and SME L did not have processes digitally ready for automation, SME N for internal reasons of authorization and processes privacy, and SME H the need for AI features.

Of the 43 processes ready for automation, 8 need AI features, and 35 do not. Due to the lack of technological, budget, and human resources, the SMEs that had the most complex processes dropped their automation, at least in this demonstration moment. However, they were left with information that they considered important for making some innovations soon. By placing these numbers in the various phases of the artifact M4BPA, we observe the division of the processes, as shown in Figure 17.

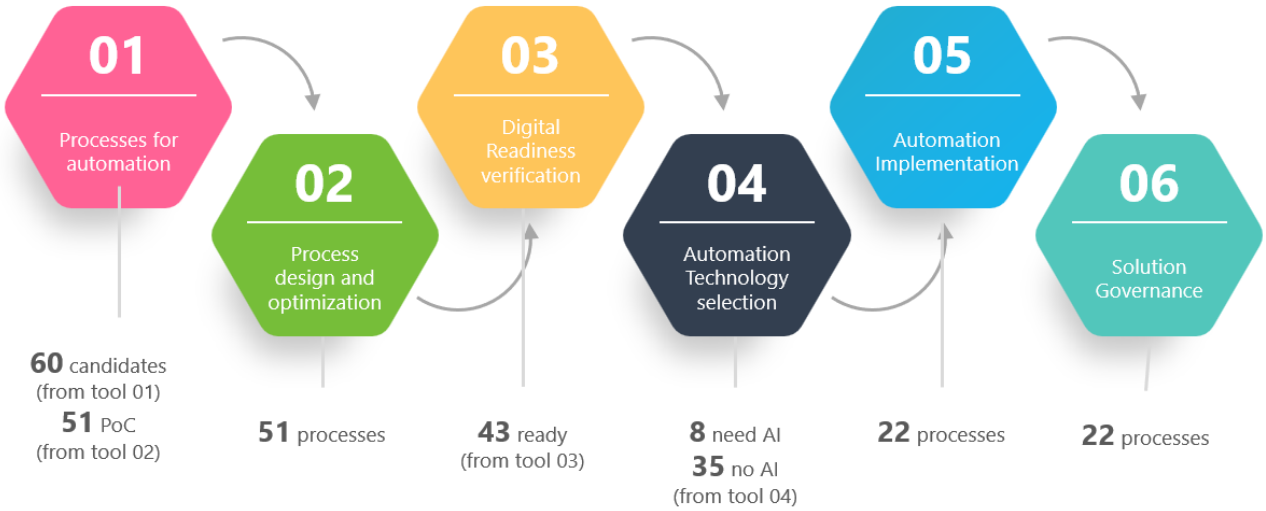

Figure 17. Number of processes for each M4BPA phase

Only three processes were considered by artifact tool 1 as not candidates for automation (output means equal to or greater than 3): C#P3, G#P5, and P#P2 (Table 12). Processes that were not normalized and with a high level of exceptions were considered. Sixty processes were considered candidates for automation. The minimum value of the output mean was 2.25. The maximum value of the output mean was 4.88, and the mean value of the 63 processes was 4.15.

Table 12. Output of tool 01 in activity 01

Proc	Repetitive	Rule-based	Normalized	Low Exceptions	Error-prone	Output mean	Candidate?
A#P1	4	5	3	3	5	4.25	Yes
A#P2	5	3	1	1	5	3.50	Yes
A#P3	4	5	5	4	4	4.38	Yes
A#P4	4	5	5	5	4	4.63	Yes
B#P1	5	5	5	4	4	4.13	Yes
B#P2	3	5	5	5	3	4.25	Yes
B#P3	5	5	4	4	5	4.63	Yes
B#P4	1	5	5	5	3	4.00	Yes
C#P1	4	5	4	5	5	4.50	Yes
C#P2	4	4	5	5	4	4.25	Yes
C#P3	*2*	*3*	*1*	*2*	*2*	*2.50*	*No*
D#P1	4	5	5	5	4	4.50	Yes
D#P2	5	5	5	5	5	4.88	Yes
D#P3	5	3	1	2	5	3.50	Yes
D#P4	5	5	5	5	5	4.75	Yes
D#P5	5	5	5	5	5	4.75	Yes
E#P1	5	5	5	5	4	4.75	Yes
E#P2	5	3	1	1	4	3.50	Yes
E#P3	3	5	5	5	5	4.50	Yes
E#P4	3	5	5	5	5	4.75	Yes
F#P1	5	5	3	3	5	4.13	Yes
F#P2	5	3	3	3	5	3.75	Yes
F#P3	5	5	5	3	5	4.25	Yes
G#P1	5	5	3	5	5	4.50	Yes
G#P2	5	2	2	2	5	3.50	Yes
G#P3	3	5	5	5	5	4.25	Yes
G#P4	5	3	2	2	5	4.00	Yes
G#P5	*3*	*2*	*2*	*2*	*2*	*2.25*	*No*
G#P6	3	5	5	5	5	4.75	Yes
H#P1	5	5	3	3	5	4.25	Yes
H#P2	5	5	3	3	5	4.13	Yes
H#P3	5	5	4	3	5	4.38	Yes
I#P1	5	3	2	2	5	3.75	Yes
I#P2	5	5	5	3	5	4.25	Yes
I#P3	5	5	5	5	5	4.63	Yes
I#P4	5	3	3	5	5	4.50	Yes
I#P5	5	5	3	5	5	4.50	Yes
I#P6	5	5	3	5	5	4.50	Yes
I#P7	3	5	5	5	5	4.38	Yes
J#P1	5	5	5	5	5	4.75	Yes
J#P2	5	5	5	5	5	4.75	Yes
J#P3	5	2	2	2	3	3.50	Yes
J#P4	5	3	2	2	5	3.75	Yes
J#P5	5	5	5	5	5	4.75	Yes
K#P1	5	5	5	3	4	4.63	Yes
K#P2	5	4	3	3	5	3.63	Yes
K#P3	5	3	1	1	3	3.13	Yes
L#P1	2	3	1	1	5	3.00	Yes
L#P2	5	5	3	3	5	4.00	Yes
L#P3	5	3	3	3	5	3.38	Yes

Proc	Repetitive	Rule-based	Normalized	Low Exceptions	Error-prone	Output mean	Candidate?
M#P1	5	4	4	5	5	4.38	Yes
M#P2	3	4	5	5	5	4.50	Yes
M#P3	3	5	5	3	5	4.38	Yes
M#P4	5	5	5	5	5	4.75	Yes
M#P5	5	5	5	5	4	4.75	Yes
N#P1	5	5	5	5	2	4.38	Yes
N#P2	3	5	5	3	3	4.13	Yes
N#P3	4	2	2	2	4	3.13	Yes
O#P1	4	5	5	5	4	4.50	Yes
O#P2	5	5	5	5	4	4.25	Yes
P#P1	5	4	5	5	4	4.25	Yes
P#P2	*5*	*1*	*2*	*2*	*4*	*2.88*	*No*
P#P3	5	4	5	5	4	4.38	Yes

The results of the PoC tests carried out on the 60 processes of the 16 SMEs show that almost all of them can be considered PoC. Around 85% of the processes that are candidates for automation are PoC and, therefore, belong to Quadrant 2 of tool 02 (see Table 13). About 85% of the candidates for automation processes are considered by SMEs designed and optimized (see Table 13), F#P1, G#P2, G#P4, I#P1, J#P4, K#P2, K#P3, and L#P1.

Table 13. Output of tool 02 in activity 01

Proc	Technical feasibility	Benefits in automation	Quadrant	PoC?	Proc	Technical feasibility	Benefits in automation	Quadrant	PoC?
A#P1	3.50	4.00	Q02	Yes	I#P1	2.25	4.50	Q04	No
A#P2	1.75	4.75	Q04	No	I#P2	3.50	4.50	Q02	Yes
A#P3	4.75	4.00	Q02	Yes	I#P3	5.00	4.50	Q02	Yes
A#P4	5.00	4.00	Q02	Yes	I#P4	3.50	4.50	Q02	Yes
B#P1	4.75	3.50	Q02	Yes	I#P5	3.75	4.50	Q02	Yes
B#P2	5.00	4.50	Q02	Yes	I#P6	3.75	4.50	Q02	Yes
B#P3	2.50	4.50	Q02	Yes	I#P7	5.00	4.50	Q02	Yes
B#P4	4.25	4.00	Q02	Yes	J#P1	5.00	4.50	Q02	Yes
C#P1	4.25	4.00	Q02	Yes	J#P2	5.00	4.50	Q02	Yes
C#P2	5.00	4.00	Q02	Yes	J#P3	2.75	4.75	Q02	Yes
D#P1	5.00	4.50	Q02	Yes	J#P4	2.25	4.50	Q04	No
D#P2	5.00	5.00	Q02	Yes	J#P5	5.00	5.00	Q02	Yes
D#P3	2.00	4.50	Q04	No	K#P1	4.00	4.25	Q02	Yes
D#P4	4.50	4.25	Q02	Yes	K#P2	2.25	4.50	Q04	No
D#P5	4.50	4.75	Q02	Yes	K#P3	1.75	4.25	Q04	No
E#P1	5.00	4.75	Q02	Yes	L#P1	1.25	3.75	Q04	No
E#P2	1.75	4.50	Q04	No	L#P2	2.75	4.50	Q02	Yes
E#P3	5.00	4.00	Q02	Yes	L#P3	2.50	4.25	Q02	Yes
E#P4	4.00	4.00	Q02	Yes	M#P1	4.50	4.75	Q02	Yes
F#P1	2.75	4.00	Q02	Yes	M#P2	3.75	3.75	Q02	Yes
F#P2	1.75	5.00	Q04	No	M#P3	4.50	3.75	Q02	Yes
F#P3	5.00	4.00	Q02	Yes	M#P4	5.00	4.50	Q02	Yes
G#P1	4.50	4.50	Q02	Yes	M#P5	5.00	4.50	Q02	Yes
G#P2	2.75	4.50	Q02	Yes	N#P1	4.50	4.50	Q02	Yes
G#P3	5.00	3.75	Q02	Yes	N#P2	4.25	3.75	Q02	Yes
G#P4	3.00	4.50	Q02	Yes	N#P3	3.00	4.00	Q02	Yes
G#P6	5.00	4.50	Q02	Yes	O#P1	4.00	4.25	Q02	Yes
H#P1	3.00	4.50	Q02	Yes	O#P2	3.75	4.50	Q02	Yes
H#P2	3.50	4.25	Q02	Yes	P#P1	4.25	4.50	Q02	Yes
H#P3	2.50	4.50	Q02	Yes	P#P3	3.75	4.50	Q02	Yes

About 84% of the optimized processes are considered by SMEs as ready for automation. The 8 processes that cannot go to activity 4 are C#P1, C#P2, F#P2, H#P1, H#P2, L#P2, L#P3, and O#P2. The characteristic or factor that contributed most to the digital non-readiness of the process for automation was *digital input*. These 8 processes still have physical support, and this is not convenient for automation. Note that SME C and SME L can't continue with the study of their processes, as they don't have any ready for automation.

From the results of tool 04 from the artifact M4BPA, we can conclude that only 8 of the 43 ready processes for automation need AI features for their automation (Figure 18). In Figure 19, SME C and SME L are represented with 0 processes because none of them had processes ready for automation. The processes that need AI features to fulfill their automation belong to SME A (A#P1), SME B (B#P3, B#P4), SME E (E#P2), SME H (H#P3), SME I (I#P2), SME J (J#P3), and SME N (N#P3).

Of the 43 processes that could be automated, 22 were automated, around 51%. The SMEs participating in the demonstration were not open to automation with AI features, so 8 processes were left for the future. Of the 35 processes that the artifact considered could be automated without the use of AI, 22 were automated, around 63%. This automation involved developing bots (using the SME's resources), making auxiliary Excel files with bots and Excel macros, training HR in the functionalities of some of their applications (not knowing the mechanisms for automating tasks), setting up cron tasks, and developing small PHP scripts.

Automation Technology Selection (Activity 04 - tool04)			
	(without AI)	*Technology*	(with AI)
Process Requirements	***Rule-based*** A#P1; A#P3; A#P4; B#P1; B#P2; B#P4; D#P1; D#P2; D#P3; D#P4; D#P5; E#P1; E#P3; E#P4; F#P3; G#P1; G#P3; G#P6; I#P2; I#P3; I#P4; I#P5; I#P6; I#P7; J#P1; J#P2; J#P3; J#P5; K#P1; M#P1; M#P2; M#P3; M#P4; M#P5; N#P1; N#P2; O#P1; P#P1; P#P3	***Type of process***	***Knowledge/Experience-based*** B#P3; E#P2; H#P3; N#P3
	Structured A#P3; A#P4; B#P1; B#P2; D#P1; D#P2; D#P3; D#P4; D#P5; E#P1; E#P3; E#P4; F#P3; G#P1; G#P3; G#P6; H#P3; I#P3; I#P4; I#P5; I#P6; I#P7; J#P1; J#P2; J#P5; K#P1; M#P1; M#P2; M#P3; M#P4; M#P5; N#P1; N#P2; N#P3; O#P1; P#P1; P#P3	***Type of data***	***Unstructured*** A#P1; B#P3; B#P4; E#P2; I#P2; J#P3
	High A#P1; A#P3; A#P4; B#P1; B#P2; B#P3; B#P4; D#P1; D#P2; D#P3; D#P4; D#P5; E#P1; E#P3; E#P4; F#P3; G#P1; G#P3; G#P6; H#P3; I#P2; I#P3; I#P4; I#P5; I#P6; I#P7; J#P1; J#P2; J#P5; K#P1; M#P1; M#P2; M#P3; M#P4; M#P5; N#P1; N#P2; O#P1; P#P1; P#P3	***Level of standardization***	***Low*** E#P2; J#P3; N#P3
	Low A#P1; A#P3; A#P4; B#P1; B#P2; B#P3; B#P4; D#P1; D#P2; D#P3; D#P4; D#P5; E#P1; E#P2; E#P3; E#P4; F#P3; G#P1; G#P3; G#P6; H#P3; I#P2; I#P3; I#P4; I#P5; I#P6; I#P7; J#P1; J#P2; J#P3; J#P5; K#P1; M#P1; M#P2; M#P3; M#P4; M#P5; N#P1; N#P2; O#P1; P#P1; P#P3	***Level of complexity***	***High*** N#P3

Figure 18. Output of tool 04 in activity 04

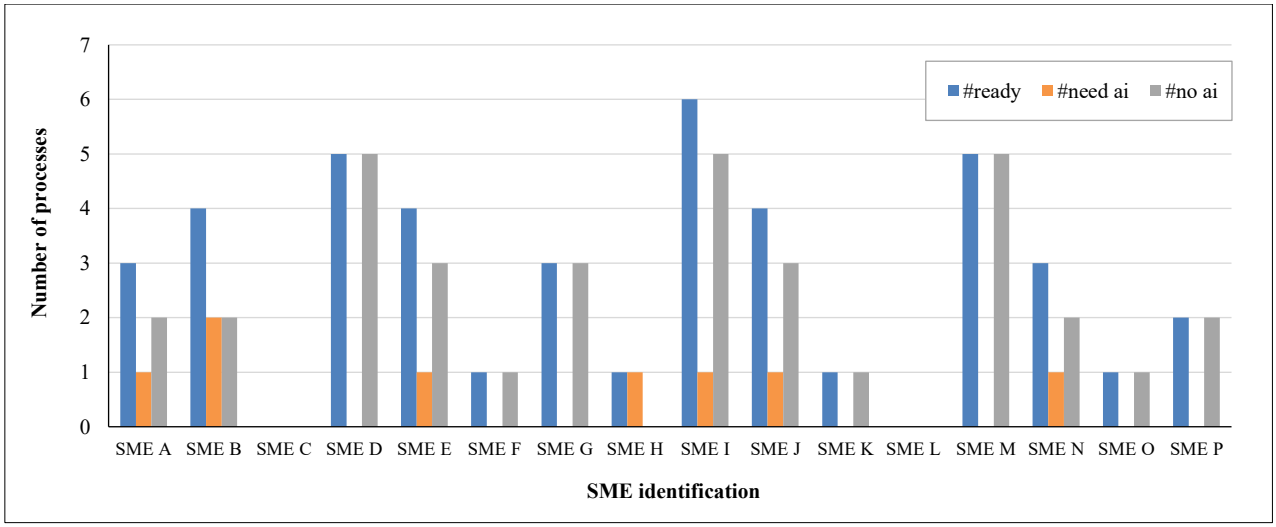

Figure 19. Distribution of processes and their technology for automation per SME

In the following paragraphs, we describe some of the findings that the SMEs made in this demonstration regarding the tasks and documentation mentioned in the design of activity 06.

In general, in SMEs where process automation has taken place, there has always been concern about involving HR in the procedure (as the M4BPA artifact shows). HR was involved in the design of the process and the testing and validation of the process automated. SMEs had trained their HR. With this involvement, there was no resistance to changing the way the process was carried out.

The interlocutor of SME H showed discouragement in applying automation or adopting IT systems to bring innovation to the SME due to the resistance of its current HR. But at the same time, he asked us about the next steps and whether we could help the company a little in this regard. Our answer was a big yes.

Regarding the security and privacy of data, SMEs have not forgotten these items. Concerning the results provided by the artifact M4BPA, in some SMEs, they were the validation or confirmation of the knowledge already existing in the organization about the processes, for example, SME A, SME B, SME D, SME E, SME F, SME G, SME K, SME L, SME N, SME O, and SME P. In SMEs that were not so comfortable with the topic, the results were viewed with attention with some willingness to change.

This demonstration procedure in SMEC was a little more complex, as they were not aware of the area of BPA. We would venture to say that we felt a lot of resistance to the subject. However, by the end of the demonstration process, the SME was already showing some willingness to invest a little more time in learning these new concepts. They were alerted to the difficulties they might encounter along the way. Awareness-raising was also carried out to involve the human resources department, which knows the process.

SME K calls our attention to the importance of the governance plan and the evaluation of the solution. They remember that factor cycling is very important in this type of procedure because, in the next iteration, we can reflect on the lessons learned before. SME L knows that it is important to have a plan of communication and change management in the organization.

SME N decided not to automate any process because of their internal politics. However, they validate the importance of these guidelines and tools. They support the theme of involving HR in the procedure and the existence of communication, change management, and governance plans in the organization. They also congrats on the idea of demonstrating M4BPA in SMEs instead of large enterprises, who, at the outset, have other opportunities and resources that the little ones don't have.

Since the automated process in SME O involves more than one sector in the SME, the company took care to communicate the change in the way the process is handled.

5-2- Detailed Results

In the following subsections, we describe in more detail the results from one SME that the artifact returned. The phases and tools that form the artifact guide the explanation. We will use a codification to refer to the processes of a particular company. For example, B#P1 refers to process number 1 of SME B.

5-2-1- Artifact Activity 01 Results (SME B)

Artifact activity *01* principals' tasks are to verify the scenario as-is and to-be, choose processes to automate and choose a process for PoC. So, the first step is to identify and describe the processes (Table 14) that SME B gave us to study and fulfill the artifact demonstration.

Table 14. Description of the participants' processes

Proc.	Description
	Request product support
B#P1	The SME receives support requests for a product via telephone and email. These requests are interpreted through use cases or directed to external outsourcing companies. The JIRA platform is used to manually register and route the ticket to a specific employee according to the case. This routing and mapping is done manually. What the SME said they would like to see automated was only (and they emphasized this well) the routing of the ticket within JIRA.
	Booking holidays
B#P2	According to the SME, it's a process in which the employee fills in a form, and then their manager checks and validates it. However, this process is difficult, which, in some cases, causes collisions, such as checking the distribution of holidays among team members for the various projects. This difficulty is also seen when an employee changes their vacation period. This manual process is extremely time-consuming and has a high error rate. Sometimes, due to the need to manually check the employee's project and team involvement, leave is booked after the legal deadline.
	Receive invoices via e-mail and catalog and integrate them into the SME system
B#P3	The SME receives almost all invoices via email. When it receives an invoice, its type is checked, and its origin is validated. Then, the amount and payment deadline are calculated. This data is booked in an Excel sheet and then sent to the customer accounts in the SME's invoicing system. This process is carried out manually, and when the SME decides to do this task, it takes up to 3 working days (adding up all the time spent over a month). The SME sees an opportunity in the automation of this process.
	Absence justification
B#P4	When an employee is absent from work, they must justify their absence by filling out the appropriate form and attaching proof of their absence. Their manager analyzes the excuse and may accept it or not. If the excuse is accepted (so far, all justifications have been accepted), he or she will inform the payroll department of the situation. This process of validating and forwarding information is all done manually. Although this process doesn't happen very often, it can be overwhelming. The SME sees automation as an opportunity for great improvement and wishes to integrate email document scanning, email, and the payroll system.

The next step was to characterize the process according to the characteristics classified as important for automation to be successful during SLR. To do this, SME B used the first tool *checklist with the characteristics of candidates for automation*. We have taken some outputs from the tool (Table 15) and the result of checking whether the process is a candidate for automation (Output mean column). If the average is equal to or greater than 3, the process is considered a candidate for automation.

Table 15. Output of tool 01 in activity 01

Proc.	Candidate for automation (Activity 01 - tool01)						
	Repetitive	Rule-based	Normalized	Low Exceptions	Error-prone	Output mean	Candidate?
B#P1	5	5	5	4	4	4.13	Yes
B#P2	3	5	5	5	3	4.25	Yes
B#P3	5	5	4	4	5	4.63	Yes
B#P4	1	5	5	5	3	4.00	Yes

After this first verification, and since our artifact suggests the use of PoC as a strategy for starting the BPA procedure, the task of prioritizing the processes to be automated follows. SME B used our second tool - *the method to choose PoC* - to do this task (gives the output quadrant, as we can see in the next table).

Table 16. Output of tool 02 in activity 01

Proc.	PoC (Activity 01 – tool02)			
	Technical feasibility	Benefits in automation	Quadrant	PoC?
B#P1	4.75	3.50	Q02	Yes
B#P2	5.00	4.50	Q02	Yes
B#P3	2.50	4.50	Q02	Yes
B#P4	4.25	4.00	Q02	Yes

5-2-2- Artifact Activity 02 Results (SME B)

Artifact activity *02* involves the process and management team. There are also three tasks: break down processes in detail, design the process, and analyze and optimize the process. In this phase, the optimization of the 4 processes in the artifact was verified (Table 17), and a set of KPIs for processes was also made (this subject will be explored in the explanation of activity 06). I will not forget the back-office work of studying and optimizing the process.

Table 17. Verification of the design and optimization of all processes candidates for automation (activity 02)

Proc.	Designed & optimized
B#P1	Yes
B#P2	Yes
B#P3	Yes
B#P4	Yes

5-2-3- Artifact Activity 03 Results (SME B)

Artifact activity *03* verification involves the verification of the digital characteristics of the process for automation. SME B used tool 03. We have taken some outputs from the tool (Table 18) and the final result of checking whether or not the process is ready for automation (Output with Ready columns).

Table 18: Output of tool 03 in activity 03

Proc	Digital Readiness for Automation (Activity 03 - tool03)					
	Described	Digital input	Integration inventory	Roles	Output	Ready?
B#P1	1	1	1	1	1	Yes
B#P2	1	1	1	1	1	Yes
B#P3	1	1	1	1	1	Yes
B#P4	1	1	1	1	1	Yes

5-2-4- Artifact Activity 04 Results (SME B)

Artifact activity *04* involves the verification of the requirements of the process and the features of the AI technology. In this activity, the SME must involve the process, management, and IT team. With only 4 verifications, artifact M4BPA helps to verify what type of technology is more suitable for your automation procedure. These four verifications were concluded, also through the results obtained by SLR. To do this, we have developed the last tool, the 04 matrix process requirements vs technology. The results of SME B are in Table 19.

Table 19: Output of tool 04 in activity 04

Automation Technology Selection (Activity 04 - tool04)			
	(without AI)	***Technology***	**(with AI)**
Process Requirements	***Rule-based*** B#P1; B#P2; B#P4;	***Type of process***	***Knowledge/Experience-based*** B#P3;
	Structured B#P1; B#P2;	***Type of data***	***Unstructured*** B#P3; B#P4;
	High B#P1; B#P2; B#P3; B#P4;	***Level of standardization***	***Low***
	Low B#P1; B#P2; B#P3; B#P4;	***Level of complexity***	***High***

From the results of tool 04 from the artifact M4BPA, we can conclude that 2 of the 4 ready processes for automation need AI features for their automation.

5-2-5- Artifact Activity 05 Results (SME B)

Artifact activity *05* involves the implementation of the automation itself. In this activity, SME B was involved in the process, management, and IT team. A set of tasks has to be performed as described in the artifact description (Figure 8).

The artifact M4BPA essentially plays an auxiliary role by reminding teams that it is necessary to test the process automated and give training to the human resources. In this activity, the SMEs answered two questions with No or Yes: if the SMEs had already tested the process after automation if it was okay, and if the SMEs had given training to HR in the automated process.

Table 20 summarizes the type of technology needed to automate each process, the training of HR, and the automation status. This SME, if they want to automate all 4 processes, will need a tool with AI features for the processes B#P3 and B#P4. After learning that 2 processes could be automated without the use of AI, the SME decided to go ahead with the automation of process B#P1 using features of JIRA. As the SME is an organization that develops automation solutions, the results from M4BPA were not new but validated. Shortly, SME B will move towards automating the process B#P2.

Table 20. Artefact M4BPA output from activity 05

Automation implementation (Activity 05)			
Proc.	**Tech.**	**Tested &HR training**	**Automated**
B#P1	No AI	Yes	Yes
B#P2	No AI		
B#P3	Need AI		
B#P4	Need AI		

5-2-6- Artifact Activity 06 Results (SME B)

Artifact activity *06* involves process, management, and IT teams. A set of tasks has to be performed, as mentioned in Figure 9. The artifact M4BPA essentially plays an auxiliary role by reminding teams that it is necessary to analyze the solution and produce at least a dashboard with the comparison of before (from activity 02) and after automation KPIs, the security report, and the plan of upscaling. This artifact helps to collect the values of after-automation KPIs for each process through a form.

To validate the success of the automation of the processes, 1 KPI was collected, as shown in the Table 21. Table 21 shows the values before and after the implementation of automation of the process P1.

Table 21. Summary of all KPIs process

Proc.	KPI	Value before automation	Value after automation
B#P1	Execution time	3 min	2 min

In the following paragraphs, we describe some of the findings that the SME made in this demonstration regarding the tasks and documentation mentioned in the design of activity 06.

There has been concern about involving Human Resources (HR) in the procedure (as the M4BPA artifact shows). HR was involved in the design of the process and the testing and validation of the process automated. SME had trained their HR. With this involvement, there was no resistance to changing the way the process was carried out. Regarding the security and privacy of data, SME B did not forget these items. Concerning the results provided by the artifact M4BPA, in SME B, they validate or confirm the knowledge already existing in the organization about the processes.

SME calls our attention to the importance of the governance plan and the evaluation of the solution. They remember that factor cycling is very important in this type of procedure because, in the next iteration, we can reflect on the lessons learned before. Also, it is important to have a plan of communication and change management in the organization.

The final state of the 4 processes that SME B gave us to demonstrate the artifact M4BPA is represented in the Figure 20.

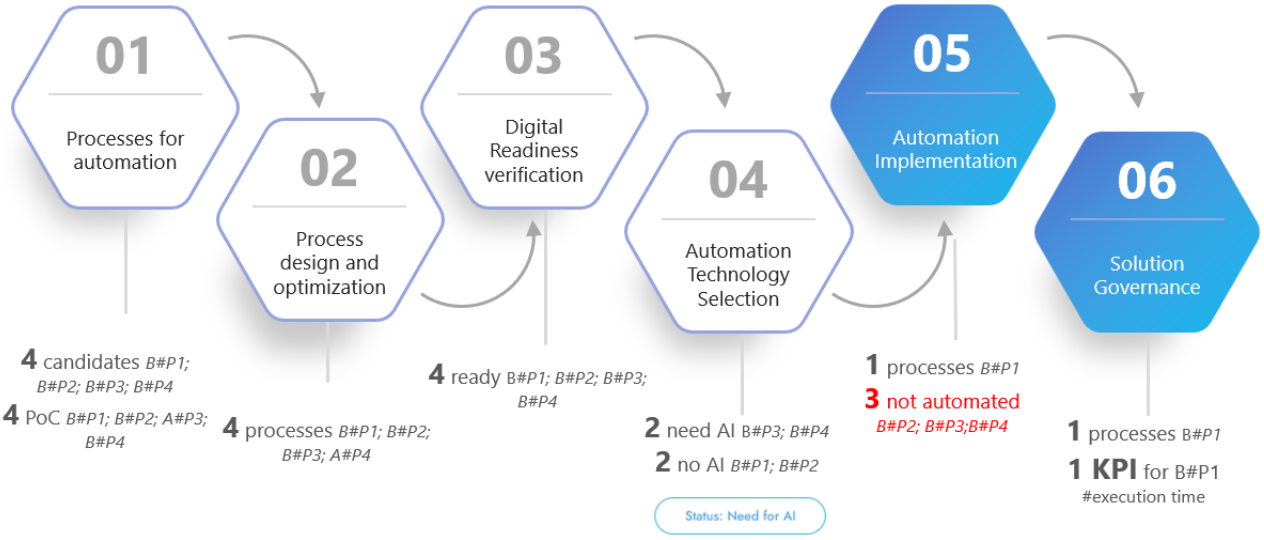

Figure 20. State of all 4 SME B processes in the M4BPA activities

5-3- Discussion

The questionnaire consisted of 11 closed questions, using the Likert scale (with 5 possible answer values) and 1 open question (Figure 21). This questionnaire covered aspects such as the importance of including HR in the BPA procedure, the relevance of the plans that support the methodology, the relevance of the existence of support tools, the correctness of the sequence of activities and their tasks, ease of use, the relevance of the results and their use for the SME. The questions were inspired by some demonstration criteria from Tuunanen et al. [64]: ease of use, effectiveness, and coherency.

From the analysis of the answers to the feedback questionnaire left with the SMEs in step 7 of the demonstration, with the reactions collected during the meetings, in general, we can mention that the results regarding the use of the M4BPA artifact were quite positive. All the participants SMEs in the demonstration have answered the feedback questionnaire, as shown in Figure 22. 16 SMEs with a mean value of all answers of 4.72 of a maximum of 5.

In this research, there was not one SME that devalued the role of HR. There were reports that HR had previously made it impossible to automate administrative business processes and even prevented innovation and the use of new technologies. Concerning the need for communication plans, change management, and solution governance, there have already been notes of novelty or that they were already used without calling them that. Sometimes, "*we do it, but we don't know we're doing it*" was the phrase we heard.

There were no SMEs that detected a different order for the steps performed in the M4BPA demonstration, even those that deal with the development of automation solutions. They welcomed the existence of tools to help SMEs interpret the guidelines in the M4BPA.

This research proved that to automate a process, it has to be properly standardized. On the SME side, it has to correctly select the best case to be PoC (a bad choice could mean the procedure fails, either because it doesn't have buy-in or because it's too complex to transform), it has to prioritize activities, establish project and process responsibilities, and continuously monitor the results of changing the way of working.

#	Questions	NA	N	M	Y	C
1	By analyzing the methodology through the descriptions on the website, did you become aware of the necessary involvement of HR in the BPA procedure?	1	2	3	4	5
2	Did you think it was relevant to have notes related to the plans for changing the work paradigm (communication, change management, and governance)?	1	2	3	4	5
3	Did you find the sequence of activities and tasks in the M4BPA correct?	1	2	3	4	5
4	When adopting the M4BPA, did you find it convenient to have the support tools?	1	2	3	4	5
5	Have you received information about the status of your processes, whether they are ready for automation or not, that you didn't know before?	1	2	3	4	5
6	With M4BPA, was it easy to find the processes that you can automate?	1	2	3	4	5
7	Was it convenient to have the PoC discovery tool?	1	2	3	4	5
8	Do you consider that M4BPA was relevant to choosing the type of technology needed for your BPA procedure?	1	2	3	4	5
9	Do you think that the results obtained through the M4BPA will be a solid basis for an automation procedure?	1	2	3	4	5
10	Would you use M4BPA again?	1	2	3	4	5
11	Would you recommend M4BPA to other SMEs with doubts about their BPA procedure?	1	2	3	4	5
12	Please feel free to leave a comment/suggestion for the M4BPA (activities, tasks, tools, guidelines).	Open question				
	NA – Not al all; N – No; M – Maybe; Y – Yes; C – Completely					

Figure 21. SMEs questionnaire from the demonstration phase

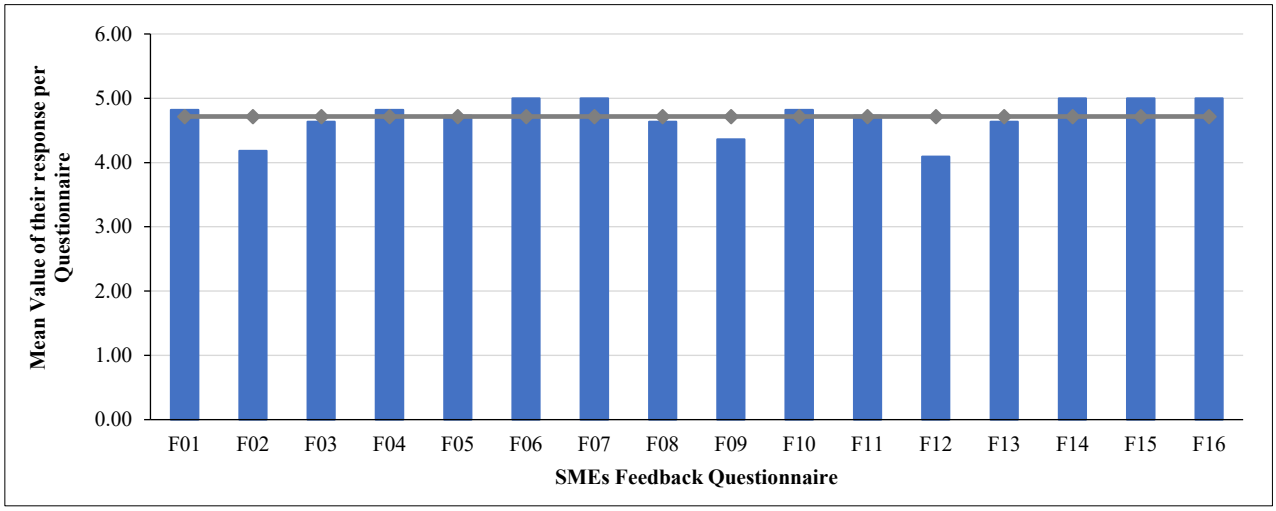

Figure 22. Representation of the mean value of each questionnaire and the overall mean value

6- Conclusions

The artifact M4BPA was created following a three-step investigation (Figure 1). In step 1, the results of an SLR [7] were used to verify the existing gaps in the BPA area, the existing artifacts that can serve in BPA procedure, the characteristics that processes must be considered as candidates for automation, the main existing tools and/or technologies, and the negative and positive factors that influence BPA in an SME.

With the results from the background research (step 1), we set out to design the solution - Solution Proposal (step 2). Our proposal began with the requirements and then the design, including all the phases, activities, tasks, and tools. Besides those constituents, we also include in the proposal the identification of the principal stakeholders and 3 plans that, in our opinion, must exist in a BPA procedure.

In the last step, the demonstration, we designed a set of activities for this phase. We described the 16 participants' SMEs and exposed the global results, as well as a detailed one from SME B.

In the demonstration of SMEs, the pillar of Human Resources was noted as important in this kind of procedure for all SMEs. The three plans existent in M4BPA – communication, change management, and solution governance -were received in some SMEs as a novelty and in others as a recall. No SMEs reported missing or out-of-order activities in the procedure. The existence of tools to support the application of the methodology (guidelines) was seen as a good innovation and was of great interest.

Finally, we would like to leave a general comment on what we found on the ground. There are still many organizations that don't have a management plan, don't have their processes documented or managed with some BPM support, and don't have human resources capable of dedicating themselves to these issues (unless they outsource or the larger ones have multidisciplinary IT teams). The role of human resources in the success or failure of a procedure to change the work paradigm is notorious. It is a pillar of the company that must not be forgotten.

There is still a lot of digital illiteracy in the area of automating administrative business processes. The meetings that took place during this demonstration showed this desire for more knowledge and more opportunities to improve without spending a lot of resources (which they sometimes don't have). Only one SME showed a lack of interest in learning more about the topic. For the most part, contacts were made to continue exchanging knowledge. We took advantage of the closing meeting to advise SMEs, which have shown difficulties in obtaining resources in this area, to check out existing programs that encourage the use of digital transformation and innovation.

6-1- Barriers

The first obstacle we faced was the SME accepting the invitation and overcoming the mistrust they showed when it came to business process automation. Our e-mail made it clear that the data would be anonymous, and even so, there were companies that did not believe in this anonymity and did not go ahead. Others showed a lack of knowledge about the subject and an unwillingness to get more involved with technology. Others accepted, but the next steps were a bit of a chore.

The second obstacle was getting in touch with the right person to have general knowledge about the company (administrator profile), about the processes (process owner or expert profile), and finally about the current state of its IT park (IT knowledge). This obstacle was overcome with informal conversations to try to find the best contact. Once contact had been made, an introductory meeting was arranged to explain the procedure and the M4BPA.

The third major obstacle was to get SMEs to follow M4BPA through to the last stage (solution governance), overcoming the inertia that 'if it's working, we won't change it. There have been situations where the SME wanted to change its processes but did not have the financial means to find the best solution. As you can see, the processes that were automated as part of this demonstration were through tools without AI, free of charge, or already existing in the organization.

6-2- Future Research

After collecting the outputs of this demonstration, it is now important to continue validating the artifact and its results. We will plan and convene a focus group with at least 8 participants. We will be looking for these participants to be from areas related to business management and/or business process automation projects (from the administrative area) so that the feedback collected can have meaning and weight in the analysis of the artifact.

After this validation, we intend also make a set of didactic and explaining material to foment literacy in the BPA area and make it possible for every SME (with or without IT staff).

7- Declarations

7-1- Author Contributions

Conceptualization, S.M., H.S.M., and A.S.; methodology, H.S.M. and A.S.; software, S.M.; validation, S.M., H.S.M., and A.S.; formal analysis, S.M.; investigation, S.M.; resources, S.M.; data curation, S.M.; writing—original draft preparation, S.M., H.S.M., and A.S.; writing—review and editing, H.S.M. and A.S.; visualization, S.M.; supervision, H.S.M. and A.S.; project administration, H.S.M.; funding acquisition, H.S.M. All authors have read and agreed to the published version of the manuscript.

7-2- Data Availability Statement

Data sharing is not applicable to this article.

7-3- Funding

This work is financed by National Funds through the Portuguese funding agency, FCT - Fundação para a Ciência e a Tecnologia, within project LA/P/0063/2020. doi:10.54499/LA/P/0063/2020.

7-4- Acknowledgements

The authors want to acknowledge all the support given by INESC TEC and, in particular the HumanISE center, to this research.

7-5- Institutional Review Board Statement

Not applicable.

7-6- Informed Consent Statement

Not applicable.

7-7- Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancies have been completely observed by the authors.

8- References

[1] Zaoui, F., & Souissi, N. (2020). Roadmap for digital transformation: A literature review. Procedia Computer Science, 175, 621–628. doi:10.1016/j.procs.2020.07.090.

[2] Gartner. (2020). Gartner says worldwide robotic process automation software revenue to reach nearly $2 billion in 2021. Newsroom – Press Releases. Available online: https://www.gartner.com/en/newsroom/press-releases/2020-09-21-gartner-says-worldwide-robotic-process-automation-software-revenue-to-reach-nearly-2-billion-in-2021 (accessed on May 2025).

[3] Statista. (2021). SMEs in Europe – Statistics & facts. Statista Research Department, Hamburg, Germany. Available online: https://www.statista.com/statistics/1254442/digitalization-adoption-among-eu-smes/ (accessed on May 2025).

[4] IBM. (2025). RPA is essential for small and midsized enterprises to gain a competitive advantage. Available online: https://www.techtarget.com/searchcio/robotic-process-automation/RPA-Is-Essential-for-Small-and-Midsized-Enterprises-to-Gain-a-Competitive-Advantage (accessed on May 2025).

[5] Schlegel, D., Rosenberg, B., Fundanovic, O., & Kraus, P. (2024). How to conduct successful business process automation projects? An analysis of key factors in the context of robotic process automation. Business Process Management Journal, 30(8), 99–119. doi:10.1108/bpmj-06-2023-0465.

[6] Stravinskienė, I., & Serafinas, D. (2021). Process management and robotic process automation: The insights from systematic literature review. Management of Organizations: Systematic Research, 85(1), 87–106. doi:10.1515/mosr-2021-0006.

[7] Moreira, S., Mamede, H. S., & Santos, A. (2024). Business process automation in SMEs: A systematic literature review. IEEE Access, 12, 75832–75864. doi:10.1109/ACCESS.2024.3406548.

[8] Mishra, S., Sree Devi, K. K., & Badri Narayanan, M. K. (2019). People & process dimensions of automation in business process management industry. International Journal of Engineering and Advanced Technology, 8(6), 2465–2472. doi:10.35940/ijeat.F8555.088619.

[9] Ahmad, T., & Van Looy, A. (2020). Business process management and digital innovations: A systematic literature review. Sustainability, 12(17), 6827. doi:10.3390/su12176827.

[10] Enriquez, J. G., Jimenez-Ramirez, A., Dominguez-Mayo, F. J., & Garcia-Garcia, J. A. (2020). Robotic process automation: A scientific and industrial systematic mapping study. IEEE Access, 8, 39113–39129. doi:10.1109/ACCESS.2020.2974934.

[11] Flechsig, C., Anslinger, F., & Lasch, R. (2021). Robotic process automation in purchasing and supply management: A multiple case study on potentials, barriers, and implementation. Journal of Purchasing and Supply Management, 28(1), 100718. doi:10.1016/j.pursup.2021.100718.

[12] Hofmann, P., Samp, C., & Urbach, N. (2020). Robotic process automation. Electronic Markets, 30, 99–106. doi:10.1007/s12525-019-00365-8.

[13] Puica, E. (2022). How is it a benefit using robotic process automation in supply chain management? Journal of Supply Chain and Customer Relationship Management, 2022, 1–11. doi:10.5171/2022.221327.

[14] Siderska, J. (2020). Robotic process automation – A driver of digital transformation? Engineering Management in Production and Services, 12(2), 21–31. doi:10.2478/emj-2020-0009.

[15] Sobczak, A. (2019). Developing a robotic process automation management model. Informatyka Ekonomiczna, 2019(2), 85–100. doi:10.15611/ie.2019.2.06.

[16] Sobczak, A. (2022). Robotic process automation as a digital transformation tool for increasing organizational resilience in Polish enterprises. Sustainability (Switzerland), 14(3), 1333. doi:10.3390/su14031333.

[17] Syed, R., Suriadi, S., Adams, M., Bandara, W., Leemans, S. J. J., Ouyang, C., ter Hofstede, A. H. M., van de Weerd, I., Wynn, M. T., & Reijers, H. A. (2020). Robotic process automation: Contemporary themes and challenges. Computers in Industry, 115, 103162. doi:10.1016/j.compind.2019.103162.

[18] Wewerka, J., & Reichert, M. (2021). Robotic process automation – A systematic mapping study and classification framework. Enterprise Information Systems, 17(2), Article e1986862. doi:10.1080/17517575.2021.1986862.

[19] Ansari, W. A., Diya, P., Patil, S., & Patil, S. (2019). A review on RPA – The future of business organisations. 2nd International Conference on Advances in Science & Technology (ICAST-2019), Mumbai, India.

[20] Choi, D., R'Bigui, H., & Cho, C. (2021). Candidate digital tasks selection methodology for automation with robotic process automation. Sustainability (Switzerland), 13(16), 8980. doi:10.3390/su13168980.

[21] Patri, P. (2020). Robotic process automation: Challenges and solutions for the banking sector. International Journal of Management, 11(12), 322–333. doi:10.34218/ijm.11.12.2020.031.

[22] Siderska, J. (2021). The adoption of robotic process automation technology to ensure business processes during the COVID-19 pandemic. Sustainability (Switzerland), 13(14), 8020. doi:10.3390/su13148020.

[23] Zhang, C., Issa, H., Rozario, A., & Soegaard, J. S. (2021). Robotic process automation (RPA) implementation case studies in accounting: A beginning to end perspective. Accounting Horizons, 37(1), 193–217. doi:10.2308/horizons-2021-084.

[24] Sobczak, A. (2021). Robotic process automation implementation, deployment approaches and success factors – An empirical study. Entrepreneurship and Sustainability Issues, 8(4), 122–147. doi:10.9770/jesi.2021.8.4(7).

[25] Qatawneh, A. M., Lutfi, A., & Al Barrak, T. (2024). Effect of Artificial Intelligence (AI) on Financial Decision-Making: Mediating Role of Financial Technologies (Fin-Tech). HighTech and Innovation Journal, 5(3), 759–773. doi:10.28991/hij-2024-05-03-015.

[26] Hindel, J., Cabrera, L. M., & Stierle, M. (2020). Robotic process automation: Hype or hope? In WI2020 Zentrale Tracks, 1750–1762. doi:10.30844/wi_2020_r6-hindel.

[27] Jeyaraj, A., & Sethi, V. (2020). Embedding Robotic Process Automation into Process Management: Case Study of using taskt. AIS Transactions on Enterprise Systems, 5(1), 1-19.

[28] Leite, G. S., Albuquerque, A. B., & Pinheiro, P. R. (2020). Process automation in the scenario of intelligence and investigation units: An experience. Advances in Intelligent Systems and Computing, 1225, 627–641. doi:10.1007/978-3-030-51971-1_51.

[29] Vitharanage, D., Manuraji, I., Bandara, W., Syed, R., & Toman, D. (2020). An empirically supported conceptualisation of robotic process automation (RPA) benefits. In Proceedings of the 28th European Conference on Information Systems (ECIS2020), 6–15.

[30] Abidemi, A. (2024). The role of technology and automation in streamlining business processes and productivity for SMEs. International Journal of Entrepreneurship, 7(3), 25–42. doi:10.47672/ije.2510.

[31] Pardesi, S. (2024). Integrating hyper-automation with RPA and AI for end-to-end business process optimization. Darpan International Research Analysis, 12(3), 199–211. doi:10.36676/dira.v12.i3.67.

[32] Rani, R., H. J., Agrawal, T., & Varalakshmi, K. R. (2024). Transforming RPA in science & commerce. In Proceedings of the 2024 1st International Conference on Innovative Sustainable Technologies for Energy, Mechatronics and Smart Systems (ISTEMS 2024), 1–6. doi:10.1109/ISTEMS60181.2024.10560163.

[33] Hull, R., & Nezhad, H. R. M. (2016). Rethinking BPM in a cognitive world: Transforming how we learn and perform business processes. In Lecture Notes in Computer Science, 9850, 3–19. doi:10.1007/978-3-319-45348-4_1.

[34] Nurhayati, & Fitrisari, D. (2016). Business process automation of document filing based Alfresco for referral BPJS patient (case study: BPJS Center of Dharmais Cancer Hospital). 2016 International Conference on Informatics and Computing (ICIC), 406–410. doi:10.1109/IAC.2016.7905753.

[35] Athanasopoulos, K., Nikoletos, G., Georgiadis, G., Stamelos, I., & Skolarikis, S. (2017). Process management in the Greek public sector: A case study in the municipality of Kalamaria. ACM International Conference Proceeding Series, Part F1325, 1–6. doi:10.1145/3139367.3139467.

[36] Alves, C., Valença, G., & Fraga, G. (2018). Integrating requirements and business process models in BPM projects. Proceedings of the 44th Euromicro Conference on Software Engineering and Advanced Applications (SEAA 2018), 273–280. doi:10.1109/SEAA.2018.00052.

[37] Denner, M. S., Püschel, L. C., & Röglinger, M. (2018). How to exploit the digitalization potential of business processes. Business and Information Systems Engineering, 60(4), 331–349. doi:10.1007/s12599-017-0509-x.

[38] Torkhani, R., Laval, J., Malek, H., & Moalla, N. (2018). Intelligent framework for business process automation and re-engineering. International Conference on Intelligent Systems (IS), 624–629.

[39] Ahmad, T., & Van Looy, A. (2019). Reviewing the historical link between business process management and IT: Making the case towards digital innovation. Proceedings of the International Conference on Research Challenges in Information Science (RCIS), 1–12. doi:10.1109/RCIS.2019.8877039.

[40] Dumčius, M., & Skersys, T. (2019). Improvement and digitalization of business processes in small-medium enterprises. CEUR Workshop Proceedings, 2470, 22–27.

[41] Huang, F., & Vasarhelyi, M. A. (2019). Applying robotic process automation (RPA) in auditing: A framework. International Journal of Accounting Information Systems, 35, 100433. doi:10.1016/j.accinf.2019.100433.

[42] Hartley, J. L., & Sawaya, W. J. (2019). Tortoise, not the hare: Digital transformation of supply chain business processes. Business Horizons, 62(6), 707–715. doi:10.1016/j.bushor.2019.07.006.

[43] Ludacka, F., Duell, J., & Waibel, P. (2019). Global accounting with the TIM BPM Suite at Deutsche Bahn Group. CEUR Workshop Proceedings, 2428, 130–141.

[44] König, M., Bein, L., Nikaj, A., & Weske, M. (2020). Integrating robotic process automation into business process management. In Lecture Notes in Business Information Processing, 393, 132–146. doi:10.1007/978-3-030-58779-6_9.

[45] Leon, A. T. (2020). Framework for the automation of business processes. International Journal of Systems Engineering, 4(1), 11. doi:10.11648/j.ijse.20200401.11.

[46] Noppen, P., Beerepoot, I., van de Weerd, I., Jonker, M., & Reijers, H. A. (2020). How to keep RPA maintainable? In Lecture Notes in Computer Science, 12168, 414–430. doi:10.1007/978-3-030-58666-9_26.

[47] Susilo, A., Prabowo, H., Kosasih, W., Kartono, R., & Utami Tjhin, V. (2021). The implementation of robotic process automation for banking sector: Case study of a private bank in Indonesia. ACM International Conference Proceeding Series, 365–371. doi:10.1145/3512576.3512641.

[48] Costa, D. A. da S., Mamede, H. S., & da Silva, M. M. (2022). Robotic process automation (RPA) adoption: A systematic literature review. Engineering Management in Production and Services, 14(2), 1–12. doi:10.2478/emj-2022-0012.

[49] Feio, I. C. L., & dos Santos, V. D. (2022). A strategic model and framework for intelligent process automation. In 2022 Iberian Conference on Information Systems and Technologies (CISTI), 9820099. doi:10.23919/CISTI54924.2022.9820099.

[50] Herm, L. V., Janiesch, C., Helm, A., Imgrund, F., Hofmann, A., & Winkelmann, A. (2022). A framework for implementing robotic process automation projects. Information Systems and e-Business Management, 1-35. doi:10.1007/s10257-022-00553-8.

[51] Lazareva, N., Karasevskis, K., Girjatovcs, A., & Kuznecova, O. (2022). Business process automation in retail. In 2022 63rd International Scientific Conference on Information Technology and Management Science (ITMS 2022), 9937096. doi:10.1109/ITMS56974.2022.9937096.

[52] Liutkevičienė, I., Rytter, N. G. M., & Hansen, D. (2022). Leveraging capabilities for digitally supported process improvement: A framework for combining Lean and ERP. Business Process Management Journal, 28(3), 765–783. doi:10.1108/BPMJ-05-2021-0296.

[53] Neto, U. T., Oliveira, T., Pillat, R., Alencar, P., Cowan, D., & Melo, G. (2022). AKIP process automation platform: A framework for the development of process-aware web applications. WEBIST 2022 – Proceedings of the International Conference on Web Information Systems and Technologies, 64–74. doi:10.5220/0011550000003318.

[54] Smirnov, A., Kashevnik, A., Shilov, N., Teslya, N., Petrov, M., Sinko, M., Arneving, J., Humpf, M., & Kolmer, T. (2022). Product configuration automation: Digital transformation platform and case study. IN4PL 2022 – Proceedings of the 3rd International Conference on Innovative Intelligent Industrial Production and Logistics, 115–122. doi:10.5220/0011524100003329.

[55] Moreira, S., Mamede, H. S., & Santos, A. (2023). Business process automation in SMEs. Lecture Notes in Business Information Processing, 464, 426–437. doi:10.1007/978-3-031-30694-5_31.

[56] Gandía, J. A. G., Gavrila, S. G., Ancillo, A. de L., & del Val Núñez, M. T. (2024). RPA as a challenge beyond technology: Self-learning and attitude needed for successful RPA implementation in the workplace. Journal of the Knowledge Economy, 1-28. doi:10.1007/s13132-024-01865-5.

[57] Chakraborti, T., Isahagian, V., Khalaf, R., Khazaeni, Y., Muthusamy, V., Rizk, Y., & Unuvar, M. (2020). From robotic process automation to intelligent process automation: Emerging trends. Lecture Notes in Business Information Processing, 393, 243–256. doi:10.1007/978-3-030-58779-6_15.

[58] van der Aalst, W. M. P. (2013). Business process management: A comprehensive survey. ISRN Software Engineering, 2013, 1–37. doi:10.1155/2013/507984.

[59] Eulerich, M., Pawlowski, J., Waddoups, N. J., & Wood, D. A. (2022). A framework for using robotic process automation for audit tasks. Contemporary Accounting Research, 39(1), 691–720. doi:10.1111/1911-3846.12723.

[60] Martinek-Jaguszewska, K., & Rogowski, W. (2022). Development and validation of the business process automation maturity model: Results of the Delphi study. Information Systems Management, 40(2), 1–17. doi:10.1080/10580530.2022.2071506.

[61] Šperka, R., & Halaška, M. (2022). The performance assessment framework (PPAFR) for RPA implementation in a loan application process using process mining. Information Systems and e-Business Management, 277-321. doi:10.1007/s10257-022-00602-2.

[62] Szelągowski, M. (2021). Practical assessment of the nature of business processes. Information Systems and e-Business Management, 19(2), 541–566. doi:10.1007/s10257-021-00501-y.

[63] Wellmann, C., Stierle, M., Dunzer, S., & Matzner, M. (2020). A framework to evaluate the viability of robotic process automation for business process activities. In Lecture Notes in Business Information Processing, 393, 200–214. doi:10.1007/978-3-030-58779-6_14.

[64] Tuunanen, T., Winter, R., & vom Brocke, J. (2024). Dealing with complexity in design science research: A methodology using design echelons. MIS Quarterly, 48(2), 427–458. doi:10.25300/MISQ/2023/16700.