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Integrating Requirements and Business Process Models in BPM Projects

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***Abstract* — The increasing demand of society for improved services has driven public sector organisations to embrace process-centric approaches. The adoption of Business Process Management (BPM) requires an in-depth understanding of the organisational culture, business rules, and stakeholders needs. BPM should be adapted to suit the specific context of organisations, which often involve the development of process-oriented systems to enhance process execution. In this paper, we present our experience during a five-year study aimed at implementing BPM at Pernambuco Court of Accounts, in Brazil. We propose a novel BPM method in which requirements modelling activities intertwine with business process modelling in the BPM lifecycle. Finally, we propose a set of good practices to successfully integrate requirements into a BPM project. These practices provide a rich reflection on the adoption of BPM by a public organisation.**

Keywords—Business Process Management; Requirements Modeling; Public Sector.

I. INTRODUCTION

Nowadays, public sector organisations are embracing digital transformation to be more efficient, improve their internal processes, and provide high-quality services to citizens. To succeed in such e-Government initiatives, the public sector has increasingly adopted Business Process Management (BPM) to assist the continuous improvement of business processes [1, 2]. Process-centric approaches enable organisations to optimise resources, make tacit knowledge more explicit and automate manual processes.

Although the adoption of technology is not necessarily an essential part of a BPM project [3], process improvement often involves the adoption of information systems. It is important to obtain a correct understanding of the business processes before considering the implementation of a new process-centric information system or BPM Suite (BPMS). The introduction of BPM practices requires a holistic understanding of the organisational context and involvement of stakeholders during the project. In this setting, the BPM team must engage stakeholders to support organisational change and embrace the new or redesigned processes. Stakeholders need to be at the centre of the project. Their requirements and work routines must be understood clearly to ensure that the improved processes bring real value for them.

The BPM lifecycle involves a set of phases to create business process models and business rules specification artefacts. During these phases, several models are developed to represent different aspects of organisational routines. In particular, the knowledge captured in business process models serves as the main source of requirements for process-centric information systems [4]. The mapping between business processes and requirements is not trivial [5]. Process models encapsulate organisational knowledge in a more abstract form, while requirements represent detailed descriptions of functionalities to be implemented.

In this paper, we describe a practical experience on integrating requirements and business process models during BPM projects. We present the results of a five-year study conducted at Pernambuco Court of Accounts (TCE-PE – Tribunal de Contas do Estado de Pernambuco). TCE-PE is a public organisation responsible for auditing state and municipalities' accounts. The organisation has embarked on a large BPM program with the aim of improving and automating its business processes. In Section 2, we describe key concepts of BPM and discuss the alignment between business process models and requirements. In Section 3, we present our research method and describe the context of the studied organisation. In section 4, we present the proposed BPM method and illustrate how we intertwined requirements with business process modelling activities in BPM projects. In Section 5, we describe good practices obtained from our experience at TCE-PE. Finally, in Section 6 we present conclusions, limitations, and future studies.

II. BACKGROUND

A. Business Process Management

Von Rosing et al. [6] give a very comprehensive and practical definition of BPM. According to the author, "*Business Process Management is a discipline involving any combination of modelling, automation, execution, control, measurement, and optimisation of business activity flows in applicable combination to support enterprise goals, spanning organisational and system boundaries, and involving employees, customers, and partners within and beyond the enterprise boundaries*". From this definition, we highlight the importance of achieving enterprise goals by involving stakeholders during BPM projects.

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Vom Brocke et al. [7] argue that successful BPM must be aware of organisational context. Different organisations may have very different goals in mind when starting a BPM project, e.g. automation, standardisation, radical transformation. Depending on their goals, organisations may rely on the intensive use of technology or solely focus on systematising and improving their routines. In both cases, a key aspect of any BPM project is acquiring a wide understanding of the structure, policies and operations of the organisation. To achieve that, business analysts must capture the current state of the organisation, elicit stakeholders' business goals, and propose solutions (automated or not) to achieve those goals.

Business processes represent the value chain of organisations. Hence, they are seen as the most valuable assets to manage in order to enhance organisational performance [8]. Business process models are key artefacts generated during BPM lifecycle. This lifecycle involves the following activities [9]: modelling the current situation; analysing problems, their causes, and opportunities for improvement; modelling the improved situation and implementing the improved business process; and monitoring the execution of business process.

Since the improvement of business processes depend on the analysis of process models, generating high quality and expressive models is critical. Over the last decades, several notations and languages for business process modelling have been proposed, such as BPMN, EPC and IDEF [9]. These notations offer rich graphical elements to represent business activities flow. A recommended practice is to use as few elements in the model as possible [11]. Several transformations are required to capture the real world phenomenon into a final representation ready for automation [12]. Each transformation involves specific mappings and refinements. Business process models communicate organisational activities to different groups of stakeholders. Moreover, they must be sound and complete, since they can also be the basis for process automation in a BPMS.

Different types of information systems, such as complete BPMS, workflow management systems, or customised information systems enable the automation of business processes. In particular, BPMS is a generic packaged software that supports the modelling, analysis, improvement and automation of business processes [13]. Important market vendors such as Oracle and IBM provide BPMS tools with powerful functionalities for business process simulation, implementation and monitoring. The decision to buy a packaged tool or build a customised information system must be analysed carefully by the organisation. In general, strategic goals of the BPM project will determine the buy versus build decision.

B. Requirements and Business Process Modelling

The interplay between business process models and requirements specification has been extensively studied in academia. Some examples that integrate both fields include the study of Coskuncay et al. [14], who adopted a unified modelling approach to create business process models and requirements specifications. An extended version of Event-Driven Process Chain notation (eEPC) enables models generation. In a similar way, Aysomaz and Demirors [4] proposed a method called *UPROM* to systematically translate business process knowledge from the business domain to the technology domain. The approach supports the development of integrated EPC models for business processes and user requirements. Other studies investigated the expressiveness of BPMN notation in terms of clarity and completeness to model business processes [15,16].

Demirors et al. [16] used business process models to elicit contractual requirements for the acquisition of information systems. Aysolmaz et al. [18] investigated the problem of inconsistency between EPC business process models and natural language requirements in software development projects. Cox et al. [5] derived requirements from process models by using the problem frames approach. Hiisila and Kujala [18] combined business process models with use cases and business rules for IT development. In their turn, Lapouchnian and Mylopoulos [20] examined how to use goal models to generate customisable executable processes via Business Process Execution Language (BPEL).

To obtain concrete business value, the generated business process models must represent end-to-end business processes that embrace different departments of the organisation [3]. Such knowledge is often fragmented and diffused. Therefore, the modelling effort resembles a jigsaw puzzle where the pieces are integrated to create a coherent story of the business logic. To address this challenge, Silva and Rosemann proposed an approach called *Processpedia* to support collaborative process modelling [21]. It captures tacit knowledge by fostering the participation of stakeholders based on their distinctive characteristics and skills. Similar approaches have been developed by the requirements engineering researchers to engage users in the requirements gathering process [22, 23].

The elicitation of organisational knowledge to generate business process models can adopt the same techniques used for requirements elicitation, such as interviews, document analysis, focus groups and observations [9]. Frequently, organisations generate different artefacts that complement each other, since different types of artefact suit different communication purposes [24]. Hence, business process modelling and requirements specification are intertwined activities to develop process-oriented systems. Business process models described in notations such as BPMN or EPC, and requirements expressed in natural language are synergistic techniques. However, a key issue involves the synchronisation and traceability between the requirements specification and business process models [25].

The described approaches mainly focus on the alignment of requirements and business process models. However, they do not address the issue on how to integrate requirements during the entire BPM lifecycle. We believe this is a critical challenge that organisations face when they adopt BPM. To address this gap, we propose a novel BPM method. We created the method in an empirical manner during an action study conducted at TCE-PE. The research method is presented in the following section.

III. RESEARCH METHOD

In this section, we present the research questions. Then, we provide a detailed description of TCE-PE organisational context. Finally, we describe the action research performed at the studied organisation.

A. Research Questions

We directed our study to investigate the following research questions (RQ):

RQ1 – How to integrate stakeholders' requirements and business process models in BPM projects?

This research question addresses issues involved in the generation and integration of requirements specifications and business process modelling during BPM projects (i.e. generating requirements from business process models as well as reflecting system requirements into business process models). To answer this RQ, we proposed a BPM method that includes a sequence of phases combining business process modelling and requirements specification. We answer RQ1 in Section 4.

RQ2 – What are the good practices to successfully introduce requirements engineering activities in BPM projects?

This RQ enabled us to synthesise our experience during the BPM projects conducted at TCE-PE. Our close involvement at the studied organisation allowed us to understand the challenges faced by the BPM team and stakeholders, reflect upon our action, and elaborate good practices for introducing requirements engineering activities within the BPM lifecycle. These reflections of practice represent the specific experience of one organisation. However, we believe that organisations facing similar challenges may find the practices useful. We answer RQ2 in Section 5.

B. Organisational Context

TCE-PE is a public organisation based in Recife, Brazil. The organisation is in charge of auditing state and municipalities' accounts. The organisation aims to be recognised as an effective instrument for improving public administration, protecting social interests and preventing corruption. In general, internal and external stakeholders do not have a complete understanding of the services offered by the organisation. In addition, staff does not understand exactly how they can contribute to enhance business processes. TCE-PE departments' work as isolated islands, with disconnected activities and teams that pursue their own goals. Given this context, top management decided to sponsor a BPM initiative back in 2012. The main motivations to embrace a process-centric perspective were (i) citizens' demands for improved quality of public services, (ii) top management decision to adopt e-gov solution via an electronic process tool, and (iii) continuous pressure of society for accountability and transparency.

In 2013, the BPMO (Business Process Management Office) was officially instituted at TCE-PE. The unity conducts BPM projects for standardising, improving and automating key business processes to increase efficiency and quality. The BPM initiatives are supported by well-established managerial approaches (e.g. adoption of Balanced Scorecard and bi-monthly strategic monitoring) and a strong project-oriented culture (e.g. adoption of PMBOK principles and project management tool). The largest BPM project focuses on improving and automating the account auditing process. The goal of this process is to evaluate and judge the accounts of public bodies and individuals responsible for state and municipalities administration. The auditing aims to ensure the legality, legitimacy and best value of public money.

TCE-PE acquired a bespoke workflow tool to support the automation of business processes. This solution is not a standard BPMS available in the market, but rather a workflow system. In fact, the tool acquisition was an executive decision motivated by the fact that other public organisations have adopted a similar solution from the same supplier. This is a hybrid tool, combining the basic characteristics of a BPMS with customised features of an information system. It enables the creation of process models using BPMN notation, but it does not offer a complete process engine to automatically generate process-based applications. In light of that, we defined a BPM method that enables the modelling and analysis of business processes as well as supports their automation through the specification of requirements to be implemented by the tool.

C. Action Research

The purpose of action research method is to influence or change some aspect of a studied phenomenon. It involves the collaboration between researchers and those at the centre of the research, who are typically seen as central actors of the study [26]. The method proposes a systematic study of planned change, following a PDCA (Plan-Do-Check-Act) cycle. Action research is an appropriate approach for our purpose of solving a practical problem in a real scenario, which is developing a BPM method that integrates requirements engineering activities during business process improvement and automation.

We classify the action research reported on this paper as a *Technical Action Research* (TAR), which is a case-based consultancy initiative [27]. TAR uses or gives an artefact for others to use in a real project. Hence, researchers learn about the robustness of the intended effects and the mechanisms that generate them in an uncontrolled setting. These findings enable the improvement of the artefact. TAR differs from traditional action research by focusing on artefact conception and refinement to treat a specific problem. Besides, we considered the canonical action research principles from Susman and Evered [28], as shown in Figure 1.

We undertook the action research during a five-year BPM initiative at TCE-PE. The study involved a group of researchers from a local university that established an R&D collaboration project to jointly run the BPMO with TCE-PE staff. Seven researchers formed the research team: four researchers with practical and academic experience in BPM and three undergraduate students. Besides, two internal staff participates in the BPMO operation. Two authors are researchers and the last author acts as BPMO manager.

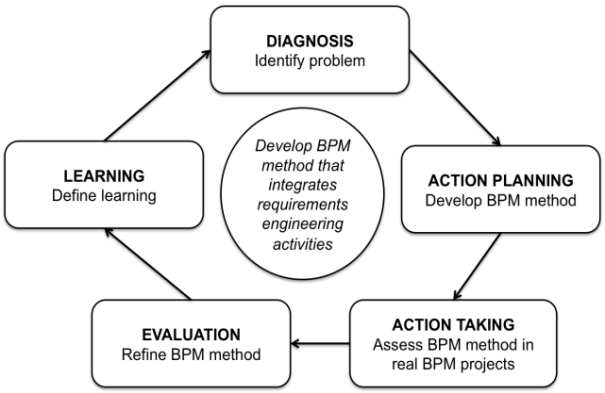

Fig. 1. Action research cycle based on [27].

We started the *diagnosis* phase with the problem of developing the methodological artefacts to conduct BPM projects at TCE-PE. The problem considered TCE-PE goals and stakeholders, such as the sponsor of the BPM initiative. During the *action planning*, we developed a BPM method as a practical artefact to support the modelling and analysis of business processes, specification of requirements, and subsequent automation of business processes. In the *action taking* phase, we applied and evaluated the proposed BPM method in BPM projects at TCE-PE. During the *evaluation* phase, we refined the BPM method to better fit the contextual reality of TCE-PE. The data that supported such analysis resulted from participant observations during the projects and focus groups conducted with members of the BPMO, IT team and stakeholders of the business areas. During these meetings, we discussed our experience and elicited suggestions to improve the method, in a typical *learning* step. The practices proposed in Section V were obtained during the meetings. The complete action research cycle was performed during the execution of eight BPM project aimed at improving key business processes of the organisation. Hence, the proposed BPM method was continuously applied and refined eight times, during the course of five years.

IV. Proposed BPM Method

In this section, we describe the proposed BPM method and discuss how requirements activities can be integrated in the BPM lifecycle. We developed a BPM method based on well-established BPM practices [7,9,10]. The method addresses specific characteristics of the organisation, e.g. internal culture and nature of its business processes. Hence, we considered TCE-PE contextual factors, such as rigid hierarchical structure, centralised decisions, poorly integrated IT systems, immature software engineering practices, and business processes regulated influenced by legal constraints. Thereby, we believe the proposed method is suitable for organisations with similar contexts. The method is divided in seven phases, as presented in Figure 2. We adopted a standard BPM lifecycle proposed by CBOK and BABOK. Our main contribution is the instantiation of the classic BPM lifecycle to the context of a public organisation with limited support of IT tools. Therefore, we describe a practical and simplified approach to conduct BPM projects.

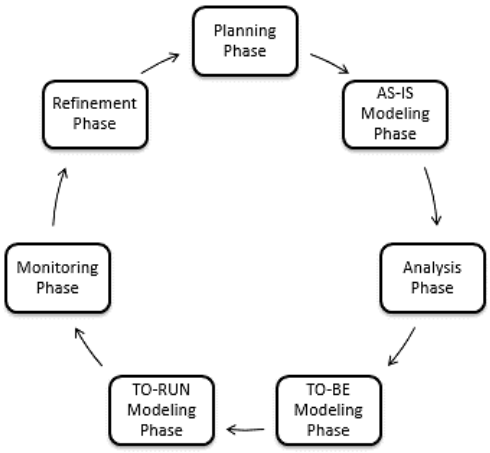

Fig. 2. Lifecycle of the proposed BPM Method.

For each phase, we defined clear steps, visual flow of activities using BPMN notation and document templates. Table 1 presents the set of requirements and business process artefacts generated in each phase. The phases of our proposed BPM method are:

1. Planning Phase. This phase aims to formulate the BPM project in detail. The stakeholders are identified and invited to attend a kick-off meeting, in which the goals, schedule and manager of the project are presented. During this meeting, the BPM team elicits overall stakeholder needs (i.e. high level goals) and critical success factors for the project. These are the main outputs of this phase, together with a high-level scope of the business process, stakeholders, potential risks, and expected results. All these items are included in the vision document. The outputs of this phase are the list of stakeholders and their key needs, vision document, and initial risk management plan.

2. AS-IS Modelling Phase. The goal of this phase is to model the current situation of the business process under improvement. The AS-IS business process model describes the existing flow of the business process. We use Bizagi Process Modeller[1] to create the models. By understanding the actual functioning of the process, it is possible to identify the main difficulties and bottlenecks to be improved. To gather information about the business process, we adopt varied requirements elicitation techniques, such as individual interviews and focus groups with stakeholders, analysis of legislation and other relevant documents, and evaluation of internal information systems containing data of business process activities. The current business process (AS-IS business process model) expressed in BPMN notation is the output of this phase.

[1] https://www.bizagi.com/pt/produtos/bpm-suite/modeler

TABLE I. ARTEFACTS CREATED

Phase	Artefacts
1. Planning	- Vision document, with key stakeholders and high-level description of their key needs and goals. - Initial risk management plan.
2. AS-IS Modelling	- Documentation of interviews and focus groups conducted with stakeholders. - AS-IS business process model.
3. Analysis	- Analysis document with Ishikawa diagram, categorisation map of problems, spreadsheet with problems, causes and solutions, empathy map, etc.
4.TO-BE Modelling	- TO-BE business process model. - Initial requirements specification. - List of performance indicators. - Updated risk management plan.
5.To-Run Modelling	- TO-RUN business process model. - Prototypes. - Final requirements specification. - Spreadsheet integrating information for process automation.
6. Monitoring	- Process monitoring report including the analysis of performance indicators. - Monitoring meetings minutes.
7. Refinement	- Planning report for the next BPM cycle.

3. Analysis Phase. During this phase, we perform a critical analysis of the AS-IS business process model. It involves several exploitative techniques, such as categorisation map of problems, Ishikawa diagram, SWOT analysis, risk analysis and gap analysis. These techniques foster analytical thinking to identify incremental gains for the business process. Currently, we are experimenting with several exploratory and intuitive techniques to foster innovation. We developed an approach based on Design Thinking to identify new opportunities, understand customers' needs with empathy and generate creative ideas for the business process [29]. The output of this phase is the analysis document, which describes proposals for process improvement.

4. TO-BE Modelling Phase. This phase aims to elaborate the enhanced version of the business process. It involves several meetings with stakeholders to explore the alternatives for process improvement and subsequent automation. During the meetings, initial requirements are elicited and specified in natural language. The requirements describe business rules, legal and regulatory constraints, desired functionalities to be implemented at the tool, etc. We also identify requirements from TO-BE process models by determining which parts of the process will become functionalities in the tool. Members of the IT department assess the feasibility of requirements. Representatives of business areas describe how the business is executed and request demands for the tool. The BPMO team analyses the requirements based on the structure of the improved business process model, business rules, legal restrictions and foreseen evolution of the business process. In the BPM projects conducted at TCE-PE, we created business process models, textual requirements, and prototypes to facilitate the communication among actors. These artefacts are co-created by the BPMO, business areas and IT department. Then, the artefacts are shared with internal actors and the supplier, as shown in Figure 3. Finally, this phase identifies indicators to measure the performance of the improved process and updates the risk management plan. The key outputs of this phase is the improved version of the process model (TO-BE business process model) using BPMN and an initial requirements specification.

5. TO-RUN Modelling Phase. In this phase, the proposed improvements on the business process are automated. The main steps are (i) to generate and configure the TO-RUN business process model in the tool, with the activities to be automated, (ii) to specify and validate requirements that will become functionalities in the flow of the automate process. These steps are performed in parallel. The requirements represent system activities in the TO-RUN business process model. It is also possible to identify new requirements after executing the business process. These requirements include unexpected executive decisions and potential process improvements. After creating the requirements specification, the three internal teams conduct additional meetings to analyse how the requirements affect the elements of the TO-RUN business process model (e.g. adapt some activities and/or change the process flow) or the structure of the automated business process in the tool (e.g. include new profiles, change variables, etc.). In addition, the requirements may trigger the creation/refinement of TO-RUN sub-process models. This may due to restrictions to implement functionalities, need to reuse models, and complexity to maintain several processes flows. The IT department is responsible for documenting the requirements in natural language. In parallel, the BPMO team creates interface prototypes using Balsamiq tool[2] (Figure 4). The prototypes visually define how the tool must implement the requirements. The IT department may also start this cycle by creating a prototype to extract requirements and then refine the TO-RUN business process model. Hence, we have situations where we create prototypes before specifying requirements and vice-versa. The prototypes and textual requirements specification are given to the supplier, who will implement specific modules in the tool based on this documentation. In parallel, the BPMO team continues to configure the business process in the tool. The configuration involves the translation of business rules into profiles, upload of template documents, and inclusion of other relevant information. The BPMO and IT teams evaluate if the functionalities delivered by the supplier are correct with respect to the artefacts provided (i.e. requirements specifications, business process models, and prototypes). Each requirement for the new release of the tool represents additional activities of the automated process. The testing of the tool is supported by a shared spreadsheet, in which the teams indicate if the test of a given feature is successful or if a bug is identified. At the end of this phase, the business process is fully automated at the tool.

[2] https://balsamiq.com/

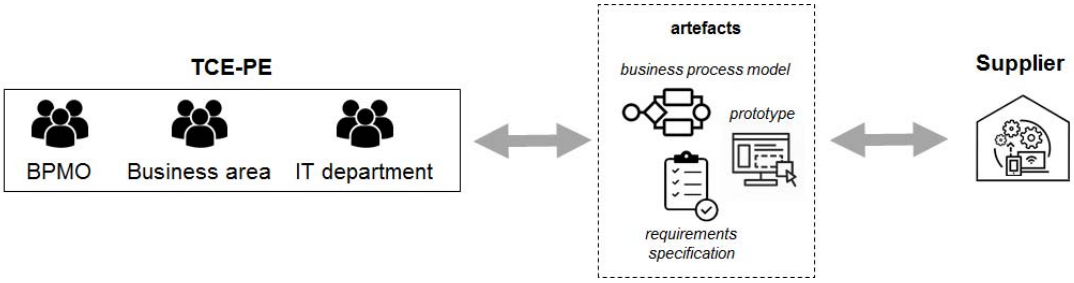

Fig. 3. Communication among actors of BPM projects.

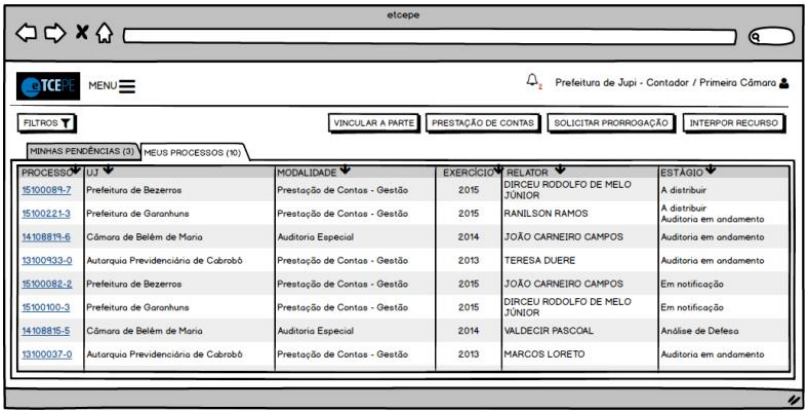

Fig. 4. Prototype of the account auditing process.

6. Monitoring Phase. During this phase, the BPMO team collects and analyses the results of business processes execution available at the tool. Ideally, business process owners should perform this task. However, depending on the maturity level of the organisation, the BPMO team may need to be responsible for the business process monitoring. The team verifies which activities of the business process are not performed in an acceptable manner. Then, they identify the potential causes of problems and suggest solutions to address them. The BPMO manager discusses these results during monitoring meetings with key stakeholders. Depending on the criticality of the actions, the manager may visit business areas to promote the necessary corrections (e.g. discuss the problems with the areas; elicit changes for the business process; etc.). The required changes should be registered as improvement actions to be addressed by the business areas. The outputs are the process monitoring report containing the list of improvement actions and minutes of monitoring meetings with stakeholders.

7. Refinement Phase. This phase focuses on accomplishing improvement actions. It is important to highlight that some actions occur right after the monitoring phase, while others are planned for an upcoming improvement cycle. The BPMO team checks the actions by conducting regular meetings with key stakeholders, such as process owners, staff of business areas and executive board. The business areas report the status of the process execution and highlight potential issues that hamper the proper operation of the business process (e.g. lack of resources, time constraints, etc.). Finally, the BPMO manager evaluates whether the actions solved the problems effectively and communicates the areas of eventual changes in the business process. Critical problems are prioritised for the following cycle of business process improvement. The output of this phase is the planning report for the next BPM cycle.

V. GOOD PRACTICES

From our experience of conducting BPM projects at the studied organisation, we present a set of good practices (P) to successfully integrate requirements activities in BPM projects. The practices were gathered during several meetings the authors (who are members of the BPMO) conducted with the IT team and stakeholders of the business areas involved in the projects. The authors took notes of ideas for improvement of the BPM method, criticisms and challenges faced during the projects. The meetings notes were discussed among all members of the BPMO. Then, we integrated these feedbacks in the following good practices.

P_1 – Create multiple artefacts to better communicate business processes.

In BPM projects using a complete BPM suite, the code is automatically generated from the business process models. Given that TCE-PE preferred to adopt a workflow-based process tool, our process automation required the use of three complementary artefacts: business process models, prototypes and textual requirements specifications. This approach considers the expressiveness of each artefact,

which enables the representation of different types of information. For instance, the BPMO and IT teams define textual requirements to describe parameters, variables, expressions and queries used by the tool. This information cannot be included in TO-RUN business process models. Nevertheless, providing only business process models is not sufficient for the supplier to capture all relevant knowledge to implement process functionalities in the tool. Therefore, the teams create prototypes to define the expected layout of the automated process (e.g. flows, colour, size, format and labels of interface elements). The prototypes demonstrate how the business process flow and information will appear for users. Creating and aligning multiple artefacts improves the communication during our meetings with the business areas and the tool supplier. This observation confirms the relevance of effective communication for the success of BPM projects (vom Brocke et al., 2014). In particular, the teams may start modelling the business process. Then, they concentrate on defining requirements for the tool, when they may recognise relevant information to include in the business process model. This shows the interdependence and complementarity among these artefacts.

P_2 – The requirements that support business process improvement must be traceable, consistent and sufficiently detailed.

During BPM projects, the BPMO and IT teams recognised the problems caused by inconsistent and obscure information spread in different artefacts that support business process automation. In light of that, we created a central spreadsheet to consolidate all relevant information that must be aligned to enable the process configuration in the tool. For each activity in the business process, there are columns in the spreadsheet describing relevant information (e.g. actor/responsible area, resources, business rules, etc.), requirements (e.g. variables, logical expressions, codes, etc.) and prototypes (e.g. field, user profile, layout, etc.). The manual mapping of several artefacts is not effective. Nevertheless, it represents the real context of a public organisation, where requirements and software engineering practices tend to be quite informal. Manually interrelating different artefacts that support business process automation is risky and time-consuming. For instance, the BPMO team may generate errors in the business process models by neglecting new requirements. In an ideal scenario, we would need appropriate synchronisation and traceability tools. The teams creating the artefacts need to balance the level of detail of the information. If the artefact content is too fine-grained, its complexity also increases. This hampers a fast and easy implementation by the supplier. For instance, it is more effective to conduct meetings with the supplier, instead of indicating the rationale behind decisions in the documents. Our experience shows that frequent meetings allow a faster understanding and validation of produced artefacts.

P_3 – Stakeholders should co-create requirements and business process models with the BPM team.

In our initiative, stakeholders from business areas were involved in the creation of all artefacts related to business process modelling and improvement. Stakeholders are experts in the business processes and offer vital information on how the processes must perform and how the tool must present the flow of information. It is paramount that information available on the artefacts (e.g. business rules in process models or system features in requirements specifications) is simple to facilitate the involvement of business stakeholders. Our experience confirms the established recommendation that process models must avoid technical jargons or over complex process flows (Jeston and Nelis, 2008). During our projects, some stakeholders were able to develop prototypes or analyse business process models to discuss their decisions and show that their proposals are feasible. To ensure the engagement of key stakeholders, the organisation should offer incentives and assign clear roles for stakeholders during the BPM project.

4 – Business process improvement requires a structured but flexible approach.

Defining the right scope of business process improvement is tricky. The TO-BE business process model is the ideal scenario covering the full improvement of the business process. However, the organisation must perceive that business processes need to be automated in different cycles or iterations due to several reasons, ranging from cultural factors to legal and resource constraints. The first BPM project cycle must encompass urgent or less-risky improvements, so that users become acquainted with the digital transformation of their routines caused by the tool. After the first version of the improved business process is automated and embraced by users, more sophisticated requirements can be implemented and further business process improvements can be proposed in the following BPM cycles. The project must also adopt a flexible approach. Sometimes, discussions regarding process automation may start from a prototype to define a textual requirement, while in other situations the business process model guides the requirements definition. Therefore, we believe that each project should instantiate and adapt the BPM method to fit the specific characteristic of the business process under improvement.

VI. CONCLUSION

In this paper, we presented the experience of TCE-PE during the implementation of BPM projects. We conducted an action research study to propose a BPM approach that integrates requirements and business process improvement activities. The resultant practical artefact was developed on top of well-established BPM practices that we instantiated to fit the specific context and needs of the studied organisation. Thereby, our goal was not to create an original BPM method, but rather to show how to apply the BPM lifecycle in practice.

Overall, public organisations in Brazil are under increasing pressure to improve their internal processes and services delivered to society, as well as to increase accountability of their results. . However, the internal teams are not widely opened to embrace changes and innovate. Hence, in the first years of our BPM initiative, we faced strong reluctance from stakeholders of the business areas to follow the method. Therefore, we had to simplify and adapt the method to better suit their needs. We managed to

overcome their resistance by disseminating a cultural change that foster BPM values at the organisation [1]. By following an action research approach, we can continuously refine the proposed method. After each of the eight BPM projects performed so far, we conducted post-mortem meetings with the involved teams to examine the challenges and successes of the projects. For instance, in the first version of the method we did not include prototyping as a produced requirements artefact. We decided to create visual prototypes after facing difficulties to communicate the requirements for the tool supplier. We believe that prototyping is very useful to complement and explain how business process models should be implemented.

The method still faces some limitations. The manual generation and integration of artefacts is risk-prone. We are aware of the problems caused by the lack of tool to support automated traceability between business process models and requirements specifications. In the future, we aim to enhance our BPM method by including more sophisticated requirements engineering techniques and tools.

Our method contemplates the implementation of business processes by means of a process-centric information system. Thus, the method may not be suitable for projects adopting a standard BPMS. Nevertheless, we do believe that our findings can be useful for other organisations with similar contexts and goals.

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