

Applying BPMS to the Public Sector Using OSS

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Abstract: A great effort is currently placed in reengineering the public sector services processes due to the recently released Digital Reform Bible of the Hellenic State. It is recognized that the lack of process automation leads employees to working inefficiently, wasting time in repetitive, sometimes even unnecessary procedures. In this context, there is a great loss of available resources in the public sector and of citizens' person hours. This paper aims to bring evidence that Business Process Management Systems can be adopted by the public sector, improving the performance of the reformed processes. We also show that this goal can be achieved using Open Source Software. Towards this end we did a case study in a public organization, i.e. the Technical University of Crete, reforming a time consuming process, that of printer cartridges procurement, that involves a large number of actors. Moreover, our case study addresses the challenging task of modeling a process with feedback (loop). In order to find out whether this kind of systems can indeed improve the performance of the institution and can be accepted by the affected parties, a pilot test was conducted, followed by a survey. The latter confirmed our hypothesis that performance is improved and also provided encouraging results regarding the employees' acceptance of the system, both from the users' (participants) and the administrators' points of view.

Keywords: Business Process Management Systems, Workflow Management Systems, Open Source Software, Case Study.

Introduction

A great effort is currently placed in reengineering the public sector's processes due to the recently released Digital Reform Bible of the Hellenic State [9]. In this effort the business process reengineering is expected to play a key role and the Business Process Management Notation (BPMN) [2], [8], is mentioned explicitly.

One of the greatest challenges in Greek public organizations is the failure to provide clear and accurate task assignments and process mapping, which leads to responsibility disclaiming and limits transparency. In addition to that, the omnipresence of bureaucracy and the obsolete legal framework [12] impels the personnel to work with minimal agility. Past experience [10] has shown that the lack of established procedures within an organization can lead to great losses, since individuals may take initiatives that do not comply with the organizations' strategy and violate regulations without being noticed. In such cases having established processes isn't enough. Although Business Process Management does not neces-

sarily require the use of any technological means, Business Process Management Systems (BPMS) can be used to execute the business processes and monitor their performance and activities. Furthermore, BPMSs offer various reports and analytics that can be used further as an aid to the decision making and operational research endeavours [6].

The purpose of this case study is to benefit from the implementation of BPM in an attempt to increase the productivity and limit the expenses of an organization. To achieve that, a BPMS was used to automate the process of ink cartridges' procurement, which according to the Department of Computer Infrastructure Administration of the Technical University of Crete, is a time consuming process that distracts the administrators from other more important tasks.

Our case study addresses the still challenging task of modeling a process with feedback (loop), an issue not covered in previous works. Moreover, the survey that followed the implementation and the pilot operation shows that the process performance is improved and that the employees would accept to use our system. Thus we expect that this work will have an impact in the implementation of the Digital Reform Bible.

In the following, we firstly review the open source BPMS frameworks. Subsequently, we present our case study, including the modeled process, our results and recommendations. We conclude with our summarized findings and future work.

Open Source Software for BPMS

Every Workflow Management System consists of the following components [1]:

- *Process definition tools*, usually a graphical environment where the process model is designed by using a Business Process Modelling Language.
- *Workflow enactment service*, which is essentially the run-time environment that utilizes one or more workflow engines, that define how the system will operate based on the process model.
- *Administration and monitoring tools*, like dashboards with live data from the process progress or different types of reports with usage statistics.

Recent works propose two more components [5]:

- *Integration Tools*, allowing for the collaboration of the BPMS with other existing business software.
- *Repositories*, where data, documents, process models etc. are stored.

Before choosing the BPMS that was employed for the development of our platform, six different open source BPMSs were tested. For this purpose a simple process was executed with each of the following systems: [ProcessMaker 3.2.1](#), [Camunda BPM 7.8.0](#), [Bonita BPM 7.6.3](#), [Activiti 7.0](#), [jBPM 6.4](#) and [YAWL 4.2](#) in

order to conduct a comparative analysis. The comparison of these systems was based on:

- a) the ease of installation and configuration
- b) the ease of development and execution of a process based on standards
- c) the friendly and modern interface

It should be mentioned that for the present case study, the systems were used as standalones and they were not embedded in other existing platforms used by the organization. After performing the necessary process on Camunda BPM, Bonita BPM, Activiti and jBPM, the systems were deemed to be less appropriate for the case in question, since they are Java-based applications that demand further configuration and cannot offer the desired interface when used as standalones. On the contrary, even though YAWL was evaluated as the easiest software to handle, it was not selected, as it did not follow BPMN as a modelling standard and the provided interface seemed outdated. Thus, ProcessMaker was selected as the most appropriate system since it follows BPMN and it is provided in a software bundle easy to install and execute. Essentially, ProcessMaker is the only LAMP/WAMP stack (Linux/Windows, Apache Web Server, MySQL Database, PHP programming language), the deployment of which is easier compared to the mentioned Java-based stacks.

Case Study

Introducing Business Process Management into a Greek public organization is not a trivial task. As it is suggested by Athanasopoulos et al. [3] and Delias [7], the whole project becomes more complicated due to restrictions posed by the legal framework and internal regulations of each organization. In addition, there is not a generic method that dictates the way that BPM and BPMSs can be integrated into businesses, and therefore every case should be considered as unique [15].

The first step for the present case study, was to identify a candidate process. After a meeting with the relevant parties in the Department of Administrative Computer Infrastructure, we focused on the procurement of ink cartridges for the University as it had a number of features that made it a great candidate. It is a relatively simple, but a time consuming process for many diverse and distant employee positions. The current procedure includes phone calls and emails combined with continuous communication between the administrators and the users. Given that most of the users cannot properly specify the desired ink cartridge, the majority of the time is consumed to resolve misunderstandings. Additionally, in numerous cases, ink cartridges that will never be used were purchased.

Taking all the above into consideration, the case study used a Business Processes Management System in order to automate the process of procurement, aspiring to reduce the time spent on the engagement with the users, while limiting possible mistakes, and keeping track of the consumption, and, therefore, the ex-

penses. In order to accomplish that, a new platform was developed, using the selected open source BPMS, where the users can log in and place their orders, while the administrators can handle every task related to the procurement. On top of that, to further facilitate the administrator, the system automatically provides an aggregate list of the selected products, limiting the time spent in double checks and the collection of the orders. Lastly, “history tools” are offered, where the administrators can view past orders, and statistics of usage, in pursuance of a better tracking of the expenses.

Modeling the Process

In Figure 1 the main process that was deployed is depicted using the Business Process Management Notation (BPMN) language [11]. BPMN is a process modeling language that allows the graphical representation of workflow, roles, limitations etc. It was developed as a human-readable way of process representation that would be both understood by business and IT people [13]. As shown, there are two roles regarding the stakeholders, i.e. the *user* and the administrator (*admin*).

The process begins with the *inform the users* task, where the administrator selects which users will take part in the procurement process. When this task is completed, three tasks are simultaneously initiated:

- The *send emails* task, which is an automated task where an email is sent to the users, informing them for the launch of the procurement process and providing them with instructions.
- The *place order* task, which is the only task directly assigned to the users, prompting them to fill a form with their order. The form is designed to be user-friendly, and the information is presented in such a way as to limit possible mistakes, e.g. there is a list with printers linked to their corresponding products, thus preventing a user from mismatching a product (an ink cartridge) to a printer.
- The *monitor the process* task, where the administrator can check which users have already placed an order.

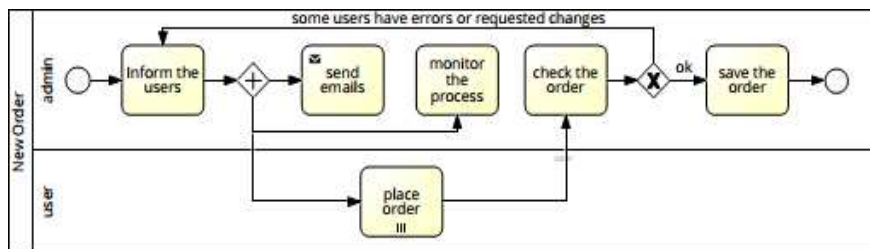


Fig 1. Main process model in terms of BPMN 2.0.

As someone may notice in Figure 1, the above tasks follow a parallel gateway but the flow does not converge after they finish. This modeling approach is contrary to BPMN good practice, however, it is appropriate for the *ProcessMaker* tool, where the *send emails* task is terminated automatically and the *monitor the process* task is terminated by the user, and therefore they do not need to be connected to an end-type event. Thus, we can report that *ProcessMaker* does not support well the convergence to an and-type gateway based on the BPMN standard.

When the task *place order* is completed by all the users (or when the procurement period is over), the task *check the order* is assigned to the administrator, who has to go through every order and accept it or decline it. If one or more orders are not accepted, the process starts from the ground up, solely with the users who need to place their order again. In the event that no mistakes are found in the placed orders, the process can move on and an aggregated list of the ordered products will be automatically exported for the administrator's assistance (save the order in the database task), leading the process to end.

At this point, there should be a special reference regarding the tasks with feedback (loop). The selected BPMS, as well as other BPMSs, have an issue on handling parallel tasks (e.g. *place order*). In many cases a task has to be claimed by many users separately, and for this reason the flow doesn't move on until every single user claims his task. In cases like procurements there is a great likelihood that users will fail to complete their assigned task, and, as a result, the process stalls, leading the developers to seek for workarounds. In our case, a new task was created and assigned to the administrator, the execution of which allows the proper editing of some database values, forcing the system to end the parallel task. For further information and technical details on this topic the reader can consult the thesis of Benioudaki [4].

Results and Recommendations

To ensure that the developed system would meet the expectations of a real-world project, a pilot test was conducted within the Technical University of Crete. For the purpose of the case study, the person in charge for the particular procurements was given the role of the administrator. For this reason, two meetings were required, firstly to demonstrate the platform, and, secondly to train the employee that would assume the role of the administrator, since, during the test, assistance from the developers would not be provided, in an attempt to observe the users' adaptation to the new platform. In addition, 19 members of the university's community were given the role of the user, without any further training, only relying on the directions given in an informative email. The users were given a period of ten days to place their order and during this period every case scenario was tested, e.g., what happens if a user needs to place an order after the end of the given period, if he needs to edit his order after the submission, or if he does not place his order at all.

Subsequently, a user satisfaction survey was conducted, where the 19 individuals that had been given the role of the user participated. The sample of the users consists of 57.89% females and 42.11% males. The 42.11% was above 45 years old (yo), the 26.32% was between 36-45yo, and, the 31.57% was among 18-25yo. In terms of the participants' profession, the largest share (36.84%) was Laboratory Teaching Staff members, the 31.58% was students, the 21.05% was administrative staff, and, the 10.53% was Professors.

The first crucial factor to determine the success of the project refers to the time needed for an order to be placed, with and without the developed platform. For both cases, possible responses were 1) less than 5 minutes (m), 2) 6-10m, 3) 11-15m, 4) more than 15m. Figure 2 shows the boxplot comparing process time with the existing approach (legacy) compared to the use of the BPMS. To compute the boxplot, we used specific values for the four alternatives: (1) 5m, (2) 8m, (3) 13m and (4) 15m. So this is a conservative figure that, however, shows a substantial acceleration of the process, halving execution time.

Another key question for establishing the success of the platform, was whether the participants thought that the platform improved or not the procedure. The vast majority (94.74%) stated that the platform improved the procurement process, while 5.26% (one user) stated that the platform neither improved nor worsened it. In Figure 3 the satisfaction of the participants is illustrated for the questions:

- Q1: Rate the user friendliness of the platform e.g. menu, the messages etc.
- Q2: How satisfied are you with the ease of navigation within the platform?
- Q3: Rate the graphics of the platform e.g. colors, buttons, icons etc.
- Q4: Rate the overall ease of filling an order form (lists with available products, input fields etc).
- Q5: Rate the overall experience in using the developed platform.

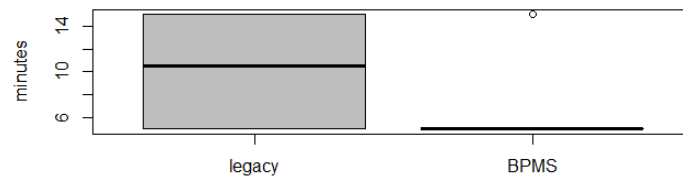


Fig. 2 Acceleration of the process in minutes

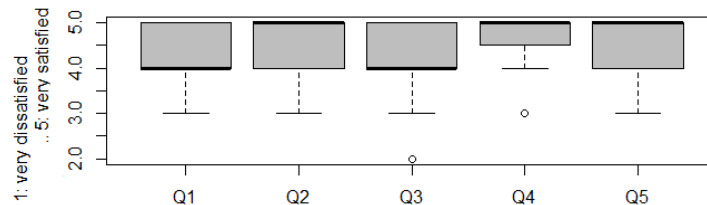


Fig. 3 Results of satisfaction survey

For the above mentioned questions the users had to express their satisfaction in a scale from one to five, where, five (5) corresponds to the user being very satisfied, four (4) to satisfied, three (3) to neutral, two (2) to dissatisfied, and, one (1) to very dissatisfied.

As the purpose of the project was to examine whether such systems can be easily integrated within public institutions, the developed platform, as an instance of the simplest way of integrating a BPMS in an organization, proved to be adequate for the automation of the ink cartridges' procurement process, leaving space for further improvement. Also, as far as the administrators are concerned, not only were they willing to adopt the developed system, but they found the system easy to use. Furthermore, during the development and the following pilot test, certain issues arose regarding the security of the platform. From our experience, when developing such solutions, emphasis should be given to the security as well as to the development of the process.

Conclusions

Even though there are some attempts for technological integration in the Greek Public Sector, an adequate level of automation seems to be far from occurring. Our case study recommends the use of an open-source Business Process Management System that contributed to the automation of the time consuming process of ink cartridges' procurement. The feedback gained from the pilot test and the satisfaction survey is encouraging.

Our work is in line with the effort that is currently placed in reengineering the public sector services processes in the context of the recently released Digital Reform Bible of the Hellenic State [9] and extends previous works [3] by using an open source solution and by comparing the available frameworks. Also, the present paper refers to the parallel tasks, which to the authors' best knowledge is a feature that needs special handling in numerous BPMSs and is an issue that needs further documentation.

A very interesting direction for future work is the integration of agents representing actors (or public organizations) in a business process. Their participation could be dependent on sophisticated business rules, possibly expressed using computational argumentation, so that their actions within the process are explainable and context-dependent (e.g. an agent deciding on whether a piece of sensitive data can be shared with a requesting person [14]).

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