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Business Process Management Analysis with Cost Information in Public Organizations: A Case Study at an Academic Library

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Abstract: Public organizations must provide high-quality services at a lower cost. In order to accomplish this goal, they need to apply well accepted cost methods and evaluate the efficiency of their processes using Business Process Management (BPM). However, only a few studies have evaluated the addition of cost information to a process model in a public organization. The aim of the research is to evaluate the combination of cost data to process modeling in an academic library. Our research suggests a new and easy to implement process analysis in three phases. We have combined qualitative (i.e., interviews with the library staff) and quantitative research methods (i.e., estimation of time and cost for each activity and process) to model two important processes of the academic library of the University of Macedonia (UoM). We have modeled the lending and return processes using Business Process Model and Notation (BPMN) in an easy-to-understand format. We have evaluated the costs of each process and sub process with the use of Time-Driven Activity-Based Costing (TDABC) method. The library's managers found our methodology and results very helpful. Our analysis confirmed that the combination of workflow and cost analysis may significantly improve the decision-making procedure and the efficiency of an organization's processes. However, we need to further research and evaluate the appropriateness of the combination of various cost and BPM methods in other public organizations.

Keywords: academic library; business process management; cost analysis; process analysis; business process modeling; TDABC

1. Introduction

Public sector organizations, such as academic libraries, are compelled to provide first-class services despite their limited funding. Academic libraries have experienced significant cost reductions over the last decade due to reduced financial resources and digitalization of services [1–3]. The libraries' managers need to adopt cost saving techniques and analyze process costs to manage this challenge.

An effective cost analysis will help academic libraries efficiently allocate the library's resources and reduce costs by avoiding non-added value activities [1,4]. TDABC is an easy to implement accounting method that uses time equations to evaluate the cost and time for each process. Unlike the Activity-Based Costing (ABC) method, TDABC evaluates efficiently the indirect costs and avoids subjective and time-consuming activities [4]. However, academic libraries should first model the most important processes before adopting a costing method [5]. The library's managers should adopt Business Process Modelling for various reasons.

Business Process Modeling will help them thoroughly analyze the workflow, the activities, and the resources used for each process. The analysis of processes may help managers reduce operating expenses and overcome barriers between information systems

and staff [6,7]. It would also improve the control of the most important business processes. Implementing BPM may also help managers face operational challenges and deliver high-quality services [8,9].

Public sector organizations should adopt BPM for two main reasons. The primary reason is to reduce operating expenses and enhance the efficiency of existing infrastructure through increased digitization. The second reason is to offer high standard services [10]. Public sector organizations lag behind private sector companies in adopting BPM. Their managers face various challenges [11,12], that make it difficult to properly implement process management. In general, public and private organizations differ in various fields, such as accountability, policy transformation mechanisms, and culture [13]. Many strengths and obstacles exist, just as they do in the business world, that make it challenging to properly implement the procedural management in the public sector. The origin of these differences is not exclusively tied to the public sector; rather, it is the fact that there are challenges overall [13].

The combination of cost analysis data from a costing system and BPM diagrams may provide an in-depth analysis of financial value-flows and cost allocation. Cost analysis may be provided at multiple levels, such as process, sub-process, activity, and resources. Cost information will help managers organize business processes and allocate the organizational resources more efficiently. They can also evaluate the direct and indirect costs for each activity and understand how to reduce costs by improving or removing activities of a business process.

However, only a few researchers have evaluated the addition of cost information to Business Process Modeling [14,15]. Magnani and Montesi (2007) [15] included cost in business process models and evaluated the hotel reservation process. Mueller-Wickop et al. (2011) [14] proposed a finance notation to model financial flows with the use of BPMN. The modeled processes were extracted from Enterprise Resource Planning (ERP) and Accounting Information Systems (AIS). Nevertheless, there is a lack of real case applications with public organizations. Moreover, business process modeling techniques used in previous research [14,15] lack the concepts to present financial information accurately.

The aim of this study is to evaluate the integration of cost analysis data to process mapping in a real case scenario. We have chosen the library of the University of Macedonia, Thessaloniki, Greece as our case study. UoM is a medium-sized university, which serves a broad range of scientific fields at the undergraduate and post-graduate level. The academic library provides its services to 17,910 students and 200 professors. The UoM library managers cannot have a breakdown of expenses by activity due to the inefficiency of the accounting information system [4]. Thus, they cannot estimate and evaluate the cost of the library's services [4].

The paper is organized as follows. The theoretical background is presented in Section 2 after the introduction section. The research methodology is discussed in Section 3, while the results of our case study are presented in Section 4. In the last section, we discuss the findings of our studies and conclude our research.

2. Theoretical Background

2.1. Business Process Management

BPM is "the combination of art and science" to oversee how work is performed in an organization. It ensures consistent outcomes and takes advantage of improvement opportunities [16]. BPM is a well established and commonly used field of study. The process lifecycle is fundamental to BPM because it helps standardize how a process is introduced to and maintained within an organization [16].

BPM is analogous to the ambidexterity of an organization, since it reflects the entity's ability to model, deploy, optimize, and manage processes in response to an ever-evolving external environment. The need for context awareness in BPM projects to generate business value grows in the context of fast digitization. However, there is heated disagreement in the academic community over the connection between BPM and digital innovation.

Despite having its beginnings in the revolutionary Business Process Reengineering of the 1990s, several academics have argued that BPM has shifted its attention to process control and optimization in the last few decades. Researchers noted as early as the turn of the millennium that large firms lacked the agility to respond to digital disruption and adapt existing BPM practices to disruptive technologies due to inertia, a lack of incentives, or an underestimation of the value of the new prospects presented by these technologies. However, BPM is able to utilize cutting-edge digital technologies in a more experimental manner, as seen with robotic process automation [16].

Organizational ambidexterity is one of the most important concepts because of its link to long-term market success. The firm's ambidexterity can be seen in how it successfully navigates the competing pressures of exploration and exploitation. Both the exploitation success trap, which strengthens and exacerbates organizational inertia by limiting responsiveness to environmental shifts, and the exploration failure trap, which lacks concrete short-term results while being oriented to search for innovation, can be avoided by keeping an eye on these competing forces [17–19].

The goal of BPM is to analyze and examine business processes in a methodical way so that they can be optimized [20]. An organization is a holistic system of processes, as defined by management science. Business Process Modeling languages, such as BPMN, produce comprehensible graphical representations of an organization's critical processes. Organizational information systems cannot be built without first utilizing process modeling and mapping. Business process management's goal is to synchronize organizational goals and strategies to market requirements [21].

BPMN 2.0 is an easy-to-understand notation that uses various symbols, which describe process flow. The most important symbols are: (a) event (start, intermediate, and end), (b) flow symbols (sequence flow, message flow, and association symbol), (c) activity or task, (d) message, (e) sub-process, (f) gateway (the decision point that separates the process flow according to a condition), (g) data elements (information and document), and (h) swim lane (it groups business process objects to a lane).

One step forward in the use of BPM is the addition of pricing information in BPM models. An in-depth evaluation of monetary value-flows and cost allocation may be possible with this additional data. The managers will be able to analyze the cost of each process at various levels (sub-process, activity, and resource).

2.2. BPM and BPMS

Increasing customer demands, volatile markets, and unpredictable economic shifts have all contributed to today's challenging business climate. Thus, businesses must deal with the ever-shifting nature of the marketplace and, to thrive, continually innovate and modify their methods of operation. As a result, many businesses now operate under a new BPM-based organizational model. BPM has recently emerged as a central topic in management studies. Management is the study of directing activities inside an organization to achieve desired results consistently and profit from obtainable enhancements [22].

The idea of a business process serves as the foundation for BPM. Thus, a business process is the collection of related tasks carried out by employees in an organized fashion context of a technical kind [23]. As such, it defines what (activities), who (organizational and technical environment), and how (coordination) of work inside an organization [22]. The concept of business processes has become increasingly popular in recent years as a means by which businesses can record, control, and improve their operations [23].

Recent research on BPM highlights the rising recognition that BPM is not just about technology, but also involves a holistic organizational approach, incorporating human components of business processes. As a result of the widespread adoption of BPM principles by businesses around the world, a new category of software has emerged: the so-called business process management system (BPMS). These programs facilitate and coordinate business process execution and task allocation [19].

Instances of business processes are managed by the BPMS and carried out in accordance with the rules set out in their corresponding process models. The primary artifact used to depict a process is a process model. Business modelers typically employ a graphical representation of the process, utilizing elements from a predefined language or notation, such as activities, gateways, events, sub-processes, resources, and data [19].

Each human resource's position and role within the organization are modeled in a process model in addition to the process itself. In order to execute business processes and keep track of them (as instances or cases), process models are developed and refined [22].

In accordance with the process models, a BPMS allocates work during the execution of a business process instance to the appropriate human or non-human resources (automations) [24]. BPM is becoming increasingly complicated and dynamic with the involvement of highly qualified individuals.

2.3. BPM in the Public Sector

Public sector organizations face difficulties in meeting the expectations for enhanced public services as a result of the swift changes in local and global socio-economic settings. The public sector is frequently characterized by antiquated and rigid procedures, red tape, and bureaucracies, and it frequently experiences abrupt changes in policy as a result of elections and shifts in the political landscape. Public sector enterprises all over the world have shown a significant interest in adopting BPM concepts and practices because they see the potential of BPM as an enabler for high performance and increased customer centricity [25].

BPM practices in many companies or sectors have been researched over time. However, as von Brocke et al. (2016) [26] point out, it is unclear whether these techniques apply to all industries. An earlier study on BPM found that while product and service firms adopted BPM differently, commercial and public enterprises adopted it similarly [27]. Given their basic differences, it is debatable if these models and their relationship to process performance are comparable in the context of the public sector [28]. However, the findings indicate that private organizations have considerable route coefficients for information technology, resources and expertise, process improvement, and measurement that are not present for public organizations [28]. According to Van Looy and Van den Bergh (2017) [27], public organizations are lagging behind in adopting BPM practices, so it is imperative that they invest in IT support and boost employee expertise (through trainings or knowledge-sharing communities) in order to improve the performance of the organization.

Public sector organizations face important challenges. Due to severe budget cuts, they need to reduce costs but also increase productivity [8,9,16]. Government agencies have made great strides in recent years to streamline their processes and provide more consistent services. However, governments have traditionally lagged behind private-sector businesses in adopting new technologies. The delay may work in the public sector's favor by allowing agencies to select the most effective methods [18,29]. In relation to these revolutionary shifts, BPM has been pondering how to incorporate radical, disruptive innovation into its operations without compromising on efficiency or operational excellence [18,29].

Business process management could benefit public sector organisations looking to update their outdated processes by better integrating information technology (IT) [30,31]. Public organizations may adopt a cost-effective enterprise model that will allow them to modernize and digitize their infrastructure. The implementation of BPM may also help them implement high quality services [10,32].

BPM's ability to easily model a wide variety of business processes is an important advantage. The use of BPM allows a fast and low-cost integration of new IT systems into existing business operations [33,34]. By modeling the organization's processes and including data about the allocation of resources, BPM presents managers with a unified picture of their business [35]. According to Gulledge and Sommer (2002) [31] and Genon et al. (2011) [36], public organizations can reap many benefits from implementing BPM. These are: (a) better alignment of public administration goals with resource management goals; (b) greater

transparency and accountability; (c) constant improvement of services; (d) greater productivity and cost savings; (e) faster response to policy shifts and unforeseen occurrences; and (f) higher efficiency.

2.4. Activity-Based Costing and Time-Driven Activity-Based Costing

The costs, however, must be estimated with the use of an accounting method. ABC and TDABC are two relatively new, but widely used, costing methods. In 1998, Cooper and Kaplan came up with ABC costing system [37]. ABC provides an accurate assessment of indirect costs and unit cost estimates for each activity [34]. Reviewing timesheets, conducting employee interviews, and gaining insight from direct observation contribute to a precise estimate of the total cost. However, the ABC method may be difficult to implement in organizations with many functions. Due to its reliance on regular updates through interviews and surveys, ABC is a time-consuming and resource-intensive method. For these reasons, many businesses have abandoned the ABC method [34–40].

TDABC is a simpler, more accurate, and easier to use method compared to ABC [21,39,40] (Table 1). TDABC measurements are defined in terms of time [39]. TDABC calculates time, money, and resource requirements for each task. TDABC uses time equations to calculate the unit cost per time for each activity. Managers can easily make modifications to this method, such as adjusting the resource rate or recalculating how long each activity takes. Indirect cost estimation [38], activity cost estimation [41], and the identification of critical and inefficient processes [42,43] are all analyzed with the help of TDABC.

Table 1. Comparison of ABC and TDABC cost methods.

Feature	ABC Method	TDABC Method
Cost allocation	In two stages	In one stage
Estimation of drivers	Subjective	Objective
Action for an additional activity	Survey	Estimation of the unit time of the new activity
Method cost	Expensive	Easy to create and maintain
System building	Per season or per year	Per event
System update	Expensive	Flexible
Information	Less precise	Precise
Transparency	Good	Very good
Overestimation of costs	Yes, possible overestimation of unit cost and sale price	No
Differentiation of service level	No	Yes
Oversimplification of activities	Yes	No
Capacity planning	Neglects unused capacity	May perform further capacity analysis

Cost information has been proposed as a BPMN extension by Magnani and Montesi (2007) [15]. They identified the following types of diagrams: (a) processes with a single token, (b) processes with a nested single token, and (c) processes with multiple tokens and multiple ends. With the exception of the last class, where only the average cost was added, all other classes of diagrams included cost intervals and average costs. Sampath and Wirsing (2009) [44] proposed cost and reliability estimates for each process task. They recommended segmenting the operation into a series of smaller, repeatable steps to more accurately calculate the total cost. Using the RCA cost methodology, Mueller-Wickop et al. (2011) [14] incorporated cost data into BPMN models. They [14] proposed a simplified version of financial notations for complicated BPMN processes. They added accounting data to only three BPMN symbols (i.e., activities, link arrows, and groups) without analyzing cost estimations. However, none of the above-mentioned studies have integrated TDABC or any other widely used costing methodology into BPM process models.

2.5. The Use of TDABC in Academic Libraries

TDABC approach was initially applied to evaluate the library lending services of the Arenberg Library, which is located within the Katholieke Universiteit of Leuven, Bel-

gium [45]. The authors concluded that TDABC may be able to reduce the cost of the library services because it breaks down the expenditure per transaction and shows the inefficient and costly activities. This information may assist staff to take all the necessary actions to reduce time required to fulfill the patrons' requests. The TDABC method takes into account a wide variety of factors that are not directly related to an employee's performance at work, but have an impact on her/his productivity and effectiveness. These features may include communication time, rest periods, personal time for breaks, arrival and departure time, and rest period.

Stouthuysen et al. (2010) [46] used the TDABC method to evaluate the cost of a procurement process for an academic library of a Belgian university. The authors assert that TDABC may help managers to visualize better the efficacy of capacity usage and the efficiency of the purchase process. This information could help them achieve more effective cost management.

On the other hand, Kont and Jantson (2011) [47] claim that the ABC model, as well as the TDABC model, are both appropriate for university libraries. The same authors [48] used the TDABC method in 2015 to conduct an analysis of the acquisition process costs at an Estonian university library. The authors came to the conclusion that the TDABC technique is appropriate for use in a library because it can analyze a large number of activities that have complicated time drivers. TDABC may also provide reliable information that identifies nonvalue activities. In summary, the TDABC method seems to be one of the most effective ways to understand cost behavior and set a cost structure for academic libraries.

Siguenza-Guzman et al. (2014) [1] assume that TDABC can be used in large libraries. They claim that the participation of library employees is a very important factor for the application of TDABC method. They also conclude that TDABC results will improve decision-making for the library staff and library administrators.

The application of TDABC to the cataloging procedure of a library is the subject of a second case study by Sigüenza Guzmán et al. (2014) [1]. The authors believe that TDABC is an effective method for cost analysis in cataloging operations and that it may provide useful information for decision-making. Another case study describing the adoption of the TDABC approach in two Belgian libraries was reported by Siguenza-Guzman et al. (2016) [41]. They analyzed the labor flow of the most important library functions (i.e., acquisition, cataloging, circulation, and document delivery). According to their results, the TDABC method could be used in libraries to improve process benchmarking and help managers understand how to improve the library's processes.

3. Methodology

The aim of our study is to examine the hypothesis that the addition of financial information from TDABC method to process models is beneficial for a public organization. Our research adopts a case study approach. The case study is a research strategy that examines thoroughly a phenomenon within its context [49].

We have modeled the two most popular for the user library processes (i.e., the lending and the return of item/s from the main collection) of the circulation department of the UoM library. This department is considered the most important, since it manages the most popular library services (i.e., lending, return, renew, pay fine, and shelving). [50,51]. UoM is a middle-sized Greek university, which offers undergraduate and postgraduate studies. The UoM library employs twenty one librarians and serves about 18,100 students and professors. The UoM library managers cannot evaluate efficiently the cost because the library's accounting system cannot allocate the costs for each service [4]. Our study will help UoM library's managers to evaluate efficiently the library's processes and to detect organizational inefficiencies, risks, and high costs.

Our analysis is divided into three phases. In the first phase, we have created the process models. We have studied the library's guides and interviewed the UoM library managers and staff using open questions. We have identified the activities and the different

scenarios (i.e., cases) for the lending and return process, since both processes have more than one case.

In the second phase, we have used the TDABC costing method to estimate the time and cost of each process. We have followed these five steps to apply TDABC [45]: (1) estimate the total cost of each resource group, (2) estimate the practical time capacity of the resource groups, (3) calculate the unit cost of the resource groups, and (4) estimate the time for each activity via direct observation with the use of a stop watch and create time equations for each process. We have also validated the results of the observations with repeated measurements, and we (5) estimate the cost per activity and the cost of each process, according to different cases.

In the third phase, we have added cost and time information to the process models. We have extended the research of Magnani and Montesi (2007) [15] and used BPMN notations to include not only cost but also time information [52]. We have estimated the total cost and time for each case. We have included this information in the activity symbol to make it easier for the library manager to read and understand. We have also estimated the probability for each choice. Following Magnani and Montesi (2007) [15], we have displayed this information near the gateway symbol. At the end of the diagram, we have displayed, in a separate table, the activities, total time, and cost for each case. Finally, we have estimated the total average cost for the lending and return process according to the probability of each case.

We have estimated the costs for each process during a whole year (January–December 2017) to cover winter semester, spring semester, and the holiday season periods. During the spring semester of 2017, we have recorded the time spent for each activity with the use of a stopwatch. We have validated our data by repeating the measurements for the winter semester of 2017. Finally, we have estimated the average time of each process [1]. The total number of observations was rather large (100 for the lending process and 101 for the return process) to obtain more accurate results.

4. Results

Figure 1 presents the modeling and cost analysis of the lending process from the main library collection, with the use of BPMN 2.0 and TDABC. Firstly, the patron (i.e., student, professor, or citizen) searches the library's online catalog to find out whether a copy of the item(s) is(are) available for borrowing (Activity a). If it is (they are) available for lending and the patron wants to borrow it (them), he/she writes down the unique identification number and looks it (them) up at the main collection's bookshelves (Activity b). If he/she finds it (them), he/she carries it (them) to the main desk of the library. The first librarian available at the circulation desk requests the patron's borrowing card (Activity c). She/he enters the borrowing card's barcode to access the patron's record from the library's circulation system and starts the lending transaction (Activity d). If the patron has an unpaid fine, the operation cannot be carried out unless the fine is paid (Activity e). The customer pays the fine with cash (Activity f) or with a credit card (Activity g). The librarian processes the transaction (Activity h) and issues a receipt (Activity j).

The librarian updates the library system and enters the barcode(s) of the item(s) (Activity k). The librarian stamps the item's due date on the attached card on the last page of the lending item(s) (Activity l). Finally, the librarian uses the necessary equipment to desensitize the lending item(s) and hands it (them) to the patron (Activity m) [4].

There are three cases related to the lending process (Figure 1). According to the first case, the patron borrows the lending item(s). This process (Activities: a, b, c, d, k, l, and m) lasts 0.95 min and costs 0.77 euros. According to the second case, the patron pays a fine with cash and then borrows the lending item(s). This process (Activities: a, b, c, d, d, e, f, h, j, k, l and m) lasts 2.32 min and costs 1.93 euros. According to the third case, the patron pays a fine with his/her credit card and then borrows the lending item(s). This process (Activities: a, b, c, d, d, e, g, h, j, k, l and m) lasts 2.29 min and costs 1.9 euros.
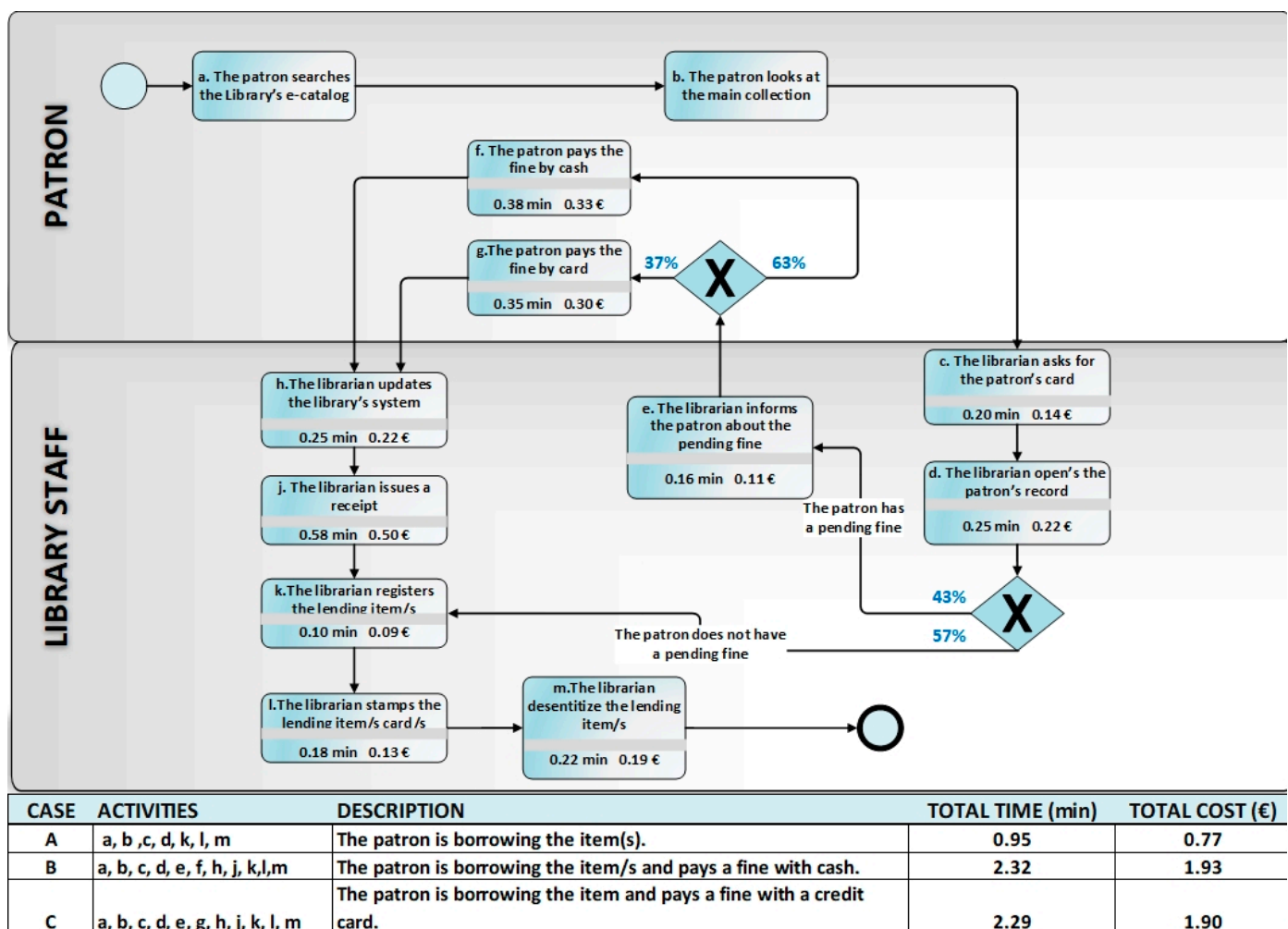
CASE	ACTIVITIES	DESCRIPTION	TOTAL TIME (min)	TOTAL COST (€)
A	a, b ,c, d, k, l, m	The patron is borrowing the item(s).	0.95	0.77
B	a, b, c, d, e, f, h, j, k,l,m	The patron is borrowing the item/s and pays a fine with cash.	2.32	1.93
C	a, b, c, d, e, g, h, j, k, l, m	The patron is borrowing the item and pays a fine with a credit card.	2.29	1.90

Figure 1. Business Process Model for the lending of item/s from the main collection.

According to our cost analysis, the total cost of the lending process varies from 0.77 to 1.93 euros (Figure 1). The lending process can be implemented much more quickly when the patron has no pending fines (estimated time = 1.35 min and estimated cost = 0.77 euros). If the patron has to pay a fee by cash or card, then the total cost and time is almost doubled (Figure 1). It almost takes a minute to pay a fine with a credit card or cash.

The average cost for the lending process is (Figure 1):

(Case A cost * Percentage of Case A cases) + (Case B cost * Percentage of Case B cases) + (Case C cost * Percentage of Case C cases) = 0.77 * 0.57 + 1.93 * 0.43 * 0.63 + 1.90 * 0.43 * 0.37 = 0.408 + 0.523 + 0.302 = 1.233 euros.

The percentage of patrons who pay a fine is rather high (43%).

Figure 2 presents the modeling and cost analysis of the return process to the main collection, with the use of BPMN 2.0 and TDABC. Firstly, the patron brings the lending item(s) to the library. The first available librarian in the circulation desk picks the item(s) from the patron (Activity a) and enters his/her barcode(s) in the library's circulation system (Activity b). If there are any unpaid fines, the librarian asks the patron for her/his borrowing card and informs her/him about the pending fines (Activity c). The patron pays the fine with cash (Activity e) or with a credit card (Activity d). The librarian updates the system (Activity f) and issues a receipt (Activity g). The librarian sensitizes the lending item(s) (Activity h) and places it (them) in the trolley (Activity j). The next morning or noon, the librarians sort and place the returned items on the library's shelves (Activity k) [4].
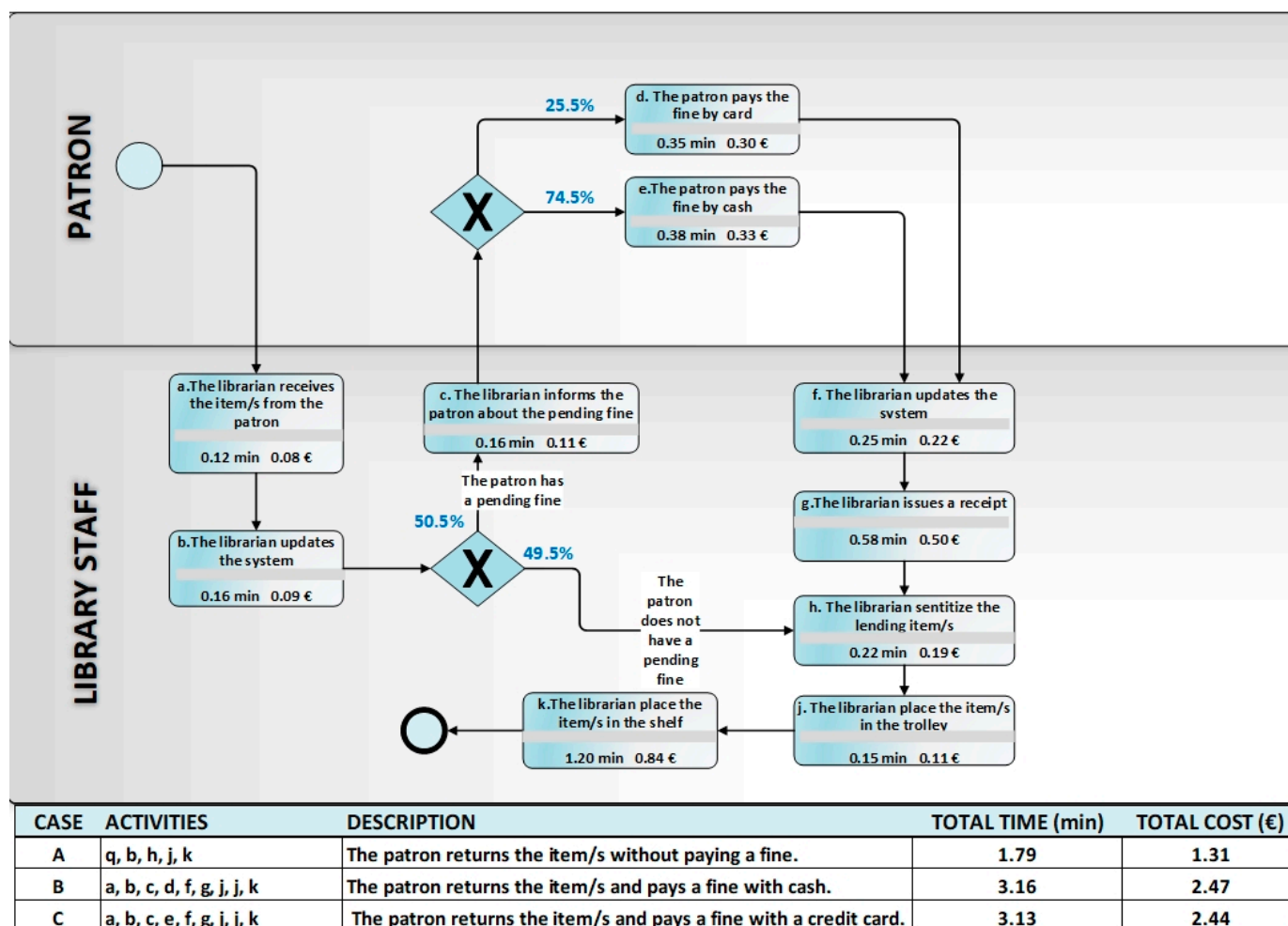
Figure 2. Business Process Model for the return of the lending item/s from the main collection.

There are three cases related to the lending process (Figure 2). According to the first case, the patron returns the lending item(s). This process (Activities: a, b, h, j and k) lasts 1.79 min and costs 1.31 euros. According to the second case, the patron pays a fine with cash and then returns the lending item(s). This process (Activities: a, b, c, e, f, g, h, j and k) lasts 3.16 min and costs 2.47 euros.

According to the third case, the patron pays a fine with his/her credit card and then returns the lending item(s). This process (Activities: a, b, c, d, f, g, h, j and k) lasts 3.13 min and costs 2.44 euros.

According to our cost analysis, the total cost of the return process varies from 1.31 to 2.47 euros (Figure 2). The most time consuming and expensive activity of the return process (Figure 2) is placing the item(s) back on the library shelves (estimated time = 1.2 min; estimated cost = 0.84 euros). The payment of a fine with cash or a card is also a time-consuming and expensive step (total estimated time is almost two minutes and total estimated cost is almost one euro).

The average cost for the return process is (Figure 2):

(Case A cost ∗ Percentage of Case A cases) + (Case B cost ∗ Percentage of Case B cases) + (Case C cost ∗ Percentage of Case C cases) = 1.31 ∗ 0.495 + 2.47 ∗ 0.505 ∗ 0.745 + 2.44 ∗ 0.505 ∗ 0.255 = 0.648 + 0.929 + 0.314 = 1.891 euros.

The percentage of patrons who pay a fine is high (50.5%).

We have described the methodology of our research and the results of our analysis to the library managers. The managers found our analysis very useful and constructive. The analysis of cost, time, and probability of each choice for the lending and return process

helped them understand the origin of costs and identify non-value-added activities. They also had a better understanding of how they could reduce the overall cost of these two processes, which are so important to the library.

5. Discussion and Conclusions

Public sector organizations, such as academic libraries, should try to be more efficient and cost effective and adopt private sector best practices, such as process modeling. We have evaluated the integration of TDABC cost data to the process models of the two most important services of the UoM library. The use of BPMN modeling with cost data helped library managers analyze detailed and easy to understand cost and time information for each process. This new visualized tool helped them understand how to improve the cost effectiveness of the lending and return processes.

They have realized that the most expensive activities of the lending process (Figure 1) relate to the payment and management of the patron's fines. The payment of a fine during the return process is also a time-consuming and expensive sub-process. The percentage of patrons who have to pay a fine during the lending or return process is rather high. However, the payment of fines is a sub-activity that can be avoided. The patrons seem to receive incomplete information about when to return lending items. The library staff should try to inform constantly the patrons to return the lending items on time. They could also use the library's information system to send automated messages to the patrons [4].

UoM library's managers discovered that the most time-consuming and expensive activity of the return process (Figure 2) is the placement of the item(s) on the library shelves (Estimated time = 1–2 min; Estimated cost = 0.84 €). According to Kissa et al. (2019) [4], this activity does not require specialized knowledge and can be carried out by trainees. The library managers may adopt blended learning techniques [43] and educate the trainees face to face or with e-learning courses. The UoM library could also use new technologies, such as robotic services, to automate repetitive processes.

Public organizations should try to modernize their operations and improve productivity, outcomes, transparency, and accountability. BPMN is a useful process modeling tool, which may help managers improve the efficiency of the organization's processes. The application of BPMN helped the library's managers to understand the process flow and detect organizational inefficiencies. TDABC is a reliable and easy to implement cost method, which helps identify the value-added and non-value-added activities and the origin of costs.

The combination of BPMN and TDABC analysis helped library' managers suggest ways to reduce the duration of the two processes and improve the use of resources. The combination of time and cost information to the library's process models may help a public organization enhance the quality of its services and increase the value to its customers.

The use of BPMN process diagrams with cost data can be added as an extra module in an ERP system. Our methodology suggests only the use of the activity and gateways BPMN symbols to present cost data. The user should use the extra ERP module to create a process and cases for each process. She/he may also insert all the necessary data according to TDABC method (i.e., resources data (i.e., type, name, availability (hours per month) and cost), assignment of resources to activities, duration of each activity), and the total number of observations for each case. The module should evaluate the cost and time of each case and the average cost and time for each process.

Alternatively, an organisation might even create a software tool for strategic process management and cost analysis. Sigcha et al. (2019) [52] have proposed the implementation of software applying TDABC cost data to BPMN process diagrams for assembly companies. They have suggested a specific programming environment with a certain programming language, framework, database management system, BPMN library, etc. They have described the software architecture based on the model-view-controller style. They have also described the following basic modules of the platform: (1) process management, (2) business process management, (3) process and cost analysis, (4) reporting, and (5) software

configuration. The suggested platform may extract various reports, such as process cards, process diagrams, etc.

BPA or BPMS systems may also include cost data on a daily or weekly basis. The use of these systems may help the library's managers to have a current and more accurate estimation of the library's processes. They can also help them compare current data with the models' estimations.

Our study contributes to BPMN literature by underlining the effectiveness of combining workflow and cost analysis in a public organization. The implications of our research suggest that the combination of cost data to process modeling may improve the efficiency of an organization's processes. Our research proposes a new process analysis that is easy to implement and consists of three phases. Our methodology combines information from administrative science and economics and may help managers analyze the most important library's processes and understand how to improve their efficiency. We have extended the research of Magnani and Montesi (2007) [15] and present financial data in an easy-to-understand format. In contrast to their research, our empirical analysis includes all the possible cases per process and the variable of time.

However, our study has some limitations. We have evaluated only two services of one academic library in Greece. In future research for the same library, we could evaluate other important processes, such as the interlibrary loan (ILL) or the renewal process with the same methodology. We could also extend our research and evaluate the processes of other Greek libraries. This benchmarking will help us assess more efficiently the advantages of workflow and cost analysis. Finally, a future study should examine thoroughly how well different cost and BPM methods work together.

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