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Time-Driven Activity-Based Costing Systems for Cataloguing Processes: A Case Study

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Abstract

TDABC is a relatively new costing management technique, initially developed for manufacturing processes, which is gaining attention in libraries. This is because TDABC is a fast and simple method that only requires two parameters, an estimation of time required to perform an activity and the unit cost per time of supplying capacity. A few case studies

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have been documented with regard to TDABC in libraries; all of them being oriented to analyse specific library activities such as inter-library loan, acquisition and circulation processes. The primary focus of this paper is to describe TDABC implementation in one of the most important library processes, namely cataloguing. In particular, original and copy cataloguing are analysed through a case study to demonstrate the applicability and usefulness of TDABC to perform cost analysis of cataloguing processes.

Key Words: Costing analysis; Time-Driven Activity-Based Costing; Cataloguing Processes; Library

1. Introduction

In the current economic situation, characterized by periodic shortages and limited budget resources, libraries are in search of methods to improve their process efficiency and provide high-quality services at lower costs (ACRL Research Planning and Review Committee, 2010; Cottrell, 2012). In order to improve their performance, library managers need to consider cost reduction and the inclusion of service costs in their decisions (Hoozée, Vermeire, & Bruggeman, 2012). Furthermore, they should strive to identify improvement opportunities and to eliminate costs related to non-value adding activities (Ellis-Newman, Izan, & Robinson, 1996). In order to do this, library managers must keep their activities, resources and costs under control, relying on valid information about activity costs, resource capacity and their performance (Stouthuysen, Swiggers, Reheul, & Roodhooft, 2010).

In service institutions such as libraries, several methodologies for costing analysis have been used for decades, whereas the Time-Driven Activity-Based Costing (TDABC) is one of the most recent approaches. TDABC is a cost management technique developed by Kaplan and Anderson to overcome the difficulties presented by previous costing systems (Kaplan & Anderson, 2007). By implementing TDABC in libraries, key benefits are expected, including the possibility of benchmarking different scenarios; identifying non-value added activities; and justifying decisions and choices for staff recruitment, training and new service development (Siguenza-Guzman, Van den Abbeele, Vandewalle, Verhaaren, & Cattrysse, 2013a).

Although some research has been carried out with respect to TDABC in libraries, these studies have been focused on specific library activities such as

the inter-library loan (ILL), acquisition, and circulation (Siguenza-Guzman, Van den Abbeele, Vandewalle, Verhaaren, & Cattrysse, 2013b). More research is still required to determine whether TDABC can be useful in other library services. Therefore, the aim of the paper is to provide more detailed insight on implementing TDABC for library cataloguing processes. We focus on this unit because cataloguing is considered for many libraries, to be one of their most expensive processes, especially original cataloguing (Manaf & Rahman, 2006). The remainder of this paper is organized as follows. Firstly, a brief outline of the theoretical background of costing systems is provided (§ 2). Secondly, the different steps involved in implementing TDABC in original and copy cataloguing are explained (§ 3). Thirdly, we discuss the similarities and differences found in the original and copy cataloguing regarding time and cost per activity (§ 4). In addition, a number of recommendations where process improvements were unveiled are included in this section. Fourthly, the benefits encountered when implementing the TDABC model in an academic library in Belgium are described (§ 5). We end this paper with a brief conclusion (§ 6).

2. Theoretical Background: Costing Systems

2.1. Traditional Costing Systems

Several library cost analysis studies have been performed since the 1970s (Roberts, 2003). However, these studies were mainly treated as technical rather than organizational or managerial innovations (Kont, 2011). Ellis-Newman et al. (1996) report that the majority of prior studies on library costs were undertaken in the United States, utilizing cost allocation models more compatible with traditional costing methods. Traditionally, the total product cost consists of direct costs, such as the cost of materials and direct labour, and a percentage of overheads as indirect costs (Siguenza-Guzman et al., 2013a). The latter includes training, marketing, and infrastructure, among others. Traditional costing systems are adequate when indirect expenses are low and product variety is limited. However, in an environment with a broad range of products and enhanced services, such as a library, indirect costs have become substantially more complex than direct costs (Siguenza-Guzman et al., 2013a). This situation renders traditional methods inadequate; not only for estimating the effect of strategic decisions, but also for providing crucial information to library managers (Ellis-Newman & Robinson, 1998; Kaplan & Cooper, 1998).

2.2. Activity-Based Costing Systems

Activity-Based Costing (ABC) is an advanced costing calculation that seeks to remedy the limitations of traditional methods (Kaplan & Cooper, 1998). ABC, promoted by Cooper and Kaplan in the mid-1980s, first accumulates indirect costs for each activity and then assigns the activity costs to the services causing that activity (Cooper & Kaplan, 1988; Ellis-Newman & Robinson, 1998). ABC has proven to be a valuable tool for libraries through its implementation in several case studies. For instance, Ellis-Newman et al. (1996) examined the application of ABC in academic libraries of two Western Australian universities. This study illustrates how activity costing helps managers to differentiate key activities from others that do not add value. In an additional study, Ellis-Newman and Robinson (1998) discuss the benefits of ABC for library managers and the steps involved in implementing ABC in an academic library. The authors show how traditional costing systems are unable to explain the relationship between costs and the underlying activities. Furthermore, Ellis-Newman (2003) demonstrates the type of information that an ABC system provides to assist decision-making with a case study in the user services area of an Australian academic library. In turn, Ching, Leung, Fidow and Huang (2008) employ ABC to examine the Super e-Book Consortium in Taiwan and Hong Kong. The study finds cost drivers of consortia business operations, and identifies the key consortium activities and their relevant costs. Moreover, Goddard and Ooi (1998) examined the development of ABC through a case study applied to library services at the University of Southampton. The authors present ABC as an option to overcome some of the problems of overhead allocations. Despite the benefits of ABC, they also describe significant problems with its practical application such as the amount of resources and time required for its development and maintenance. Eventually, Novak, Paulus and Clair (2011) describe how a medium-sized university library implemented ABC and other decision-making strategies to make budgetary cuts and thereby, redirecting library services.

Although a relatively extensive stream of literature finds that ABC systems provide interesting advantages for decision making in libraries, ABC also has its limitations. Kaplan and Anderson (2004, 2007) note that ABC is difficult and costly to implement and maintain, especially when the current accounting system does not support the collection of ABC information. Data collection is time consuming and costly because of the need to interview and survey the library staff to estimate the percentage of time spent on each

activity. While it works well in small organizations and limited activities, it becomes problematic to scale up to larger organizations (Hoozée et al., 2012). Managers also question the accuracy of the system since cost assignments are based on individuals' subjective information on how they spend their time. Furthermore, staff resistance could arise, as employees might feel threatened by the suggestion that their work should be improved. As a consequence, ABC systems tend to be outdated, and in some cases are abandoned and substituted by less demanding approaches such as Time-Driven Activity-Based Costing (Wegmann & Nozile, 2009; Yilmaz, 2008).

2.3. Time-Driven Activity-Based Costing Systems

TDABC is a useful cost management technique developed by Kaplan and Anderson in 2004 to overcome the difficulties presented by previous costing systems (Kaplan & Anderson, 2004). TDABC assigns resource costs directly to cost objects using a fast and simple framework that only requires the unit cost of supplying resource capacity, and an estimation of the time duration of an activity (Kaplan & Anderson, 2007). Unlike the percentages that employees subjectively estimate for an ABC model, the time duration in a TDABC model can be readily observed and validated (Kaplan & Anderson, 2007). For each activity, «costing equations» are calculated and computed by time equations, which are the sum of individual activity times (Yilmaz, 2008). Through the use of time equations, TDABC allows incorporation of variation in the time demands made by different types of transactions, and consequently the representation of all possible combinations of activities that a process performs (Kaplan & Anderson, 2007). Five main TDABC advantages, highlighted by Siguenza-Guzman et al. (2013a), are its simplicity to build accurate models and improve the understanding of the different processes; the opportunity of modelling complex operations thanks to the use of multiple drivers; a good estimation of resource consumption and capacity utilization; its fast maintenance compared to ABC models; and the possibility of using TDABC in a predictive manner.

TDABC has been carried out in specific library activities such as inter-library loan (ILL), acquisition and circulation. For instance, the first case study by Pernot, Roothooft and Van den Abbeele (2007) uses TDABC to calculate ILL costs and describes TDABC as a useful technique to reduce ILL resource costs and to renegotiate ILL service prices based on more accurate costs. The

authors conclude that TDABC is very suited to cope with increasing cost pressures, and its findings can contribute to improve library services at lower costs. A second case study presented by Stouthuysen et al. (2010) describes the use of TDABC for a library acquisition process. The authors state that TDABC provides library managers with a better insight into cost drivers, visualizes the acquisition process efficiencies and capacity utilization, and leads to potential cost efficiencies. As an illustration, they consider that 50% of some costs could be saved if administrative assistants get involved in the acquisition process instead of being performed by the head of department, provided that they are capable of doing these tasks. In addition, the authors demonstrate that TDABC can be updated rapidly and inexpensively to changes. Due to this flexibility, they consider that TDABC can be applied to other processes such as cataloguing or digitalized activities, with significant benefits. The latest case study by Siguenza-Guzman, Van den Abbeele, Vandewalle, Verhaaren and Cattrysse (2014) uses TDABC to analyse lending and returning processes. The authors provide several important insights for a successful implementation of TDABC in libraries such as: 1) collecting the time duration of the activities through direct observation to improve the level of accuracy; 2) using graphical representations of activity flows to validate the collected information straightforwardly; and 3) showing that clarifying the measurement purpose is crucial in improving the level of acceptance, and achieving the desired commitment with staff. They conclude that the TDABC implementation is worthwhile since it leads to a more accurate cost and process analysis for supporting decision-making.

3. TDABC in Cataloguing Processes

The data used for this research was collected at the Arenberg Campus Library[1] (Campusbibliotheek Arenberg, hence the abbreviation CBA) of KU Leuven in Belgium. CBA offers information sources on subjects of the exact sciences, engineering, architecture, kinesiology, and rehabilitation sciences (Campus Bibliotheek Arenberg, 2013). Its services are handled by approximately 20.5 full-time equivalent employees (FTE). In this case study, we focus on describing the application of TDABC in two types of cataloguing activities: original and copy cataloguing. The former refers to creating a new bibliographic record from scratch, while the latter to adapting a pre-existing record to the characteristics of the item in hand (Reitz, 2004).

For this case study, qualitative interview data with quantitative data analysis were combined following the six steps presented by Everaert, Bruggeman, Sarens, Anderson and Levant (2008) to calculate the cost of activities through the TDABC model. These steps illustrated in Table 1 are described in detail by Siguenza-Guzman et al. (2014).

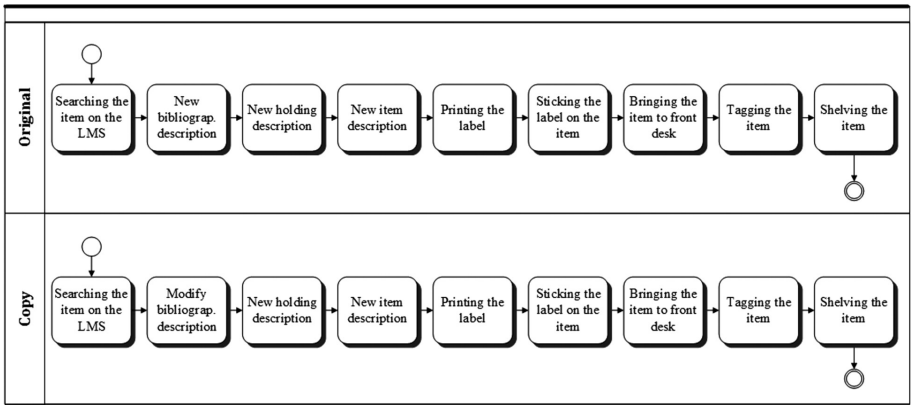
To identify resource groups involved in cataloguing activities as required in Step 1, multiple interviews were conducted. Initial interviews started through brief discussions with the library manager, and then moved to a more detailed level with the library staff. For each activity, a final interview was performed in order to validate specific details about the different sub-activities. During the interviews, key activities involved in each process were described in detail by employees in charge. The information was used to build flow charts of activity sequences. As Siguenza-Guzman et al. (2014) indicate, flowcharts allow a good overview of the different activities performed in a process, to identify additional expenditures such as computer maintenance and software licences, and afterwards to validate the activities in an optimal and simple manner. Figure 1 shows the activity flow of original and copy cataloguing respectively.

The total cost of each resource group required in Step 2 was provided by the accountant and library manager via the Library Management System (LMS). The costs were classified into direct and indirect costs. Direct costs included salaries of staff and student library employees — SLE (i.e. students hired to perform secondary activities), equipment, and technology. Conversely, examples of indirect costs included stationery, electricity, support, telephone, training, and other items used to perform an activity (Vazakidis & Karagiannis, 2009).

Table 1: Time-Driven Activity-Based Costing steps (Everaert et al., 2008).

Time-Driven Activity-Based Costing	
Step 1	Identification of resource groups
Step 2	Estimation of the total cost of each resource group
Step 3	Estimation of the practical capacity of each resource group
Step 4	Calculation of the unit cost of each resource group
Step 5	Estimation of the standard time duration of each activity
Step 6	Multiplying the unit cost of each resource group by the time duration per activity

Fig. 1: Original cataloguing process.



Note. – LMS = Library Management System.

The salary of cataloguers were calculated based on the average salary earned by employees responsible for cataloguing. According to the Chief Librarian, the total number of personnel assigned to cataloguing represents 1 full-time equivalent (FTE). The 1 FTE consisted of six people, each dedicating different amounts of their time to cataloguing processes. This corresponded to about €59,000 on a yearly basis. LMS costs covered the annual integrated library system and supporting software license fees attributed for the CBA. The Library Management System includes functionalities for acquisition, cataloguing, circulation and reporting. This integrated library solution was acquired for the entire library which consisted of the Central Library, three Campus Libraries and several Faculty Libraries for the Humanities and Social Sciences group. The LMS costs amounted to €17,000 on a yearly base. The annual computer maintenance costs for specific tasks such as reparation, maintenance, cleaning and depreciation of a PC in the cataloguing processes equaled €5,000. RFID maintenance costs refer to the costs associated with the maintenance, repair and inspection of the RFID system and yearly costs corresponded to about €17,000.

In the case of indirect costs, the library accountant estimated that about €195,000 was annually spent on general overhead (GO) costs. GO costs included management, secretary, accounting, training, staff meetings and stationery material. Other indirect values such as electricity, telephone, heating

and transportation were not accounted as part of general overhead costs since they were paid by the University and not charged to the library (Ellis-Newman & Robinson, 1998). In order to calculate the overhead costs attributed to cataloguing activities, general overhead cost was divided by the total number of FTE working at the entire library. This resulted in a yearly overhead of approximately €9,500 per FTE. An overview of the total cost of each resource group can be seen in Table 2.

Then, the practical capacity estimation of each resource group was calculated in Step 3. According to Kaplan and Anderson (2007, pp. 52–53), practical time capacity can be estimated in two different ways: 1) assuming an 80% of theoretical time capacity for people due to breaks, arrival and departure, training, meetings, and chitchats; and 85% for machines due to maintenance, repair, and scheduling fluctuations. 2) Calculating the real values according to the library situation, for example, available working hours, excluding holidays, meetings and training hours. In order to simplify the study, the first option was selected. For staff capacity, 38 hours per week were accounted as theoretical time capacity. It means 30.4 hours per week for practical capacity (staff practical capacity = 38 hours * 80%). Assuming fifty-two weeks per year, the practical capacity of a cataloguer is equal to 94,848 minutes per year $\left(30.4\frac{\text{hours}}{\text{week}}\times 52\frac{\text{weeks}}{\text{year}}\times 60\frac{\text{minutes}}{\text{hour}}\right)$. In the case of machines, the theoretical time capacity was set equal to the time in which cataloguers were available that is again 38 hours per week. Thus, the practical capacity for machines is 32.3 hours per week (machines practical capacity = 38 hours * 85%), and 100,776 minutes per year $\left(32.3\frac{\text{hours}}{\text{week}}\times 52\frac{\text{weeks}}{\text{year}}\times 60\frac{\text{minutes}}{\text{hour}}\right)$.

Table 2: Total cost of each resource group.

Total cost per resource group	
Resource Group	**Cost (€) per year**
Cataloguers	€59,000
Library Management System	€17,000
Computer Maintenance	€5,000
RFID Maintenance	€17,000
General Overhead	€9,500

Once the practical capacity was obtained, the cost per unit time was calculated in Step 4 by dividing the total cost of a resource (Step 2) by the practical time capacity (Step 3). An overview of the resulting costs involved in this analysis is shown in Table 3.

$$\text{Cost per unit time} = \frac{\text{time cost of the resource}}{\text{practical capacity}}$$

For the fifth step, Kaplan and Anderson (2007, p. 30) recommend that the time required to perform an activity should be estimated based on standard times rather than actual times, since these times might reflect random variation, individual employee variation and nonrecurring factors. Moreover, the authors argue that precision is not critical and that a rough accuracy is sufficient because gross inaccuracies will be revealed either in unexpected surpluses or shortages of committed resources. This level of accuracy can be obtained by multiple methods such as direct observation, interviews, process maps or leveraging time estimates from elsewhere in the institution (Kaplan & Anderson, 2007, p. 26). In our case study, the standard time to perform an activity was gathered in the academic period 2010–2011 through direct observation as recommended by Siguenza-Guzman et al. (2014). Observations were made multiple times using a stopwatch during several days at different hours in order to avoid possible biases (Siguenza-Guzman et al., 2014). Finally, based on their average values, an additional interview was performed in order to validate the data collection. Next, time equations were constructed for each activity. Time equations are the sum of individual activity times, which are represented with the following expression (Kaplan & Anderson, 2007):

Table 3: Costs involved in the analysis.

Total cost per minute for the different resource groups	
Resource Group	**Cost per minute (€/min)**
Cataloguers	0.62
Library Management System	0.17
Computer Maintenance	0.05
RFID Maintenance	0.17
General Overhead	0.10

$$\text{Time required to perform an activity} = (\beta_0 + \beta_1 \mathbf{X}_1 + \beta_2 \mathbf{X}_2 + \beta_3 \mathbf{X}_3 + \beta_4 \mathbf{X}_4 + \beta_5 \mathbf{X}_5 + \ldots + \beta_i \mathbf{X}_i)$$

With:

β_0= The standard time to perform the basic activity (e.g. 2 minutes)

β_i= The estimated time for the incremental activity *i* (e.g. time required for a librarian to enter an item in the cataloguing system = 0.5 minutes)

$\mathbf{X}_i$= The quantity of incremental activity *i* (e.g. items per batch = 1, 2…)

3.1. Original Cataloguing

The process, as shown in Figure 1, starts by searching the item in hand on the LMS in order to verify whether a similar record is already present in the database. This searching takes on average of 57s. If the item and record do not appear to match, the cataloguer creates a new record which includes the bibliographic description, requiring 306s (or 5min and 6s). A bibliographic description is the standardized description of an item including: title, edition, material specific details, details of publication, standard number, etc. (Reitz, 2004). The cataloguer then creates a new holding description, which is usually the information concerning the location of an item, taking 32s; and finally a new item description in 15s. Item description indicates item type, volume number, barcode, and loan rules. Once the new record is processed and stored in the database, the cataloguer prints the corresponding label (30s), and sticks on the item in 28s. Afterwards, the cataloguer brings the item to the front desk (30s) in order to tag the item (40s). An individual tag costs €0.30 including VAT. Eventually, the item is placed on the corresponding shelf or stack, requiring 168s (or 2min and 48s).

3.2. Copy Cataloguing

In contrast to the above process as shown in Figure 2, the cataloguer does find a record that appears to match with the item in hand. The cataloguer requires 74s (or 1min and 14s) to validate and modify the bibliographic description. Next, the cataloguer creates a new holding and item description, taking 32s

and 15s respectively. Labelling and shelving are the same as the original cataloguing process.

As the only difference between original and copy cataloguing is new versus modifying bibliographic description, we can create only one time equation by adding dummy variables in the equation. A dummy is a variable that takes the value 1 or 0 if a certain condition is true or false respectively. The resulting equation is as follows:

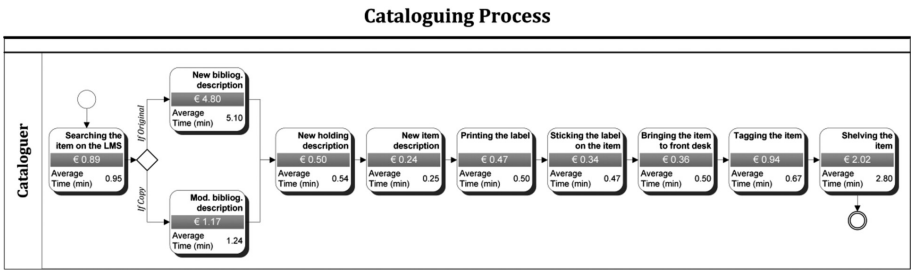
$$\begin{aligned}\textbf{\textit{Cataloguing}} &= \text{Searching} + \text{New}_{\text{Bibdescription}}\{\textit{if original\_cataloguing}\} \\ &\quad + \text{Mod}_{\text{Bibdescription}}\{\textit{if copy\_cataloguing}\} + \text{New}_{\text{holding}} + \text{New}_{\text{item}} + \text{Print}_{\text{label}} \\ &\quad + \text{Stick}_{\text{label}} + \text{Bring}_{\text{item}} + \text{Tag}_{\text{item}} + \text{Shelve}_{\text{item}} \\ \textbf{\textit{Cataloguing}} &= 0.95 + 5.10\ \{\textit{if original\_cataloguing}\} + 1.24\{\textit{if copy\_cataloguing}\} \\ &\quad + 0.54 + 0.25 + 0.50 + 0.47 + 0.50 + 0.67 + 2.80\end{aligned}$$

Once the estimated time per activity and the unit cost of each resource group is calculated, costs are assigned to cost objects by multiplying the unit cost per time of resources by the estimated time required to perform the activity. It is represented by the following mathematical expression:

$$\textit{Cost of an individual activity} = \textit{time required to perform an activity} * \textit{resources cost}$$

Figure 2 shows the resulting activity flow of the cataloguing process including average times and costs per sub-activity. Original and copy cataloguing are integrated in the same graphical representation by using decision

Fig. 2: Cataloguing process.



Note. – LMS = Library Management System.

diamonds. Finally, the total cost of the process is calculated by summing up all activity costs and can be represented by:

$$Total\ Cost\ of\ a\ Process = \sum costs\ of\ individual\ activities$$

The total costs and time incurred in the original and copy cataloguing processes are presented in Table 4. The resulting table is divided vertically into six columns and horizontally by standard and optional activities to separate the activities influenced by dummy variables. The first column lists the activities identified in the cataloguing process; the second column shows the average time per activity. The third column specifies the accumulated costs per minute of resources involved in each activity; the fourth column calculates the resulting cost incurred in the activity. The fifth column describes the condition under which two options are available to be selected: original and copy cataloguing. Eventually, the sixth column indicates the resource groups involved per activity.

The subtotal of "standard activities" is the sum of costs included in both processes: original and copy cataloguing. The average time in minutes for standard activities was 6.68 with an activity cost of €5.77. To calculate the total cost of the original cataloguing process, standard activities were summed up with the optional activity, new bibliographic description. The resulting time in minutes was 11.78 with a cost of €10.57. On the other hand, to calculate the total cost of the copy cataloguing process, standard activities were summed up with the optional activity, modify bibliographic description. The results show that the average time for copy cataloguing was 7.92 minutes and its cost was €6.94 per title.

4. Original and Copy Cataloguing

Because of budgetary constraints and technological changes, cataloguing units have significantly influenced the nature of cataloguing work (Mitchell, Thompson, & Wu, 2010). In order to become more efficient, cataloguers constantly search for new ways to increase bibliographic access without spending more money (Morris & Wool, 1999). That includes automation, outsourcing, lowered costs for traditional cataloguing, and an increasing variety of information resources to control. With regard to lowering costs, a number of studies on cataloguing costs have been reported in the literature. For

Table 4: Total cost of the cataloguing process.

	Cataloguing Process					
	Activity	**Average Time (min)**	**Cost per min (€/min)**	**Cost (€)**	**Condition**	**Resources**
Standard Activities	Searching the item on the LMS	0.95	0.94	0.89		Cataloguer + LMS + CM + GO
	New holding description	0.54	0.94	0.50		Cataloguer + LMS + CM + GO
	New item description	0.25	0.94	0.24		Cataloguer + LMS + CM + GO
	Printing the label	0.50	0.94	0.47		Cataloguer + LMS + CM + GO
	Sticking the label on the item	0.47	0.72	0.34		Cataloguer + GO
	Bringing the item to front desk	0.50	0.72	0.36		Cataloguer + GO
	Tagging the item	0.67	1.41	0.94		Cataloguer + LMS + CM + GO + RM + Tag
	Shelving the item	2.80	0.72	2.02		Cataloguer + GO
	Subtotal	**6.68**		**5.77**		
Optional Activities	New bibliographic description	5.10	0.94	4.80	*if original_cataloguing*	Cataloguer + LMS + CM + GO
	Mod. bibliog. description	1.24	0.94	1.17	*if copy_cataloguing*	Cataloguer + LMS + CM + GO
	Subtotal	**---**		**---**		
	Total Original Cataloguing:	**11.78**		**10.57**		
	Total Copy Cataloguing	**7.92**		**6.94**		

Note. – LMS = Library Management System. GO = General Overhead. CM = Computer Maintenance. RM = RFID Maintenance.

instance, the Iowa State University (ISU) conducted a longitudinal time-cost study to investigate the impact of automation on cataloguing costs (Morris, Hobert, Osmus, & Wool, 2000). Results showed that in 1987–1990, the average cost of original cataloguing at ISU was $34.13 and that copy cataloguing was $8.18 (Morris, 1992). In 1997–1998, original cataloguing costs performed by faculty cataloguers increased to $75.43 and to $58.72 when some original records were contributed by library assistants. Copy cataloguing costs, in the same period, increased to $35.82 when performed by faculty cataloguers and to $8.87 when performed by library assistants. Although costs of original and copy cataloguing increased during the time, Morris et al. (2000) also highlighted the fact that the average cost of cataloguing processes (i.e. copy, full original, minimal original and recataloguing) declined from $20.83 to $16.25 between 1990/91 and 1997/98. Authors attributed this decrease to national collaborative efforts, technological development, and reengineering efforts that have improved costs effectiveness and quality process (Morris & Wool, 1999). The University of Oregon, following the previous research at ISU, conducted a benchmark analysis during autumn 1997 to determine time and costs for acquisitions, cataloguing, and processing functions (Slight–Gibney, 1999). Results showed that the average cost for copy cataloguing was $9.23 per title, and that original cataloguing was $24.92. A third case study by Ellis-Newman and Robinson (1998) in an Australian academic library, reported the cost of library services utilizing ABC models. Results showed that the average cost of copy cataloguing at Edith Cowan University was $12.48 and original cataloguing was $54.39. Authors highlighted the importance of implementing activity-based costing systems in libraries to assign more accurate costs to services, to categorize costs, and to develop a price schedule for fee-based services.

In Table 5, all cases cataloguing costs vary library to library, even if the change in the rate of exchange and inflation are included in the three literature case studies. Charbonneau (2005) points out that these numbers logically vary because they are based on locally produced data and operations, individual cataloguing expertise, the type of material catalogued, and the cataloguing tools and resources available. Differences in overhead costs can also explain some of the cost variations. For instance, cataloguing overhead costs at ISU represent approximately 45% of the full costs, while in our case study about 10%. Unfortunately, not all studies provide detailed information on the overhead costs. In this case study, these costs include management, secretary, accounting, training, staff meetings and

Table 5: Cataloguing costs adjusted using inflation and exchange-rates.

Cataloguing costs in the four cases studies									
University	**Period**	**Original Cataloguing**	**Copy Cataloguing**	**Inflation**	**Inflated Original Cataloguing**	**Inflated Copy Cataloguing**	**EUR Conversion**	**Original Cataloguing (€)**	**Copy Cataloguing (€)**
Iowa State University (US)	1987–1990	USD $34.13	USD $8.18	68.66%	57.56	13.80	0.72	41.39	9.92
Iowa State University (US)*	1997–1998	USD $75.43	USD $35.82	37.69%	103.86	49.32	0.72	74.68	35.46
Iowa State University (US)†	1997–1998	USD $58.72	USD $ 8.87	37.69%	80.85	12.21	0.72	58.13	8.78
University of Oregon (US)	1997	USD $24.92	USD $ 9.23	39.91%	34.87	12.91	0.72	25.07	9.29
Edith Cowan University (AU)	1998	AUD $54.39	AUD $12.48	47.20%	80.06	18.37	0.74	59.41	13.63
KU Leuven (BE)	2010–2011	EUR €10.57	EUR €6.94	-	-	-	-	10.46	6.83

Note.– Inflation data from inflationdata.com (US, Dec 1987/1998 to Dec 2011), and rba.gov.au (AU, 1998 to 2011).
Exchange data from x-rates.com (USD and AUD to EUR in 2011).
* Cataloguing costs when performed by a faculty cataloguer.
† Cataloguing costs when performed by a library assistant.

stationery material; however, other university costs such as electricity, telephone, heating and transportation are not accounted for since they are not charged to the library. At ISU overhead costs are organized into overhead centres: paid leave, automation and support services (Morris et al., 2000). Some other studies consider overhead costs as approximate since they are estimates or based on incomplete data (Slight–Gibney, 1999). Additional factors that vary among libraries are the library structure and process flow, for instance, pre-cataloguing activities are included in the cataloguing costs of one library (e.g. ISU), by the acquisitions department at another library, or even delegated to library assistants or students. In our case study, this activity is not included in the cataloguing flow because it is performed by the person responsible for acquisitions. Finally, differences in the periods of analysis can also explain such cataloguing costs variations, especially due to evolving factors that need to be taken into account. These factors include the increasing automation of cataloguing activities, use of shared cataloguing and authority records, decreasing staffing for cataloguing, and the growing presence of new information formats (Morris & Wool, 1999).

Although cataloguing costs data are not necessarily comparable among libraries (McCain & Shorten, 2002); "best practices" can be adopted in other libraries to influence their own workflows and to streamline their processes. This case study contributes to the cataloguing cost study literature by providing an additional approach for calculating cataloguing costs based on a fast and simple method as is TDABC. In this case study, the copy cataloguing, as shown in Figure 3, is approximately 34% less costly and 33% less time-consuming than original cataloguing. Thanks to the TDABC's ability to disaggregate costs per activity, it is possible to clearly analyse which activities demand more time, and thus lead to higher costs. For instance, the unique difference between original and copy cataloguing is the creation or modification of a bibliographic description. Results shown in Figure 4 indicate that adapting a bibliographic description from a pre-existing record is approximately 75% less costly than creating a new full bibliographic record. Based on these findings, it is concluded that is worthwhile to recommend librarians to adapt a pre-existing record instead of creating a new bibliographic record from scratch, as this will lead to significant costs and time reductions. Copy cataloguing not only increases cataloguers efficiency by eliminating duplication of effort, but also by reducing typographical errors caused in local libraries (Beall & Kafadar, 2004).

Fig. 3: Comparison of original and copy cataloguing in terms of time and cost.

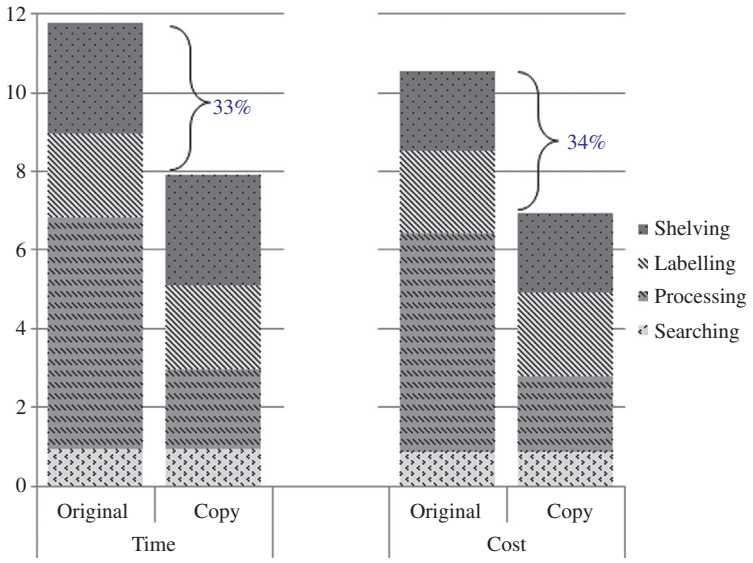
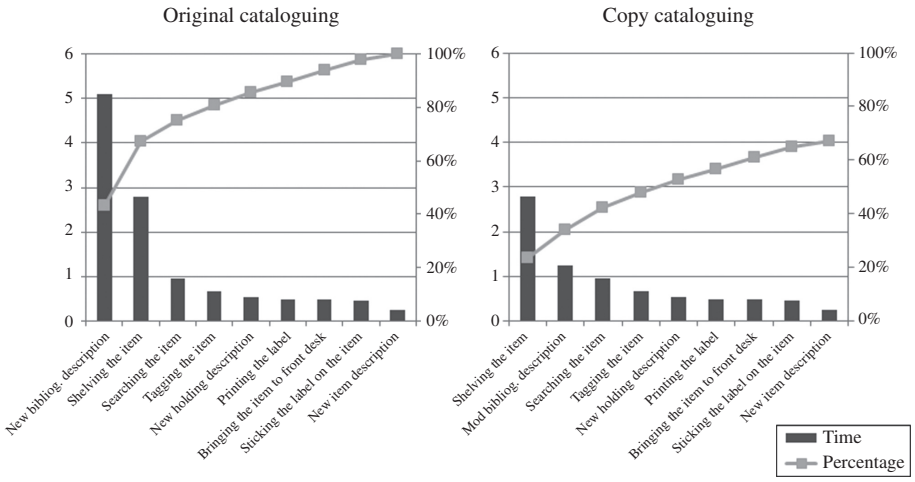


Fig. 4: Pareto chart of disaggregating costs per activity for original and copy cataloguing.



Moreover, time equations show that in this particular case, labelling activities such as printing and sticking labels, bringing an item to the front desk, and tagging the item, consume approximately 20–30% of the cataloguing

processes. Reviewing the consumed resources revealed that the cataloguer is typically in charge of labelling and shelving catalogued items. A "what-if analysis" can be performed to simulate the effect of delegating these activities to student library employees (SLE). If we take as reference the SLE costs calculated by Siguenza-Guzman et al. (2014) of 0.23 €/min, then the resulting costs would be €8.63 for original cataloguing, and €5.00 for copy cataloguing, as shown in Table 6. That is a cost reduction of about 18% for original cataloguing and 28% for copy cataloguing.

An additional improvement to the process can be to incorporate batch cataloguing practices and mass retrieval rather than cataloguing individual items or records (Mitchell et al., 2010). The process flow analysis enables library managers to group and improve certain activities such as searching, processing (bibliographic, holding and item descriptions), labelling and shelving. These batch activities, such as processing a bunch of items or records at one time, can be performed based on the staff availability at certain moments of the day or week. An example of these sorts of improvements on the cataloguing process is shown in Table 7. In this case, searching, labelling, and shelving are delegated to SLEs and calculated in a batch of 10 items. The duration time of searching items needs to be augmented since SLEs have no expertise in the use of LMS whereas a cataloguer does have. The activity of bringing the item to the front desk is eliminated, suggesting the purchase of an extra rewriting RFID machine be located in the cataloguing computer. Finally, shelving activities were recalculated based on the batching times used by Siguenza-Guzman et al. (2014) to model a returning process flow. That includes, an SLE sorting the items in the cluster (i.e. book collection divisions); and then reshelving the items. The resulting time and cost after these improvements can be seen in Table 7.

Results of the what-if analysis indicate that by doing these changes, copy cataloguing is approximately 49% less costly and 42% less time-consuming than original cataloguing. In addition, for original cataloguing, the obtained average time is reduced to 9.26 minutes and the cost to €7.49. This represents about 21% less-time consuming and 29% less-costly than in the real case. Most strikingly, is the case of copy cataloguing in which the reduction is approximately 32% in time and 44% in cost. Therefore, the results of the what-if analysis confirm the validity of implementing these changes in the cataloguing process flow as part of a best practices approach. The enhanced data flow diagram of the cataloguing process is shown in Figure 5.

Table 6: Example of a what-if analysis applied to the original model of the cataloguing process.

	Cataloguing Process					
	Activity	**Average Time (min)**	**Cost per min (€/ min)**	**Cost (€)**	**Condition**	**Resources**
Standard Activities	Searching the item on the LMS	0.95	0.94	0.89		Cataloguer + LMS + CM + GO
	New holding description	0.54	0.94	0.50		Cataloguer + LMS + CM + GO
	New item description	0.25	0.94	0.24		Cataloguer + LMS + CM + GO
	Printing the label	0.50	0.55	0.28		SLE + LMS + CM + GO
	Sticking the label on the item	0.47	0.33	0.15		SLE + GO
	Bringing the item to front desk	0.50	0.33	0.17		SLE + GO
	Tagging the item	0.67	1.02	0.68		SLE + LMS + CM + GO + RM + Tag
	Shelving the item	2.80	0.33	0.92		SLE + GO
	Subtotal	**6.68**		**3.83**		
Optional Activities	New bibliographic description	5.10	0.94	4.80	*if original_ cataloguing*	Cataloguer + LMS + CM + GO
	Mod. bibliog. description	1.24	0.94	1.17	*if copy_ cataloguing*	Cataloguer + LMS + CM + GO
	Subtotal	**---**		**---**		
	Total Original Cataloguing:	**11.78**		**8.63**		
	Total Copy Cataloguing	**7.92**		**5.00**		

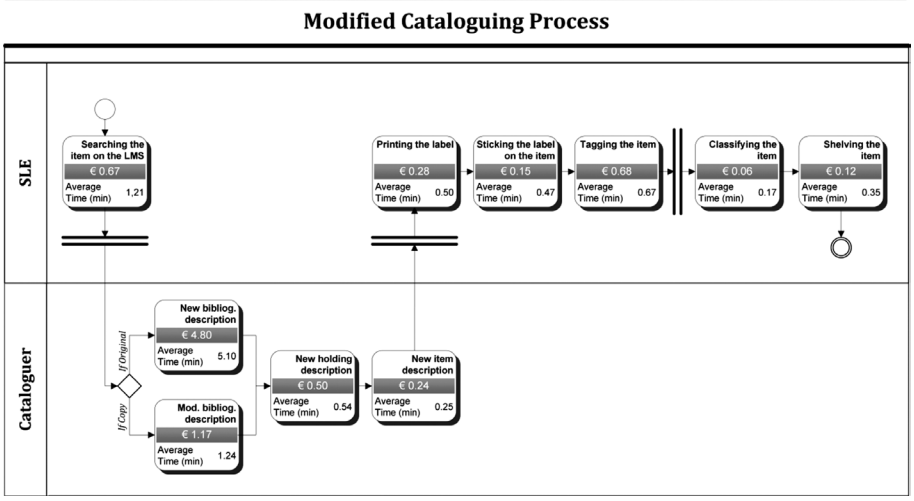
Note. – LMS = Library Management System. SLE = Student Library Employees. GO = General Overhead. CM = Computer Maintenance. RM = RFID Maintenance.

Table 7: Example of a what-if analysis to improve applied to the original model of the cataloguing process.

	Improvements on the Cataloguing Process					
	Activity	**Average Time (min)**	**Cost per min (€/min)**	**Cost (€)**	**Condition**	**Resources**
Searching	Searching the item on the LMS	1.21	0.55	0.67		SLE + LMS + CM + GO
Processing	Mod. bibliog. description	1.24	0.94	1.17	*if original_cataloguing*	Cataloguer + LMS + CM + GO
	New bibliographic description	5.10	0.94	4.80	*if copy_cataloguing*	Cataloguer + LMS + CM + GO
	New holding description	0.54	0.94	0.50		Cataloguer + LMS + CM + GO
	New item description	0.25	0.94	0.24		Cataloguer + LMS + CM + GO
Labelling	Printing the label	0.50	0.55	0.28		SLE + LMS + CM + GO
	Sticking the label on the item	0.47	0.33	0.15		SLE + GO
	Tagging the item	0.67	1.02	0.68		SLE + LMS + CM + GO + RM + Tag
Shelving*	Classifying the item	0.17	0.33	0.06		SLE + GO
	Shelving the item	0.35	0.33	0.12		SLE + GO
	Total Original Cataloguing:	**9.26**		**7.49**		
	Total Copy Cataloguing	**5.40**		**3.85**		

Note. – LMS = Library Management System. SLE = Student Library Employees. GO = General Overhead. CM = Computer Maintenance. RM = RFID Maintenance.
* Shelving time taken from Siguenza-Guzman et al. (2014).

Fig. 5: Improvements on the cataloguing process.



Note. – LMS = Library Management System.

5. Benefits of TDABC in Cataloguing Processes

The implementation of TDABC in cataloguing processes at CBA demonstrated important benefits. The first important benefit, shows the possibility to clearly *discriminate activities regarding the time*, and thus determining which activities demand more time and cost. For instance, analysis showed that labelling and shelving activities consume unnecessary resources. The second benefit is a consequence of the previous one. That is, the possibility of performing "what-if analysis" to *simulate potential scenarios;* for example, as labelling and shelving consumed unnecessary resources, what-if analyses were conducted. The first simulation showed that by delegating these activities to SLE staff, the library manager could reduce up to 23% of costs. The second simulation improves the previous simulation by incorporating batching processes. Results showed a reduction of approximately 37% of cataloguing costs, allowing librarians to improve their processes and liberate their time to perform other specialized activities. An additional benefit is that TDABC allows *benchmarking different scenarios locally and among libraries*, for example, original versus copy cataloguing. These results show that original cataloguing in this particular scenario is 30% more time-consuming, and consequently more costly than original cataloguing. Moreover, by benchmarking

time and cost of activities among libraries, TDABC allows libraries to adopt policies and procedures to improve efficiency. When sharing benchmark figures, Slight-Gibney (1999) states that for other libraries, the time spent on various activities is probably more useful than the costs. In the case of benchmarking cost, the participating libraries require a common understanding of how to attribute indirect costs to their calculations and of what costs are included/excluded in order to have standard results. This problem does not occur when benchmarking the time spent on different activities. Eventually, a fourth important benefit is that TDABC allows *justifying decisions and choices.* TDABC allows both managers and staff to better understand alternative options and accept the need for change; for example, the decision of transferring responsibilities from cataloguers to SLE staff, as well as, structuring batch activities (processing, labelling and shelving). In fact, library managers should constantly analyse their cost information and keep their models updated in order to redesign workflows efficiently and effectively, as well as to reallocate resources and tasks.

Nevertheless, Siguenza-Guzman et al. (2013b, 2014) suggest important considerations to be borne in mind at implementing TDABC in academic libraries, namely: 1) the resource intensity of data collection to gather the time duration of activities, as well as to document the activity flows; 2) the need of a dedicated software tool to keep the flows updated and consequently to facilitate long-term maintenance; and 3) the commitment of library managers and staff during the data collection.

6. Conclusion

In this paper, the TDABC implementation was described in two main cataloguing activities, namely, original and copy cataloguing. These processes were selected because they are considered to be a part of the core activities of a library to manage its collection, but are also resource intensive. Based on our findings, we can conclude that TDABC is a quicker and easier way of calculating cataloguing savings. In fact, TDABC is a useful method to perform cost analysis in cataloguing processes, and consequently provides valuable data for managerial decisions. The TDABC implementation provided library managers with important information about cataloguing costs and performance measurements; and guided decisions concerning resource allocation and process improvements. For example, based on the obtained results, the

library manager decided to delegate certain activities and define a set of batch activities. This case study, therefore, shows significant contributions to the literature on the implementation of advanced cost models for library processes, and more precisely for cataloguing activities.

A potential direction for future research is to expand this study to different cataloguing activities such as cooperative, contract, and outsourcing cataloguing. TDABC can also offer the possibility to discuss how these trends in cataloguing processes affect cataloguing units. TDABC will allow to examine whether these trends really provide an opportunity for cataloguers to spend their time on other cataloguing activities, such as enhancing existing records, or not. Another interesting area for future research would be a similar analysis for cataloguing audio-visual items and other special materials such as old books, non-print materials, and maps. Utilizing TDABC to benchmark libraries for "best practices" is an additional prospect for future analysis.

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Notes

[1] http://bib.kuleuven.be/cba/.