

Implementation of the Process-Oriented Costing System in a Hospital Department

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Abstract—This paper focuses on utilizing costing methods in hospital organizations. The objective of the study was to develop and try out an advanced costing method that would be able to quantify the true cost of individual patients and their diagnoses. Activity-based costing was used as the initial costing methodology, which had been modified in order to facilitate its use in the hospital organization. The first part of the paper analyses recent studies on utilizing costing methods in such environments. The second section presents the case study performed as well as definitions of the costing system's features. The final part includes discussion on the benefits and limitations of actually applying said costing method in the hospital organization.

Index Terms—Hospital management, activity-based costing, costing methods.

I. INTRODUCTION

In the past decade, many hospital organizations have started to face problems relating to the ability to continually provide good quality services with limited resources and expenditure. New discoveries and advances in healthcare research have resulted in an ever greater number of new therapeutic procedures, instruments and medicines. Meanwhile, patients, who are effectively the customers of healthcare organizations, are demanding higher quality and increased standards in the medical care provided. All of these trends are reflected in the constant rise in the cost of medical care, which can also be identified via macroeconomic indexes. Most developed countries spend an increasing portion of their GDP on expenses related to medical care.

Nevertheless, such rising hospital revenues are not in step with spiraling costs. The most important source of funding for a hospital organization, especially in Central Europe, comes through reimbursement from the healthcare insurance system, and direct payment by a patient is very rare. Furthermore, an aging population has a conclusively negative impact on the balance between the revenue and expenditure of the healthcare system.

Therefore, many hospitals are under pressure to be more cost effective, i.e. be able to provide a sufficient level of care on less money. Under circumstances when a hospital cannot significantly affect its revenues, reducing costs is the only way to balance the budget. Hospitals are forced in such situations to adopt more advanced cost management techniques that are usually only adopted in the business sector [1].

New management techniques and methods often reveal

fresh possibilities to manage costs, even in fields considered to be unvarying. These techniques thereby aid comprehension of links between costs and service provision in order to improve the efficiency of existing operations. Many authors have highlighted the increasing importance of costing methods (cost calculation) within hospital organizations. For instance, Gujral *et al.* [2] comment that healthcare organizations use cost accounting to estimate the unit cost of the services they provide. Edbrooke *et al.* [3] point out the increasing need for a method to obtain accurate patient costing that permits resource utilization to be identified for individual patients treated under different clinical specialties. Ridderstolpe *et al.* [4] state that a valid basis for calculation is increasingly necessary for cost control of health care against the background of greater demands and resource constraints.

II. COST CALCULATION IN HOSPITAL ORGANIZATIONS

Every scientific study of recent years has flagged up the crucial role of cost calculation in hospital organizations, an activity which had been strongly neglected in prior decades. Traditionally, hospital organizations have not been forced to use cost calculation, except when paying patients.

Hospitals in different countries are often legally required, for refunding purposes, to implement a predefined cost allocation scheme [5], [6]. This makes them unique to other sectors where such a legal obligation does not exist. Cardinaels *et al.* [7] state that the legal system mostly takes the form of a step-down allocation of costs from service departments (e.g. laundry, administration, cafeteria, etc.) to revenue generating departments, such as acute care, surgery, and laboratories. Sometimes costs are further allocated down to patient level.

Many scientific studies [8] have ascertained that most sections of a hospital use traditional costing methods based on simple division of the absorption costing technique. It is commonly known that traditional costing methods have caused distortions in indirect costs, and accounting reports normally do not provide for management interpretations and actions determining the control of deviations related to specific problems.

Despite the relatively limited development of cost calculations within a hospital environment, the first attempts to apply advanced costing methods, based on a process oriented towards the activity-based costing method, were made in the 1990s. The activity-based costing method, which has been relatively well-known since the 1980s, brings about important benefits in terms of more accurate cost allocation and the ability to measure the output of organizational activities. Cardinaels *et al.* [7] declare that systems such as

ABC may encourage a drive towards making cost efficiencies. ABC provides more detailed cost information on the activities of the hospital, which could typically result in superior cost reduction and cost management. It is commonly known that ABC is suitable for organizations with a high proportion of overhead (indirect) costs and with immense complexity in products and the activities performed.

Despite these positive effects of ABC application, the true level of utilization in healthcare organizations is very rare. ABC application is hampered by several serious limitations, such as the very high complexity of the system, which makes it very difficult to actually utilize and creates very severe demands for non-financial information. Those limitations, which are also obvious in non-healthcare organizations, are usually solved by immense simplification of the traditional ABC system. These tendencies have led to the development of methods such as *Time Driven Activity-based costing* [9], which reduces the use of cost drivers in the time drivers of *Simplified Activity-Based Costing* [10], based on incredible simplification of the system.

III. ACTIVITY-BASED COSTING

Activity-based costing (ABC) involves two steps. The first requires that costs are allocated to activities, whereas activities are allocated to a product or service in the other step. This method of costing differs from traditional costing, the paradigm of which being that activities consume resources and processes drive activities. The paradigm of ABC allows for more accurate cost calculation of direct and indirect costs [11].

The process of ABC application in healthcare organizations was developed by many authors, [2], [8] or [12]. The application procedures created are relatively diverse and often focus on narrow implementation of the method at a department in the healthcare organization. Most of these application procedures are based on an initial procedure defined by Kaplan and Johnson [13], and lately developed by Drury [14]. This covers four steps, as follows: (a) identifying the major activities taking place in an organization, (b) assigning costs to cost pools/cost centers for each activity, (c) determining the cost driver for every activity, and (d) assigning the costs of activities to products according to their individual demands on activities.

One of the earliest studies, examining the organization-wide application of ABC in a hospital, was published by Udpa [15]. The findings suggest that ABC provides more detailed cost data on the activities of the hospital, which could typically result in better cost reduction and cost management. Cao [10] states that a sophisticated cost accounting system is indispensable for bringing about effective cost control. Carvalho Jericó and Castilho [8] support the use of ABC in hospitals, declaring that information generated by ABC significantly contributes to hospital management in planning and managerial control. This is due to such data enabling behavioral changes in the organization by narrowing focus on activities and volumes of their outputs. Gurjal *et al.* [2] solve the problem of misrepresenting service costs by estimating the cost of work activities that consume resources and by linking these costs to

the services provided.

However, many authors, such as Stouthuysen [16], point to the limitations of the ABC approach. That author states that the need for some degree of caution exists in advocating the use of ABC in hospitals. Lievens *et al.* [17] for example argue that a potential drawback of ABC systems lies in the consumption of time and resources associated with developing and managing these systems.

It is obvious that progress in applying more sophisticated costing methods in hospitals worldwide is on a relatively sufficient level. Numerous studies have looked at utilizing costing methods in hospital organizations. The issue highlighted by many authors is that most applications remain merely academic models and have yet to be fully implemented in practice. One of the most important reasons could be the previously mentioned limitations of the ABC system, which could be interpreted as making it overly complex for actual use. Consequently, a suitable costing system for hospitals should provide the required information outputs but be not too complicated.

IV. COSTING SYSTEM IMPLEMENTATION

The objective of this study was to design an accurate costing system for a department of a hospital and define its application procedure. The regional hospital of Zlin, where the study was performed, is a medium-sized hospital with 33 departments of primary care, and 13 specialized centers with 2074 employees and 1084 beds, of which 938 are given over to acute care and 146 to subsequent care. In 2011, its operational budget comprised 1,694 million CZK (approx. 67.8 million euro) of revenue, whereas operating cost equalled 1,803 million CZK (approx. 72.1 million euro). The economic structure of the hospital consists of 33 primary care cost centers and 32 support cost centers.

As the entire hospital represents 33 primary care departments, it was decided to apply the methodology in the Ear, Nose & Throat (ENT) department, a medium-sized primary care department with an approximate 17.7 million CZK (0.707 million euro) operating cost per year, staffed by 7 physicians, 15 nurses and 5 other personnel.

The initial methodology adopted for design of the costing system was activity-based costing, which was modified according to the specifics of the hospital. Nevertheless, due to strong interrelations between the individual departments and units, all the organization's departments had to be investigated and analyzed. The key feature of the system consequently designed was to maintain the limited number of activities and the simple system structure. As many authors have mentioned, the sheer complexity of the methodology is the main drawback of the ABC system.

The researchers used original financial accounting data without any special kind of adjustment, as is usually the case in ABC systems. The entire year of 2011 was used as the initial period for cost allocation. For clarity, direct and indirect costs have been distinguished in order to trace a direct cost precisely to defined cost objects and to allocate the correct overhead cost through the given activities. The following cost classifications were made during the application process (see Table I).

TABLE I: STRUCTURE OF THE HOSPITAL AND DEPARTMENT COST.
(AUTHORS)

	€	%
Hospital total cost	72,146,372	100%
Direct cost*	17,710,975	25%
Indirect cost*	54,435,397	75%
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ENT Total cost	707,482	100%
ENT Direct cost	47,727	7%
ENT Indirect cost	659,755	93%

* approx.

The initial step of the implementation process was to **define the major activities that take place in the organization**. Activities form the basis of measurement for all relevant data in an ABC system. Several procedures for defining activities may be used, such as analysis of an enterprise's organizational structure, analysis of the workplace, or analysis of personnel costs [18]. Applying all three ensures that no activity is overlooked.

After analyzing the ENT department, the following primary activities were defined:

- 101 - Outpatient examination
- 111 - Audiometry
- 112 - Endoscopy
- 113 - Hearing aid assignment
- 201 - Inpatient admission
- 211 - Hospitalization - conservative - planned
- 212 - Hospitalization - conservative - acute
- 213 - Hospitalization - surgery - planned
- 214 - Hospitalization - surgery - acute
- 220 - Surgery
- 290 - Inpatient release

This group of activities represents only those performed by the department's employees. Primary department activities could be divided into primary care activities (101-113) and secondary care activities (201-290). As the final outputs of the ENT department also include the activities of additional supporting hospital departments, cost analyses of all the departments has to be conducted in order to assign the true cost of ENT activities. The following secondary (support) activities were identified:

- 9001 - Management and administration
- 9003 - Human resources
- 9004 - Information technology systems
- 9005 - Facility management
- 9900 - Supporting medical services

Activities 9001 – 9005 represent ordinary supporting activities that make up the infrastructure of the organization, and are very similar in all other types of organizations. Activity 9900 – supporting medical services – represents a very particular type of activity, which includes special departments whose outputs are consumed by other primary care departments, such as that of Imaging Methods (X-Ray CT, MRI, etc.), the Department of Clinical Biochemistry, the Department of Medical Microbiology, the Blood Transfusion Department, Nuclear Medicine, the Allergy and Clinical Immunology Laboratory, and the Department of Anatomical Pathology.

It was then possible to split hospital activities up, after performing analysis, into three major groups:

The first group was represented by the primary activities of the primary care departments (such as ENT). The second group was represented by the infrastructure's secondary activities (9001-9005). The special, third group of activities was formed of such activities that lie between these two groups. This group of activities comprised those performed by primary care departments but providing services for the other primary care departments.

After identifying the major activities, the **overhead costs were allocated to the defined activities**. This phase of the ABC implementation process is most time consuming. Individual cost elements, registered in the accounting system, include costs of materials, indirect medications which could not be assigned to specific patients, energy costs, personnel costs, etc. A different allocation mechanism was used for each cost element. Several resource cost drivers were defined, such as physician labor consumption by activities, square meters of floor space related to activities, etc. All costs were assigned to activities using the Activity Cost Matrix, which displays links between the indirect costs and activities. A problem arose when calculating the cost for hospitalization - no data for classifying hospitalization into four desired types was available. The cost could only be allocated to hospitalization as a whole. After fully allotting indirect costs to activities, the following total activity costs were identified:

- Outpatient examination € 138,701
- Audiometry € 20,974
- Endoscopy € 20,942
- Hearing aid assignment € 16,225
- Inpatient admission € 27,055
- Hosp. - conservative – plan. € 18,560
- Hosp. - conservative - acute € 38,481
- Hosp. - surgery -planned € 181,896
- Hosp. - surgery - acute € 43,450
- Surgery € 67,578
- Inpatient release € 9,154

In order to include all relevant costs for hospitalization and other activity expenses, the cost of secondary activities had to be calculated. In this case, the cost allocation process was much simpler, because only five supporting activities in all organizations were identified, and the cost for all supporting cost centers were assigned to these supporting activities. The following total costs for supporting activities were identified:

- Management and administration € 1,712,892
- Human resources € 71,566
- IT € 652,551
- Facility management € 753,847
- Supporting medical services € 8,302,167

To proceed with the cost allocation process, the proportional quantity of secondary activity costs had to be allocated to the primary activities. Due to the fact that the authors had not carried out detailed analyses of the other primary care activities, they followed a very simple allocation procedure. Firstly, they calculated the percentage for the total ENT department cost in relation to the total organization cost, which worked out at about 1% (0.707 million € out of 72.14 million €). Then the calculated portion of the secondary activities cost was assigned to the ENT department and allocated to individual activities in proportion with the activity cost. Only the Human Resources cost was allotted by

a different allocation mechanism, whereby the number of ENT employees portion on total number of employees was used. A special allocation procedure was utilized for the supporting medical cost, this only being allocated to three activities in the estimated proportions: 50% of activity cost allocated to the activity *Hospitalization* (total), 30% to the activity *Outpatient examination*, and finally 20% of the supporting medical cost allocated to the activity *Inpatient admission*.

The total cost of activities, including the secondary activity cost, was as follows:

- Outpatient examination € 169,069
- Audiometry € 22,123
- Endoscopy € 22,080
- Hearing aid assignment € 17,062
- Inpatient admission € 44,446
- Hospitalization – total € 339,413
- Surgery € 72,378
- Inpatient release € 9,719

The next step of the ABC implementation process was to **calculate activity rates** after working out the total activity

costs. In order to calculate the activity rates it was necessary to go through several steps, outlined as follows. Firstly, the cost drivers for each activity had to be set. Several different types of cost drivers were used: the number of examinations for examination activities, the number of patients for admission and release of said patients, the period for which the patients drew on hospitalization activities, and the quantity of hours given over to surgery. Secondly, it was necessary to identify the output measures of individual activities. The output measure determined the volume of the activity in the period observed. All crucial data were found on the hospital information systems, hence no method for gathering evidence needed to be established. After obtaining the necessary data, the activity rates could be calculated by simple division of the total activity cost by the activity output measure determined. Table II displays the results of this phase of the ABC implementation. The column labeled *total activity cost* shows the cost of activities including the allocated cost of secondary activities.

TABLE II: CALCULATION OF THE ACTIVITY RATES IN A HOSPITAL DEPARTMENT (AUTHORS)

Activity code	Activity name	Primary cost	Secondary cost	Total activity cost	CD	Output measure	Activity rate
101	Outpatient examination	€ 138,701	€ 30,369	€ 169,069	# of examinations	10921	€ 15.48
111	Audiometry	€ 20,974	€ 1,148	€ 22,123	# of examinations	2023	€ 10.94
112	Endoscopy	€ 20,942	€ 1,138	€ 22,080	# of examinations	1172	€ 18.84
113	Hearing aid assignment	€ 16,225	€ 836	€ 17,062	# of examinations	694	€ 24.58
201	Inpatient admission	€ 27,055	€ 17,391	€ 44,446	# of patients admitted	944	€ 47.08
211	Hospitalization - cons. - planned	€ 18,560	€ 4,073	€ 22,633	# of days for inpatients	516.2	€ 43.85
212	Hospitalization - cons. - acute	€ 38,481	€ 7,724	€ 46,205	# of days for inpatients	1032.4	€ 44.75
213	Hospitalization - surgery -planned	€ 181,896	€ 36,509	€ 218,405	# of days for inpatients	3097.2	€ 70.52
214	Hospitalization - surgery - acute	€ 43,450	€ 8,721	€ 52,171	# of days for inpatients	516.2	€ 101.07
221	Surgery	€ 67,578	€ 4,800	€ 72,378	# of hours	663	€ 109.17
290	Inpatient release	€ 9,154	€ 565	€ 9,719	# of inpatients released	930	€ 10.45

In the final phase of the costing system design it is necessary to **assign the activity cost to an individual cost object**. The system implemented was designed to calculate the cost for an individual patient or hospitalization instance as the cost object. In order to assign the true cost to cost object it was necessary to identify the volumes of individual activity outputs consumed by a specific patient/hospitalization instance. The final assignment of the consumed cost to the specific cost object facilitated calculation of the total cost per individual patient. Table III shows the calculation of the patient cost. Direct costs are traced to the cost object directly, while the activity cost are allocated by the volume of activities' outputs (output measures) consumed by the cost object. In this phase it would be possible, for example, to compare the costs for the types of individual diagnoses, and work out how the cost of an individual patient in one diagnosis can vary.

TABLE III: CALCULATION OF PATIENT COST (AUTHORS)

Name of the patient		XXX	
Diagnosis		Endoscopy surgery	
Hospitalization		6 days	
Direct cost	# of units	Unit cost	Allocated cost
Materials			€ 10.00
Total direct cost			€ 10.00
Activity name	Output measure	Activity rate	Allocated cost
Outpatient examination	1	€ 15.48	€ 15.48
Audiometry	0	€ 10.94	€ 0.00
Endoscopy	1	€ 18.84	€ 18.84
Hearing aid assignment	0	€ 24.58	€ 0.00
Inpatient admission	1	€ 47.08	€ 47.08
Hosp. - conservative - planned	0	€ 43.85	€ 0.00
Hosp. - conservative - acute	0	€ 44.75	€ 0.00
Hosp. - surgery -planned	6	€ 70.52	€ 423.10
Hosp. - surgery - acute	0	€ 101.07	€ 0.00
Surgery	10	€ 109.17	€ 1,091.67
Inpatient release	1	€ 10.45	€ 10.45
Total activity cost			€ 1,606.63
Total cost			€ 1,616.63

In order to verify the application of the costing system, five different diagnoses were chosen, with 10 patients being calculated for each diagnosis. It was expected that different patients would exert different demands on activities and the true cost for individual patients would vary. The following results proved such expectations:

Cost of **endoscopy surgery** related to individual patients varied from 685 € to 1,616 €.

Cost of **non-acute tonsil surgery** related to individual patients varied from 808 € to 1,026 €.

Cost of **acute tonsil surgery** related to individual patients varied from 905 € to 1,337 €.

Cost of **non-acute partial deafness** related to individual patients varied from 339 € to 509 €.

Cost of **acute partial deafness** related to individual patients varied from 273 € to 544 €.

V. DISCUSSION

The costing system designed herein was based on activity-based costing methodology with several modifications. Two major differences distinguished application of ABC in a manufacturing organization from the costing system hereby implemented in the hospital environment. The first difference lay in the structure of activities. The process-oriented costing system in a hospital organization functions with three levels of activity, these being primary activities, secondary (supporting) activities and hybrid activities, which are represented by primary care activities consumed inter-organizationally. This was represented by activity 9900 in the case study. The allocation procedure used for this type of activity was relatively simple and, due to issues over system accuracy, should be replaced by a more accurate allocation procedure; one based on measuring the consumption of individual department outputs.

The second difference was in the cost object used. While for the manufacturing sector single cost objects are given, e.g. a product or customer, here definition of the cost object is much more complicated. In this case study the authors chose an individual patient as the universal cost object. An important issue was also the cost variability of individual patients with the same diagnosis (DRG). In manufacturing organizations the conclusion can be drawn that the cost of each product of the same type is identical. In hospitals the true cost of patients with the same diagnosis (DRG) might differ completely. This variability could be measured by the ABC system and yield vital information for management.

Calculating the true cost of an individual patient may also result in a "profitability" analysis of patients or diagnosis types. If one compared the calculated cost and revenue for an individual patient, it would be possible to discern which types of patients of diagnosis types could financially benefit the hospital and which would not cover the expenditure required.

VI. CONCLUSION

Using an advanced process oriented costing system, such as activity-based costing, could reap rewards for hospital organizations. Such systems provide additional data outputs

that have not been previously available. Information such as true cost of individual patients, the cost of individual activities, the output of the activities, the cost consumed by such activities, or inter-departmental consumption of outputs might afford new perspectives on an entire organization. Managerial decisions based on such information could result in better cost efficiencies, less wastage and improved reimbursement negotiations.

ACKNOWLEDGMENT

This paper was carried out as part of the NT 12235-3/2011 project *Applying modern calculation methods to optimize costs in health care*, registered at the Internal Grant Agency of the Ministry of Health, the Czech Republic, (IGA MZ ČR).

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