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**Article**

## The relationship between cost system functionality, management accounting practices, and hospital performance

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## THE RELATIONSHIP BETWEEN COST SYSTEM FUNCTIONALITY, MANAGEMENT ACCOUNTING PRACTICES, AND HOSPITAL PERFORMANCE

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**Abstract:** All sophisticated management accounting practices used in hospitals require a functional costing system, which allows for better cost calculation of medical services. This is important for the hospitals because they should always look for the possibilities to improve their outcomes. This study evaluates the effects of various structural factors on quality of costing system and management accounting practices and examines how these two constructs impact on hospital performance. The data was collected using a questionnaire survey carried out among chief accountants and hospital managers in Polish and English hospitals. Multiple regression was employed to analyze the data. The findings confirmed the earlier studies that hospital performance depends on the quality of cost calculation, as well as on management accounting practices. On the other hand, the quality of cost calculation depends on hospital size and a level of computerization.

**Keywords:** cost calculation, management accounting, hospital performance, costing system.

**JEL Classification:** M41, H83.

### 1 Introduction

One of the most popular reimbursement system in Europe is diagnosis-related groups (DRG) system. It has been implemented by many European countries in order to improve financial resources allocation between hospitals and other entities of a health-care system. In such situations, the cost information is not just needed for pricing decisions made at the central level, but also for the management control systems in hospitals.

A long-standing part of a hospital's management control system is management accounting. During recent years, the use of cost accounting system has evolved from simple financial accountancy to important tool of management accounting that can be involved in the decision-making process and face the the rapid changes of environment (Bai and Krishnan, 2012; Walker, et al., 2012). This is particularly important for these countries where a DRG payment system has been implemented (Schreyögg, et al., 2006).

To improve hospital performance, managers of hospitals should use cost information in various management accounting practices (MAP). In order to use better cost information, they should generate

cost information at the level of patient. The best source of reliable and clear cost information for the management process in hospitals is cost accounting. In hospitals, the goal of cost accounting should be to support managerial decisions and to monitor the consumption of resources in the process of providing medical services.

The last few years have seen growing interest in explaining the diversity of MAP. There are more and more researchers who adopt the "contingency theory" to demonstrate how various elements of an accounting system are linked with various "contextual variables" (Emmanuel, et al., 1990). The contingency theory is derived from behavioral concepts that enrich the general theory of management with the aspects of an immeasurable relationship. It underlies the formulation of hypotheses, inference, and evaluation.

The base of contingency approach to management accounting is the premise that a universal accounting system does not exist, so it is not possible to apply it in the same way to all organizations in all conditions. The research conducted in the mainstream of the contingency theory allows to recognize the factors that affect the selection and design of the different methods of management accounting.

This theory also assumes that among the factors that impact the particular features of a proper costing system are the internal factors as well as the external environment of the organization. (Pavlatos and Paggios, 2008). The ability of cost accounting to adapt to changes in external and internal conditions affects its effectiveness (Gerdin, 2005). In any case, there is little empirical research confirming a link between internal (organizational) or external factors and quality of cost accounting system in hospitals.

On the other hand, according to the contingency theory, the fit between contingent factors and structure of the organization impacts the organizational performance (Cadez and Guilding, 2008). Consequently, a good fit entails better performance, while a poor fit implies reduced performance (Chenhall, 2003).

The final goal of contingent accounting study should be to develop and verify a comprehensive model that contains multiple components of a management accounting system and multiple contingent variables. This paper presents the results of the analysis regarding mutual relationships between the contingent variables (level of computerization, hospital size, education of managers), cost system functionality, MAP, and hospital performance. The relationships between these elements of a model were analyzed using multiply regression.

The structure of this paper is organized in the following way: the second section reviews the literature, explains the contingency model, and formulates the hypotheses. The third section describes the research methodology, and the fourth section documents the results of the study. Finally, the last section provides the discussion and conclusion.

## 2 Literature review and hypotheses

Cost system functionality is defined as “the quality of cost accounting information which is provided by a cost system” and is based on the following five critical attributes: detail, variance, accuracy, frequency, and classification. (Pavlatos and Paggios, 2009). According to the literature, the more functional and refined cost calculation systems are those that use better cost classification, for example, according to behavior, provide more detailed cost

information and calculate more cost objects (Pizzini, 2006). This study concentrates mainly on three characteristics of cost system functionality: the level of detail, the accuracy of cost information, and cost classification. The level of detail relates the ability of costing system to provide data regarding various cost objects such as individual patients, DRG, and medical procedures. The accuracy of cost information depends on the possibility to trace cost directly to patients and medical procedures in order to provide the most accurate cost information possible. The cost classification impacts the cost disaggregation according to various criteria such as cost behaviors (variable/fixed), possibility to allocate them to cost objects (direct/indirect).

These three elements of cost system functionality impact mainly on the quality of the cost calculation system in a hospital. There are four costing methodologies for the cost valuation of health-care services depending on the level of accuracy of the recognition and valuation of cost components: top-down gross-costing, top-down micro-costing, bottom-up gross-costing, and bottom-up micro-costing. Although top-down gross-costing calculation and aggregated cost data are still used by hospitals, they are not sufficient enough for today’s competitive environment. Thus, the bottom-up micro-costing approach allows for more sophisticated MAP that is vital for the successful management in hospitals. It produces “better” (meaning more relevant and useful) data that improves managerial decisions and thereby leads to improved performance (Tan, 2009).

### 2.1 The impact of cost system functionality on management accounting practices

The main function of costing systems is to support the process of managerial decision. (Abernethy and Bouwens, 2005). The more detailed and better classified cost data is more useful and relevant for managers, so such data should be provided by a sophisticated cost calculation system. The extent and quality of a costing system impacts its use in supporting strategic and operational decisions. According to the literature, cost system functionality is linked with the degree of meeting the information needs of its users (Chenhall, 2003). Cooper and Kaplan (1991) discuss

the costing system range in terms of implementing various MAP that are necessary for the management process (such as design and pricing products, cost budgeting, and process improvements) and meeting needs regarding traditional performance assessment. The coordination of various MAP needs cost data supporting operational and strategic decisions. Cost system functionality is an important factor that reflects the use of cost data in various decision areas of the organization (Nicolaou, 2001), so a more detailed and accurate unit cost data is more useful in decision-making. It has also been shown that better classified, more detailed cost data provided by costing system is more useful and relevant for the managers of the hospitals (Pavlatos and Paggios, 2009). According to other studies, cost system functionality is positively linked with the broad use of MAP, so a cost system should act as a catalyst for the utilization of cost data (Al-Omiri and Drury, 2007). Thus, the following hypothesis is tested in this study:

H1. *There is a positive association between cost system functionality and management accounting practices (MAP).*

## **2.2 The impact of cost system functionality and management accounting practices on hospital performance**

The ultimate purpose of the various managerial accounting practices is to improve the overall organization performance through cost budgeting, cost control, processes improvement, performance measurement, analysis of resource efficiency, and use of other management accounting tools. Hospital performance is a complex problem. This is due to the fact that hospitals do not operate for profit, but pursue mainly social goals such as improving health and saving patients' lives. Numerous studies have already focused on the link between cost information use in management and hospital performance (e.g. Duh, et al., 2009). Many studies show that the organization performance depends on the scope of use MAP (broad scope of cost information) (e.g. Cravens and Guilding, 2008; Hoque and James, 2000). Some of them also show that a scope of use of cost data positively affects the performance of the organizations' functioning in the health-care system

(e.g. Xiao, et al., 2011; Agbejule, 2005). For instance, according to some studies, an appropriate connection of the amount of MAP as well as their frequency may improve the performance of the organization (Gerdin, 2005). Also, Chenhall (2003) claimed that organizational performance should be employed as a dependent variable in contingency-based management accounting research. According to Afoakwah, et al. (2019), MAP play a significant role in the functioning of public hospitals, especially in terms of making the right decisions. According to their findings, public hospitals using MAP have enhanced cost control, more effectively monitor and supervise their core activities, which affects the quality and efficiency of decision-making and overall performance.

On the other hand, in many of the studies, the link between MAP and performance is inconclusive and context-dependent; some of them have proved no, or even a negative, relationship between these factors (e.g., Agbejule, 2005). Nevertheless, because of an advantage of findings pointing to a positive relationship between MAP and performance, the following hypothesis is formulated in this study:

H2. *The extent to which MAP is used has a positive impact on hospital performance.*

In addition, other studies also draw attention on the association between the the performance and cost system functionality because the better decisions depend on precise cost measurements (e.g., Hutchinson, 2010). Pizzini (2006), who investigated the relationship between different elements of the costing system (detail, frequency of measurement, cost classification) with hospital performance, ultimately found that only attributes connected with quality of cost calculation system (detail of calculation) were significantly associated with hospital performance. Thus, the following hypothesis is formulated in this study:

H3. *Cost system functionality has a significant impact on hospital performance.*

## **2.3 The contingent factors affecting cost system functionality and management accounting practices**

Cost system functionality is shaped through various contingent factors. With reference to Hill (2000),

two potential contextual variables for cost system functionality should be explored: hospital size and ownership (hospital status). The other variables taken into account in this study were education of hospital managers and the level of hospital

computerization as organizational factors that potentially influence cost system functionality. These four contingent factors represent exogenous (independent) variables in the contingency model presented on the Fig. 1.

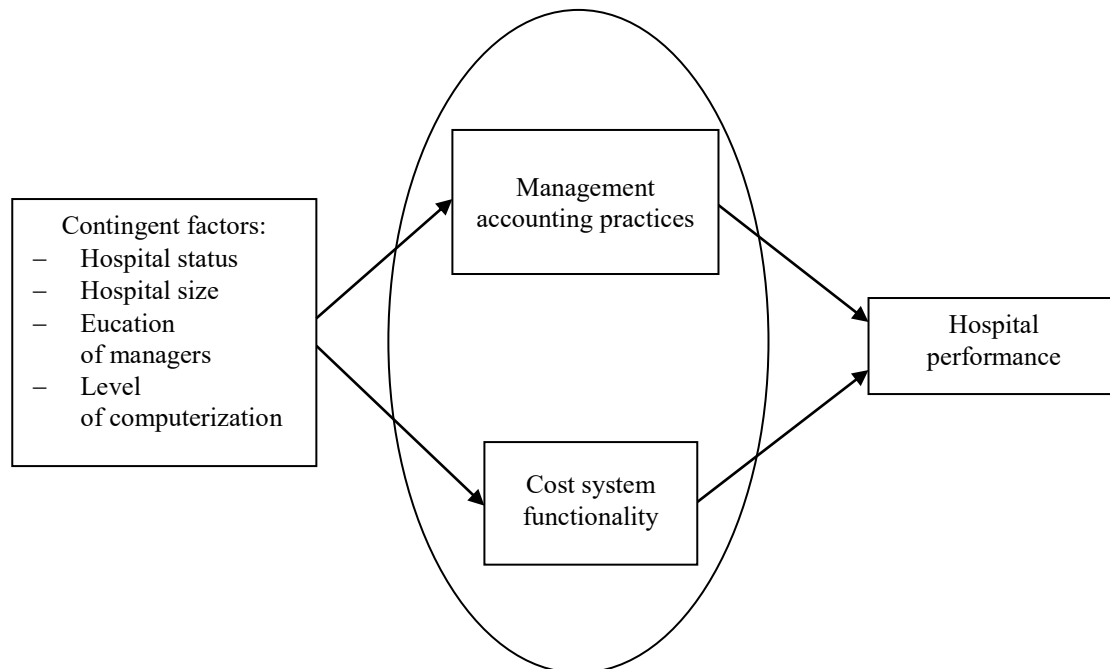


Figure 1. Model of potential relationships between contingent factors, cost system functionality, MAP, and hospital performance (Source: Author's own elaboration: Kludacz-Alessandri, 2017b)

According to some studies (e.g., Hill, 2000), hospitals in private ownership are more focused on powerful competition, so they have to cope with greater external pressure to control costs and therefore needs more extensive and detailed cost data. They place more pressure on the chase of profits and therefore more frequently implement more advanced cost accounting systems than non-profit or public hospitals. Moreover, the form of ownership influences the management's concentration on organizational profits and therefore should stimulate the use of profitability-oriented MAP (Krupička, 2020). Thus, the following hypothesis was formulated:

H4. *Hospital status has a significant impact on a) cost system functionality, b) management accounting practices (MAP).*

The most popular factor that has been examined in relation to management accounting is the size of the

organization. This factor was included in the model because it had already been reported in previous accounting studies (e.g., Guilding, 1999). As organizations grow, managers need to handle more and better information because of increasing communication and control problems (Hoque and James, 2000). Larger hospitals also gain more benefits from more accurate cost accounting system because they can better allocate the indirect costs on more medical procedures, beds, and other cost objects. Therefore, the following hypothesis is tested:

H5. *There is a positive relationship between the size of a hospital and a) cost system functionality, b) management accounting practices (MAP).*

Information technology (IT) systems play an increasingly important role in improving the effectiveness of hospitals, and they must, therefore, correspond to their organizational structure. The level of computer-

ization will depend on the basic functions and tasks of the IT system for two separated parts in the organizational structure of a hospital – medical and administrative. The medical (“white”) part is responsible for providing medical services, while the administrative (“gray”) part is responsible for the management of the hospital as a whole. The level of computerization in a hospital depends not only on “pure” technology (e.g., software utilization, computer and communication systems) in the medical and administrative parts, but also on integration of IT solutions, development of IT infrastructure, internal and external communication (Chluski, 2016). Therefore, the following hypothesis is tested:

*H6. The level of computerization in a hospital has a positive effect on a) cost system functionality, b) the management accounting practices (MAP).*

The prevailing literature lacks evidence of an association between education of hospital managers and cost management practices. The literature mainly analyzes MAP and cost system functionality in the context of various characteristics of managers (Abernethy and Lillis, 2001). However, it seems that not only characteristics but also experience and economic education are positively linked with cost system functionality and MAP. Therefore, the following hypothesis is tested:

*H7. The education of hospital managers has a significant impact on a) cost system functionality, b) management accounting practices (MAP).*

### 3 Methodology

The estimation of the reliability of the proposed model was performed using a questionnaire survey. The data was collected in the years 2012–2017. The request to participate in the study was sent to hospitals from European countries that implemented a DRG system. The respondents were represented by the chief accountants and/or the hospital managers. The questionnaires were designed to measure each observable variable using the Likert scale.

This study concerns data obtained only from Polish and English hospitals, supplemented after a pilot study carried out in 2012–2013 (Kludacz-Alessandri, 2017). The final responses used in this study came

from 76 hospitals. The final response rate for both analyzed countries was almost 34%. Hospitals differed mainly in size – in terms of the number of beds and wards. Among the respondents dominated large hospitals – 55% of hospitals had over 500 beds and over 19 wards. Small hospitals with less than 100 beds and less than six wards represented the lowest share of the surveyed group – 13%. It can, therefore, be concluded that most responses came from large public hospitals with over 500 beds and over 19 wards located in medium-sized cities.

To measure the proposed model, four multidimensional constructs were utilized: level of computerization, costing functionality, MAP, and hospital performance. To estimate the associations between these multi-dimensional constructs while increasing the model fit at the same time, a partial aggregation approach was used. This means that each construct was represented in the model with a variable that was calculated as a mean of the original indicators (Cadez and Guilding, 2008).

Each construct was defined by specific indicators represented by questions prepared on the basis of the literature review. Moreover, they were consulted with experts. Prior to regression analysis, a factor analysis was carried out to assign the single indicators into appropriate constructs. In this way, the constructs were validated. They represent various elements of the model and have been built empirically, based on analysis of previous studies.

The results of exploratory factor analyses confirmed that the best model fit arises when cost system functionality is specified as comprising the items regarding only the accuracy attribute (quality of cost calculation). The other attributes of cost system functionality were not included in the model. The basic indicators of the construct “cost system functionality” were based on previous studies and consultations with supervisors representing selected hospitals. Finally, they regard “quality of cost calculation” (Calc) and represent the features of a bottom-up micro-costing approach. Calc was measured using a tool prepared for the purposes of this study and based on the literature review (Pavlatos and Paggios, 2009). It contains a five-item, five-point Likert tool with a scale since “1” (to strongly disagree) until “5” (to strongly agree). Respondents have been asked to

assess the features of a bottom-up micro-costing approach. A final factor analysis showed that all indicators were loaded on a single construct. The factor loadings were between 0.63 and 0.94 for five items. Finally, one indicator with the lowest level of factor loading was removed from the analysis. Cronbach's alpha of 0.91 for the final construct suggests that its internal consistency is satisfactory. Therefore, the reliability of the constructs was satisfactory.

The construct "management accounting practices" was connected with selected managerial accounting techniques. At the beginning, to measure this construct, three dimensions were proposed: strategic management accounting (five items), cost information analysis (four items), and modern costing systems (three items). This construct was created on the basis of literature analysis (Uyar and Kuzey, 2016; Cadez and Guilding, 2008) regarding the levels of management accounting mediate and management accounting techniques usage. Some of these MAP have already been explained in several previous papers (Cravens and Guilding, 2008; Guilding, et al., 2000). The construct was measured using an instrument comprising of a 12-item, five-point Likert tool with a scale since "1" (to no extent) until "5" (to a great extent). Respondents have been asked to assess the degree of the MAP on this aforementioned scale.

In order to determine the final constructs and indicators, factor analysis was performed using principal component analysis with varimax rotation. It was finally revealed that all 12 items were loaded into two constructs. The first factor corresponds to strategic management accounting and cost information analysis techniques with the factor loadings between 0.69 and 0.91 for nine items. The second factor has been labeled "modern costing systems". The factor loadings were between 0.64 and 0.88 for three items. Finally, one item with the lowest level of factor loading was removed from the analysis. The Cronbach alpha for the first factor was 0.96 and for the second one 0.78. Finally, only the first factor was selected to represent MAP.

The construct regarding level of computerization (CL) was modeled on the construct "information technology" (IT) used by D. Jelonek (2009) and

characterized by means of the following elements: IT strategy, IT supervision, IT infrastructure, communication, and IT integration. In the model proposed in this study, the level of computerization of a hospital (CL) is determined by three items (Table 1). Using a five-point scale ranging since "1" (poor) until "5" (excellent), respondents have been asked to assess the level of these three components of hospital computerization.

Hospital size (SIZE) was measured by counting the number of beds in the surveyed hospitals. It was considered that the number of employees is not, in this case, the appropriate measure of size because some hospitals employ medical staff on the basis of provisional contracts, and some on the basis of an employment contract. Education of manager (Edu) was measured using a binary variable (1 = economic, 0 = "medical and otherwise"). Concerning hospital status, the sample was not representative of the population because private hospitals were underrepresented. The private hospitals and this variable were, therefore, finally removed from the model.

The construct "performance" has been analyzed by various researchers and defined in different ways. After comparison of alternative model fits, it was concluded that performance can be represented by a two-dimensional construct containing financial and non-financial performance (Chenhall, 2003; Cadez and Guilding, 2008). Financial outcome is a basic element of performance in commercial organizations. Financial measures for such organizations include, for instance, sales and profit growth, market share, return on equity (ROE) and return on assets (ROA), cash flow (Alamri, 2019). Public organizations, including hospitals, should also act in a way that allows for the balancing of financial performance with broadly understood medical performance. In the studied model, the construct "hospital performance" (Per) was measured by financial (efficiency) and medical dimension (quality of services). In the present study, financial performance is measured using indicators that reflect cost optimization, profitability, and efficient utilization of resources. Medical performance is measured using indicators of patient satisfaction and medical services quality. Other non-financial measures that could be used to measure performance include innovative perfor-

mance, employee satisfaction, new product offers (Alamri, 2019).

In accordance with previous studies, for each item of these two dimensions, respondents have been asked to assess the hospital performance in relation to competition on a scale ranging since “1” (below average) until “5” (above average) (Hoque and James, 2000; Cadez and Guilding, 2008; Cadez and

Guilding, 2012; Alamri, 2019). The selected construct consists of five indicators. The factor loadings for these items were between 0.72 and 0.95. Cronbach’s alpha of 0.91 for the final construct suggests that its internal consistency is satisfactory. Thus, the reliability of the constructs was satisfied. Table 1 includes a list of the final constructs and indicators that formed the research model.

Table 1. The list of observable variables and constructs in the research model  
(Source: Author’s own elaboration: Kludacz-Alessandri, 2017b)

Observable variables	Constructs
Degree of utilization of IT technologies in administrative part of a hospital	Level of computerization in a hospital (CL)
Degree of utilization of IT technologies in medical part of a hospital	
Degree of IT systems integration	
Tracing direct material costs (medicines, medical products) to the patients and medical procedures	Quality of cost calculation (Calc)
Tracing other direct costs (e.g., labor) to the patients and medical procedures	
Allocation of the costs of medical procedures to the individual patients	
Allocation of the cost of man-days to the individual patients	
Planning and budgeting	Management accounting practices (MAP)
Cost control	
Processes improvement	
Performance measurement	
Analysis of resource efficiency	
Contract negotiations	
Profitability analysis	
Change in the structure of services	
Decisions on the purchase of medical equipment	
Profitability	Hospital performance (HP)
Cost optimization	
Efficient utilization of resources	
Patient satisfaction	
Medical service quality	

In order to estimate the parameters of the model, it was necessary to use multiple regression analysis in the STATISTICA (StatSoft) software program. Multiple regression analysis is one of the most popular research tool for analyzing the dependence of one

explained variable on several independent variables. This method allows to determine the overall fit of the model and the relative contribution of each of the predictors to the total variance explained. It is also used to predict the value of a dependent variable



based on the value of two or more other variables. The popularity of this tool is influenced by the possibility of its use in the analysis of various types of data and research problems, ease of interpretation, and widespread availability. However, the problem with using the regression approach may be the high correlation of independent variables in a regression equation, which may make it difficult to correctly identify the most important factors contributing to the analyzed process (Ali and Bakheit, 2011).

#### 4 Results

Data analysis demonstrated that the majority of the hospitals use a bottom-up micro-costing approach. This involves identifying all relevant cost elements in as much detail as possible and then combining them in order to calculate the cost of patient treatment process (Tan, 2009). A detailed list of each element of a patient treatment process in a hospital is created and costed separately (Clement Nee Shrive, et al., 2009). The cost objects that should be taken into account should be not only the direct costs traced to the patient (e.g., materials and labor) but also the costs of medical procedures and inpatient days. By contrast, around 20% of the sample use a less functional top-down gross-costing approach, which allows to calculate the average cost of the medical procedures and patients. About 8% of respondents have a very good opinion about the cost system in their hospitals, 59% say it is good and only 33% reported it to be satisfactory. This is due to the fact that cost data generated by costing system is satisfactory for the needs of hospital management.

Also examined was to what extent the managers of hospitals participating in this study use management accounting practices (MAP). Most of the respondents use cost information in internal processes, whereas external processes seem to be of minor importance. More than 70% of the respondents “strongly agree” or “rather agree” that they use cost information for budgeting and control processes. For various management accounting techniques like profitability analysis, performance measurement, contract negotiations, decisions regarding the purchase of medical equipment and resource efficiency analysis, the mean is higher than 3.5, which also indicates high frequency of use. The lowest average usage was identified for benchmarking (mean 2.70).

The results confirmed that the best fit of a model occurs when the quality of calculation is a four-dimensional construct; MAP is a nine-dimensional construct and performance is calculated on the basis of five indicators. Constructs with only one indicator (hospital size, education of managers) are problematic to measure because it is impossible to estimate their reliability (Cadez and Guilding, 2008). For these constructs it is necessary to specify a reliability value for a single measure or assume that there is no measurement error (Hair, et al., 1998). The number of hospital beds as an indicator of hospital size and education of manager are objective measures obtained from a reliable source; therefore, minimum error of measurement can be assumed.

Prior to multivariate regression analysis, correlation analysis was used. The correlation coefficients between constructs in the research model are presented in Table 2.

Table 2. Correlation levels among defined constructs in the research model  
(Source: Author's own elaboration)

	Size	CL	Calc	MAP	Per
Hospital size – Size	1				
The level of computerization – CL	0.16	1			
The quality of calculation– Calc	0.49*	0.45*	1		
Management accounting practices – MAP	0.17	0.29**	0.45*	1	
Hospital performance – Per	0.22	0.44*	0.66*	0.79*	1
* Coefficient is statistically significant at $p < 0.01$ level					
** Coefficient is statistically significant at $p < 0.05$ level					

The data in Table 2 shows that seven out of 10 relationships are statistically significant ( $p < 0.05$ ). The subject of interest in this study are seven hypothetical relationships. The correlations for them are shown in the gray boxes. Six of them turned out to be statistically significant, which confirmed the hypotheses of this study (these correlations are marked in bold). On this basis, it can be concluded that these independent variables can be considered as potential predictors of links in the tested model. The correlation coefficients are not high, suggesting that inter-correlations between independent variables are not any problem here. According to Lewis–Beck (2015), multicollinearity should be above 0.8 to be of any concern.

The relationships between the variables belonging to the analyzed model were confirmed by multiple regression analysis. The final selection of variables was made using the backward stepwise regression analysis. It consists in the gradual elimination of individual variables that have the lowest correlation coefficients. Therefore, the least significant variable is eliminated first. The model is then re-fitted to the current subset of the variables, and again, the least significant variable is eliminated. This procedure is applied until a satisfactory version of the model is obtained, such that all irrelevant variables are removed from the data set (Macchia 2012). The standardized regression coefficients (beta) are presented in Table 3.

Table 3. Results of multiple regression analysis (*Source*: Author's own elaboration)

	Factor I Calc	Factor II MAP	Factor III Per
Education of manager – Edu	–	–0.34*	–
Hospital size – Size	0.44*	–	–
The level of computerization – CL	0.38*	–	–
The quality of calculation process – Calc	–	0.46*	0.38*
Management accounting practices – MAP	–	–	0.62*
Determination rate – $R^2$	0.37	0.30	0.73
F-statistics	22.81*	17.17*	106.5*
* Coefficient is statistically significant at $p < 0.01$ level			

The results of the Fischer–Snedecor test (F-test) mean that the research model presents significant statistical associations. The key independent variables are: education of manager, hospital size, and the level of computerization. Predictor variables included in the model explain approximately 37% of the variance of the first construct (Calc) and 30% of the second construct (MAP). The highest value of the determination coefficient ( $R^2$ ) was achieved for the third construct (0.73). This indicates that variation in the dependent variable (Per) is very well described by explanatory variables (Calc, MAP). The multiple regression model efficiently explained the variation in hospital performance because two

explanatory variables (Calc and MAP) are of significant importance.

Summarizing, the regressions results indicate a significant relationship between the contextual variables: hospital size, level of computerization, and quality of cost calculation. The variable for education of hospital manager shows an association only with the MAP in a narrower sense ( $p < 0.01$ ). The analysis also confirmed that there are no statistically significant associations between education of director of the hospital and the quality of the calculation as well as between the size of the hospital and the management accounting practices (MAP). The quality of the calculation has a positive impact

on MAP, and both these factors impact on hospital performance. On the other hand, the quality of cost calculation depends on hospital size and level of computerization.

## 5 Discussion and conclusions

This study examined the associations between contingent factors and quality of cost calculation and between quality of cost calculation, MAP, and hospital performance using a sample of 76 hospitals.

The conclusions indicate support for six of the nine hypothesized associations. The quality of the calculation depends on two contingent factors (hospital size and level of computerization). The significance of these factors in a model is not surprising, given that variables regarding size are often presented in the literature affecting cost system functionality (e.g., Lawrence, 1990). MAP is associated with the education of the managers and the quality of the calculation. With respect to the last tested model, Calc, as well as MAP, exhibits a statistically significant positive association with hospital performance.

The most important predictor of the quality of the calculation is the level of hospital computerization. This relationship is relatively easy to characterize; the high level of computerization of medical and administrative parts of a hospital and the high degree of integration of IT solutions in the organization allow for the use of a bottom-up cost calculation, which improves the quality of unit costs. It confirmed the findings from other studies that the costing system significantly improves performance when is supported by IT (Maiga, et al., 2014). Thanks to this, the calculation of various cost components such as medical procedures, inpatient days, and DRG categories is easier, even when the patient is treated in different departments. Computer programs help in improving the flow of medical and financial information, which is necessary to conduct bottom-up micro-costing. This time-consuming costing methodology is difficult to apply, especially in the conditions of absence of or inadequate hospital information systems. Therefore, the use of bottom-up micro-costing calculations should be preceded by the computerization of both parts of the hospital – medical and administrative. This is necessary to obtain

accurate data on unit costs for all procedures performed at the hospital and then to assign them to individual patients. This allows for the identification of direct costs of the patients and patient subgroups with a greater share in the total costs. This enables statistical analyses to be performed to discover the caused of differences between costs of patients for each single cost element (Tan, 2009).

In summary, it can be concluded that there is a significant positive relationship between the quality of cost calculation and MAP. Hospitals that use more cost data for such purposes as: profitability analysis, cost control and budgeting, performance assessment, and decisions regarding outsourcing and pricing, need more advanced costing systems.

The relationship between the quality of cost calculation systems and the degree of use of cost data in managerial decisions is confirmed by the findings appearing in managerial accounting literature. The results of Pavlatos and Paggios (2008) indicate that the level of cost system functionality is significantly and positively associated with the extent of the use of cost data. On the other hand, according to Al-Omiri and Drury (2007), one of the factors impacting the level of costing system is the degree of use of cost information in cost analysis and managerial decisions, for example, regarding cost reduction and setting prices. Moreover, Nicolaou (2001) also reports that costing systems are designed according to the needs for information that their users have. Thus, if the managers do not use the cost information to any great extent, especially for managerial decisions, budgeting, and performance assessment, it is not very important for them to obtain qualitative cost information. The association between cost system functionality, MAP, and hospital performance was also examined by Pizzini (2006) who used a sample of 277 US hospitals. The results indicated that utility of cost information in the management practices is positively associated with the quality of costing system, responsible for the extent of providing cost data. The ability to supply cost detail was also favorably associated with measures of hospital performance, but only the financial measures.

From a global perspective, the model is described by a very strong direct effect of MAP on hospital per-

formance. In fact, hospital performance is also determined by the quality of the cost calculation. The question is if the quality of the cost calculation has a direct or a mediating effect (via MAP) on hospital performance. The findings of Uyar and Kuzey (2016) indicate that organizational performance does not depend directly on the quality of the costing system because this factor impacts on performance via MAP. They projected that MAP plays a full mediating role between the quality of costing system and performance. MAP is positively affected by the quality of the cost calculation process, while this, in turn, positively affects hospital performance.

It would, therefore, be advisable to estimate the model using structural equation modeling (SEM) in order to check how the identified performance differences are a result of the fit between structural characteristics, cost calculation quality, and MAP. SEM is used for similar, but more advanced purposes than those of multiple regression, because it takes into account the simultaneous estimation of multiple and interrelated dependence relationships, modeling of, for example, interactions, nonlinearities, correlated independents (de Carvalho and Chima 2014). In order to derive the final structural model, it may be necessary to make additional model modifications such as the deletion of paths that are not statistically significant.

The relationship between the hospital computerization, the quality of the patient's treatment calculation process, the use of cost information in the management process, and the hospital performance can be, therefore, relatively easy to characterize because of the chronological order. Information technologies, cost information, and performance are of interest to managers, not only in commercial entities but also in non-profit organizations, including hospitals. Better quality of cost information creates the conditions for their use in the management process. This results in improvement of both the economic and medical performance of the hospital. All these components of the model are affected by contingent internal factors such as hospital size, computerization level, and the specific characteristics of managers, including their education.

It should also be noted that this analysis is not free from certain limitations. One of these is relatively

small sample size (less than 100 hospitals), another – its non-random nature. Another limitation of this study was that the analyzed data came from respondent judgments, rather than from actual financial statements. Moreover, the model does not include the factors regarding external environment. Also, the results do not present comparative data of Polish and English hospitals. These two analyzed countries differ in quality of cost calculation and MAP, so "a country" should be probably an important control variable that should be taken into account in the further research.

Despite these limitations, the findings of this study could have important significance for further hospital costing system research. The results provide a first indication of the structural characteristics that may promote improving the quality of cost calculation in hospital and MAP. The subject of this study is especially important in these times of limited medical and financial resources and growing competition in the health-care systems. In such times, managers of the hospitals have to use sophisticated management accounting tools in order to increase hospital performance. However, utilization of such tools requires high-quality cost data. Thus, the study examined whether cost calculation system quality contributes to MAP and hospital performance. The findings did not indicate if the cost calculation system quality impacts directly hospital performance, however, or if it affects performance via MAP. The cost calculation system quality may have a positive impact on the use of cost information by managers, and this may contribute positively to performance.

This paper, therefore, constitutes a useful starting point for further research on the quality of cost calculation systems in hospitals and the legitimacy in bearing the costs of such a system. In further research, it would be advisable to take into account other contingent internal factors considered in the literature as potential predictors that may affect the organizational performance via MAP, such as: management style, budgetary participation, manager's characteristics (e.g., Fuadah, et al. 2020, Pasch 2019). Among external factors worth of consideration should be: law regulations, location of the hospital, competition for patients (Schneider, et al. 2019).

## 6 References

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