A Cloud-Based Service for Affordable Cost Analysis

Research-in-Progress

André Lourenço
Instituto Superior Técnico
Universidade Técnica de Lisboa
andrelourenco@ist.utl.pt

Miguel Mira da Silva
Instituto Superior Técnico
Universidade Técnica de Lisboa
mms@ist.utl.pt

ABSTRACT

Cost reduction and cost-awareness were, are, and probably will always be one of the major concerns of all organizations worldwide. This has been accentuated by difficult economic times, and is particularly true among small and medium enterprises (SMEs) where competition is even fiercer. But as essential as it looks, advanced costing techniques are expensive to implement and require expertise not present in most organizations, making them inaccessible to most of SMEs. In this paper we present a proposal of a cloud-based solution offered as a service designed to address this problem based on re-utilization, integration with ERPs and better data visualization that will make it affordable and easier to use for SMEs. This proposal was demonstrated with a limited prototype applied in a community pharmacy and it was evaluated through interviews with experts and potential users.

KEYWORDS

Costing, TDABC, SMEs, Cost Awareness, Profitability, Software, Templates.

INTRODUCTION

More and more costing and cost-reduction is proving to be a must in every organization. Organizations are under increasing pressure to remain competitive in today's global economy. This is particularly true in the west where economies are stagnating or in recession in some cases, and even more if we look at Small and Medium size Enterprises (SMEs) (Nandan, 2010). Globally, managers from all areas facing this challenge are making cost reduction and cost-awareness one of their organizations' priorities (Deloitte 2012). Their goal is to identify areas of improvement, which of their products or services are more profitable so that they can focus on them, or in some cases managers only want to have information that at the moment is not available to them.

This need for detailed cost-awareness brings to surface a problem: **Traditional costing techniques lack the ability to evaluate the internal efficiency like profitability by product/client** focusing more on accounts like labour or material (Narong, 2009). These traditional methodologies also focus more on direct costs leaving aside overhead costs which are becoming a bigger slice of the total cost (Skoda, 2009), and most importantly they may provide wrong information on the allocation of overhead costs to final product/objects (cost objects) (Lambert, 1996). So there is the need to use some costing methodology that is able to provide this kind of information that can later also be used for pricing, calculation of process cost and eventual reengineering as well as benchmarking (Tinkler and Dubé, 2002).

There are many modern costing methodologies that aim at solving this problem like Activity Based Costing (ABC) (Cooper, 1988) and Time-Driven Activity Based Costing (TDABC) (Kaplan and Anderson, 2007). But there is a draw-back with these methodologies. They require a capital both financial and human (in terms of expertise) that is unavailable for most SMEs, and normally are assisted by software that is out of the reach of these organizations (Hall and McPeak, 2011). So now there is a challenge which has to be overcome: **Cost reduction is becoming vital for all organizations, especially SMEs, but cost analysis is out of their reach**.

In this paper we will propose a solution for this problem, which is based on a cloud-based software designed for SMEs that takes advantage of some facts: 1) many organizations inside the same industry or field have a very similar cost structure which allows some re-utilization of activities, processes and models, 2) organizations normally are obliged by law to have financial reports in certain standards which guarantees that the necessary data is already available and makes it easier for a software to collect the right data.

This solution could be applied not only to SMEs, but also to divisions within larger organizations since, in many aspects, they share many of the constraints and limitations to those of SMEs.

This proposed software also assumes that the user has very limited knowledge on accountancy, thus it must have a simple interface so that it is usable by almost everyone. In sum, it is intended to give managers a way to let them do themselves a cost-analysis of their organization, in a more affordable manner.

Our research was done using the Design Science Research Methodology (DSRM), which aims to be a commonly accepted framework for the production of Design Science Research in Information Systems and creating and evaluating IT artefacts intended to solve identified organizational problems (Hevner, March, Park and Ram, 2004). These artefacts can be constructs, models, methods or instantiations. In this research our artefact will be a method and an instantiation of it for demonstration. DSRM follows the following phases (Peffers, 2008): problem identification, objectives definition, design and development, demonstration, evaluation and communication. The steps from the DSRM are reflected in the sections of this paper. This section corresponds to the problem identification and motivation phase of DSRM.

RELATED WORK

In this section we will present what was possible for us to obtain about the state of the art and why the existing solutions don't solve the identified problem. We will also explain the most important theoretical concepts needed for the development and understanding of our proposal.

Time-Driven Activity Based Costing

Time-Driven Activity Based Costing is a costing methodology that aims at solving some of the problems of the traditional Activity Based Costing, in which costs were calculated based on the assignment of resource expenses to activities that were verified through interviews and surveys. Although this is effective for simple processes with none or small variation, it becomes inefficient and not at all accurate for more complex processes.

To address this issue TDABC was created with the objective of providing a method that was simpler, more flexible and most of all faster to implement.

TDABC only requires two parameters: (1) The unit cost of a resource (e.g. Pharmaceutical Technician), that can be calculated from the total expenses related to that particular resource divided by its capacity (normally expressed in time), and (2) the time needed to execute a particular task. With these two values it is possible to calculate the cost of a particular activity simply by multiplying the time taken by the unit cost. Furthermore processes are defined as a composition of activities.

Another ABC problem that TDABC aims to solve is that each time there is a small change or variation to an activity, there is the need to create a new activity. As an example standard packaging and hazardous packaging in a logistics department would result in two completely different activities. TDABC deals with this issue by using time-equations. A time-equation is a linear equation that represents costs in function of the time and resources it consumes, allowing to represent conditions and cycles, thus making unnecessary the simplification (and loss of information) or exponential growth of activities from other costing methodologies. This way, using the same example, in TDABC we would have the same activity "packaging", but with different times whether it is a standard or a hazardous one (eq. 1). This equation means that packaging consumes 3 minutes of the logistics department for every order, plus 5 additional minutes for each hazardous order. This greatly reduces the complexity of the processes since we can express all conditions in a single activity.

$$\text{Packaging} = 3 * \text{Logistics Department} + 5 \; [\text{If hazardous}] \qquad (1)$$

TDABC also has the advantage of being able to give information about its own accuracy as well as identifying waste, by comparing the calculated capacity of a given resource with the actual used capacity in a given period.

TDABC software solutions

The first step after the identification of the problem was to look for solutions that already addressed it. With this purpose we looked for software that worked with TDABC models. Some were found: Acorn Systems, SAP PCM, SAS ABM, Cost Perform, Oracle Hyperion PCM and TDABC Studio. It was not possible for us to evaluate any of them since there are no trial versions of them. So the information obtained from them was from consultants in the area. This was that they

do indeed process TDABC models, but all of them have limitations regarding editing of processes and time-equations, since these need to be filled by hand without any assistance or error-preventing feature; None of them has graphical editing of processes: They aren't cloud based requiring for specific hardware and not offered as a service; And they only allow to model and run a company at a time. Finally we were also told that they could have better data visualization tools integrated and that the cost of each license is on average around 30,000 € making them unaffordable for SMEs as confirmed by owners of organizations that fall in this category.

OBJECTIVES

This section corresponds to the second step of the DSRM Methodology that is the definition of the objectives for the solution. We are going to map the problems identified in the introduction of this paper with the goals now defined.

The main objective of this proposal is to present a software tool that enables SME's to conduct their own cost analysis without significant need for external assistance and with operating costs that are affordable. Associated with this main objective there are other more specific ones that must be set:

- The software must not be specific to any particular organization or industry
- It must be possible for a user with none or little knowledge in accountancy to use the costing tool
- The tool must provide mechanisms to make it accessible for SMEs
- There must be the possibility to benchmark a company's' result against others belonging to the same industry

These goals will allow us not only to assess the usefulness of our proposal in the evaluation phase, but also will set us a roadmap for its current and future development.

PROPOSAL

This section corresponds to the Design and Development step of DSRM that consists on developing an artefact to address the issues identified in the previous sections.

The artefact on this research is a software costing solution that aims at accomplishing the goals defined in the previous sections. With this purpose we propose to create a cloud-based software named "Chronus" designed for users with little knowledge on accountancy, which is easy-to-use as it assists the user in the process, more affordable and that is capable of calculating costs using the TDABC methodology. In order to present our proposal we will divide it in the main features of the solution, which represent the main contributions and how goals are met, and then we will present a very simple scenario that shows the intended use for it. This will represent how the features link between each other on achieving the goals.

Main Features

Usage of templates

Using preliminary results of other research being done by the authors of this paper, this tool will take advantage of TDABC templates. These templates consist on a set of activities combined into processes and that associated with time-equations form a TDABC model. They are created for a particular industry or field and take advantage of the fact that the business processes and cost structures of two organizations operating in the same industry have overlapped aspects and are very similar making some re-utilization possible. These templates can be created for a specific industry at the moment of the first cost-analysis in a given field and create a model that represents all common aspects of organizations belonging to it. The following analysis in that field would be based on the previously created template making it unnecessary for a full analysis.

Since obviously no two organizations are exactly the same the tool will also allow for users to adjust the used template to the specificities of their organizations. This can be achieved by using the tool to add/remove activities from the TDABC model or by changing the time-equations if the usage of resources is different or if the activity has variations specific to some condition to the modus operandi of the organization, therefore taking full advantage of the ability of TDABC to deal with complexity.

Graphical Edition of Business Processes

Since one of the goals of this solution is to be easy to use it is essential to make it easy for any user to apply a template or adjust it while doing a cost analysis of their organization. So it was decided that it should be possible to have a graphical way of modifying the templates. For this we used an interface that uses the Business Process Modeling Notation (BPMN) (Object Management Group, 2011) since we believe that this is familiar to most users of this solution and is widely disseminated, opposed to a text-based edition of the TDABC model through time-equations.

This will allow users to create/modify their business processes, and also the templates by drawing their business processes just like they were using any other modelling tool by simply dragging and dropping activities, with the application helping the user in the process by asking which resources are used in that activity and for how long. With this information it is then possible to automatically create the time-equations needed for the TDABC model without requiring any expertise from the user.

These activities and processes can then be reused, or even be saved as a template for future adjustments, only by dragging and dropping them in new processes.

Integration with Enterprise Resource Planners (ERPs)

In order to simplify the process of costing for organizations, we also propose an integration with ERPs. This would allow for the feeding of data to be done automatically or even in a continuous manner. Instead of doing a cost analysis in batches as usual, it would be possible to fetch a new transaction at the moment it occurred, making it possible to have a real-time analysis and have these results linked to performance dashboards in order to provide yet another control tool to managers. On top of this, a connection to the ERP the solution could give immediate feedback to the user about the profitability of some event. For example it could present to a salesperson how much money the organization will win/lose if the sale is executed with the current conditions.

This integration makes the process simpler by avoiding the need for users to feed the solution with data each time they want an analysis. This is also one of the aspects defined in the templates, that is, from what fields of a particular ERP should the data be fetched from.

This integration should be done as an external module so that it respects one of the goals of the solution that is to operate with any ERP.

Cloud-Based and Costing as a Service

The main aspects that drove the choice of developing this solution in the cloud were 1) allowing users to have instant access to the solution without any costs on hardware, configurations or maintenance thus reducing the initial investment needed and the time to start the project, 2) access to the tool from virtually anywhere, assuming there is an internet connection, 3) allowing users to pay according to their needs, this is, instead of paying for a license the client can have a plan based on the number of times the application is used, or the number of transactions processed, or other drivers, 4) it allows for easier benchmarking as it will be explained in the next sub-section, 5) having the solution based on the cloud makes it easier to have a community of users and experts where it is possible to create new templates and make them available, whether freely or paid. This way acquiring a template would be a process very similar to the one of buying an extension from a browser store.

Benchmarking

Thanks to two aspects of this solution: being cloud-based and using templates, it is possible to easily make a benchmark of the organization against others available in the same industry since they share the same template (even if with adjustments) and all their data is available in the same location. With this a manager can see how his/her organization in performing, where does it operate better, which are the processes where it spends more resources, where it is more efficient and also know how it positions against other companies in the same field. This can help managers identify on one hand what their competitive advantages are, and on the other see where their company is underperforming, this way identifying possible aspects for improvement.

Of course there are some security issues related to this feature that need to be addressed since a company must not have access to financial data belonging to another company. To solve this, benchmarking should be done also against the average of all other organizations in the field and not against a specific organization.

Data visualization

We believe that one of the most appealing features in any analysis tool is the way data can be visualized. We propose that this solution should present not only the numerical values but also present them in a more user-friendly way like using the fore-mentioned dashboards and also graphics and charts that better highlight points of concern for managers like unprofitable products, processes or clients and then allowing to drill-down obtaining more detail. The user should also be able to choose which filters should be applied creating custom graphics.

Another form of giving users information could be through previously configured alerts that would warn the user of events that are having a negative impact on profitability.

What-if Analysis

Another interesting feature made possible with the use of TDABC is the ability to do what-if analysis. This consists on changing variables of the model, and using the solution to evaluate the effect it would have on the rest of the model. An example of this would be to evaluate the effect of changing a process or an activity and see the repercussions it would have on client or product profitability based on past transactions. This would help diminish the risk taken when making decisions regarding introduction of products, changing processes, etc.

Use-case Scenario of the Solution

As expressed in the diagram in Figure 1 a simple sample of how the solution work is as follows: Alice has a pharmacy and decides to do a cost analysis, so she goes to the Chronus website and sees that there is already a template for pharmacies done by Bob a health consultant **a)**, so she applies it **b)**, and sees that there is an activity done by her pharmacy not present in the template. To solve this, she adds it to the model using the BPMN editor adjusting the model **c)**. Then she chooses the appropriate module for her ERP and indicates the source of the data **d)**. Finally she is able to run the model **e)**, using the resource costs and capacities fed by the ERP as well as all the transactions for a specific period of time. She can then use those results to do some benchmarking or to try and identify points where she can improve **f)**.
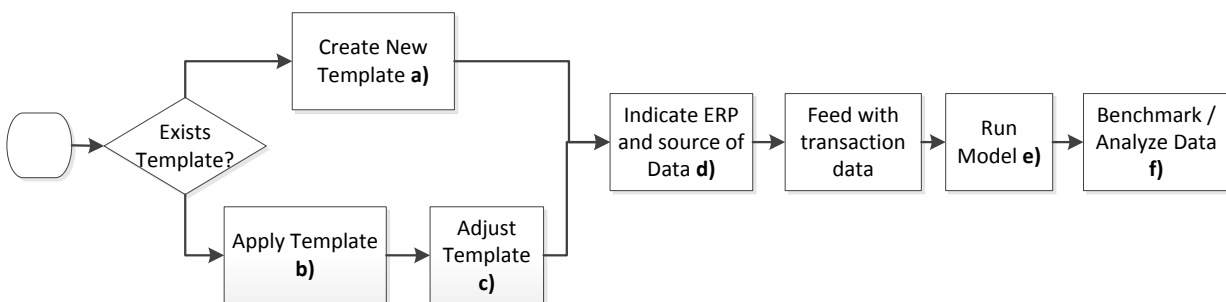

Figure 1 - Use-case scenario of the solution

DEMONSTRATION

This section corresponds to the demonstration phase of DSRM. For this purpose we developed a limited cloud-based prototype using Outsystems Technology.

We define the prototype as limited since it still does not have the features of benchmarking, integration with ERPs and graphical business process edition. We decided to focus on the creation and processing of TDABC models, the ability to evaluate templates and the fact of being run in the cloud. At this stage the prototype was still run by us and shown to a member of a task force of the Portuguese Pharmacy Association (that represents 97% of the market) responsible for finding ways to deal with inefficiencies and new challenges, that are affecting the Portuguese pharmacies threatening them to close (Antão and Grenha, 2012), through innovation.

We chose pharmacies for three reasons: 1) TDABC has been applied with success in the health industry (Kaplan and Porter, 2011), 2) the health industry is an area that has been observing rising costs which is a problem for most developed economies making it a very interesting problem to solve 3) pharmacies, in particular are smaller organizations (considered SMEs) and have the advantage of being quite similar to each other, making them a perfect fit to demonstrate the usefulness of templates.

For this demonstration we created a template of the attendance service of a community pharmacy validated in two different pharmacies. In Figure 2 we present an activity of the model, and then fed the solution with a sample input data containing both the costs and capacities of the resources as well as the transactions done in a period, all using the cloud-based solution. With this data we then ran the model and generated reports on the usage of the resources as well as on client profitability (Figure 3). As a curiosity the graph seen in the screenshot is the whale curve. The whale curve is a concept that states that on almost every organization 20% of clients generate 150% of the profit, 60% have close to neutral profitability and 20% destroy 50 % of the profit, leaving the obvious total of 100%. This graph is of extreme importance to identifying customers or products that have to be dealt with.

The feedback obtained from this demonstration is expressed in the evaluation section.
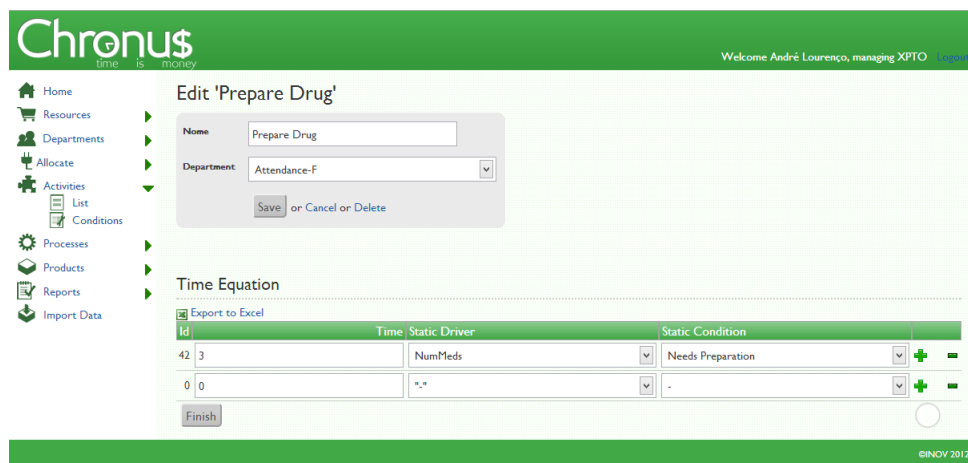

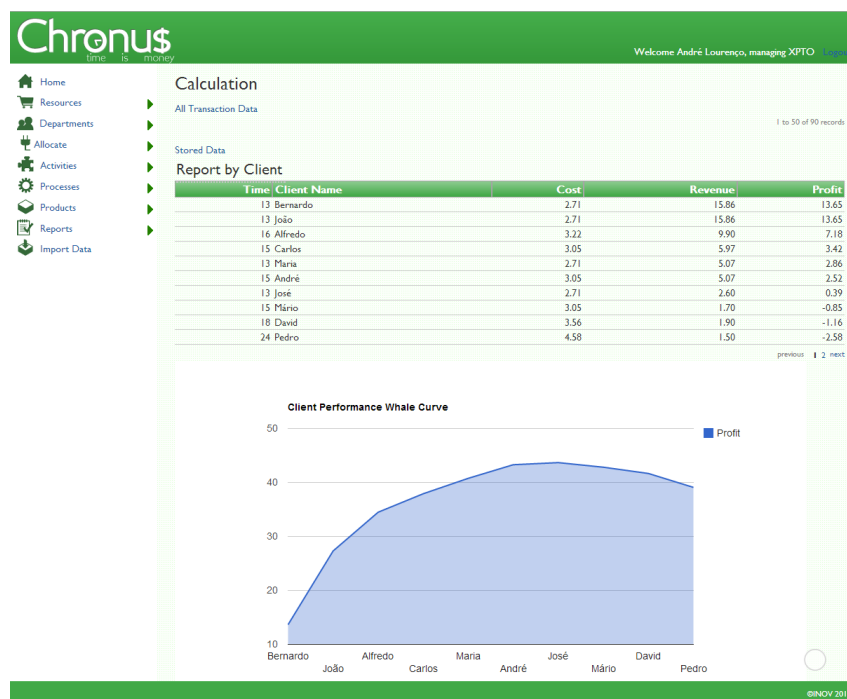**Figure 2 – Screenshot of edition of activity in template**

Figure 3 – Screenshot of report of client profitability

EVALUATION

This section corresponds to the evaluation step of the DSRM. To evaluate our proposal and its results we used: 1) Feedback obtained by the demonstration, 2) Interviews with experts and potential users. We then used these interviews to verify 1) the Four Principles proposed by Österle (Österle, 2011) to evaluate an artifact and 2) the principles defined in the Moody and Shanks Quality Framework (MSQF) (Moody and Shanks, 2011) that were developed for evaluation of data models but is also applied in this case. This evaluation is used to improve our proposal as suggested in the DSRM.

Feedback from the demonstration

The feedback obtained was that the concept of using templates was, as expected, an almost perfect-fit in the pharmacies since all of them share the same processes and work approximately in the same way, also their resources are always the same except for some little variation. It was also stated that the concept of integration with ERPs would be useful since it would make the process simpler.

One proposal made was that the solution had not only templates, but that those templates could have a set of variables that a user could define when the template is instantiated so that it could make the process of adaptation even easier. The practical example given was the case of a pharmacy that had a drug-dispenser robot. This would change the time-equations related to the attendance service and could be asked upon the instantiation of the template, instead of requiring the user to change the model.

In sum the feedback was rather positive since 1) we were able to validate the importance of our research problem since we were told that there was a need for costing but that it was really out of reach, 2) the features proposed by us were considered useful, 3) it was easy to use by someone with little knowledge of accountancy and, 4) there is no equivalent solution available.

Interviews

To evaluate the principles proposed by Österle et al. (Originality, Abstraction, Justification and Benefit) and those in the MSQF (Completeness, Integrity, Flexibility, Understandability, Correctness, Simplicity, Integration and Implementability) we made 6 interviews (40 minutes) with experts and potential users of the solution. These were: 1) a member of the board of a major consulting company, 2) the director of the emergency room service of a public hospital, 3) a professor specialized on costs, 4) the financial advisor of another public hospital, 5) the owner of a pharmacy and 6) a cost consultant.

Feedback was positive and homogenous. All interviewees recognize there is the need for implementing costing models in organizations and answered that what is holding them back is the price associated with that process. When users were asked if the price proposed by our service would change this situation the answer was positive, and there was also a positive response from consultants since there are ways for them to make profit of this new costing "paradigm".

Regarding the proposed functionalities, all were seen as positive and innovative, except for the what-if analysis that although useful and very important in the solution, is already possible with other tools. The most important features were considered by all the usage of templates (because it reduces implementation cost and time) and benchmarking (which allows organizations to see where they are under/over performing).

CONCLUSION

Currently companies operate in a very competitive global market, which is even truer if we look to SMEs. This fact makes it unavoidable that cost analysis and reduction are a present point in every company's' agenda since the only way for them to keep competitive is by increasing their performance and become more efficient and specifically more **cost-efficient** since this is one of the main competitive factors (Kadocsa, 2006). But as it was shown, many of these organizations although they recognize the need for this effort they lack the capital both in terms of money and expertise to conduct a full analysis based on modern costing methodologies. This becomes close to a paradox. To improve companies need to reduce costs, but to reduce costs they have to spend money they do not have.

We believe that our proposal will be able to provide a solution or at least a mechanism for solving this problem, since by taking advantage of the standardization or overlapping of processes observed inside each industry, it makes the process more affordable both in terms of capital and expertise needed. By offering cost analysis almost as a service where the user can without a large knowledge of accountancy, use a template previously developed by other users or by a consultant and then adjust it to his specific needs, companies will now be able in a more affordable way to:

- Calculate client and product profitability
- Calculate cost of Business Processes and allow their reengineering
- Benchmark against industry average
- Get information needed for pricing

The development of this solution would also have business advantages both for future users but also for those involved in its ecosystems, allowing for the development of future business models. As an example current consultants could still make profits developing templates instead of doing a full analysis. This could still be profitable for them since assuming three analysis of pharmacies cost 20,000€ it is still less than selling 800 templates for 100€, and the last requires one third of the work, since it is only executed once. So this appears to be the case of a free lunch where both the provider as well as the consumer obtain great benefits

Finally we believe the next steps are to obtain feedback from the scientific community through submission of papers to respectable conferences, resume the development of the solution, and then carry a series of case-studies in order to demonstrate and validate the instantiation of the proposal.

So in sum we believe that our proposal will, once it is fully developed and tested, make SMEs able to obtain more detailed information about their cost structures. This would help them make better decisions and therefore become more competitive. We are also aware that the proposal's development is still in an embryonic stage, but according to the feedback obtained from not only the evaluation but also from the demonstration of the limited prototype we believe its objectives will be met.

REFERENCES

1.	Deloitte (2012) The Deloitte CFO Survey : Priorities for 2012: Cash and Costs
2.	Tinkler, M. and Dubé, D. (2002) Strength in Numbers, CMA Management
3.	Nandan, R. (2010) Management Accounting Needs of SMEs and the Role of Professional Accountants: A Renewed Research Agenda, *Journal of applied management accounting research*, 8, 1, 65-78
4.	Hall, O. and McPeak, C. (2011) Are SMEs ready for ABC?, *Journal of Accounting and Finance*, 11, 4, 11-22
5.	Narong, David K. (2009) Activity-Based Costing and Management Solutions to traditional shortcomings of cost accounting, *Cost Engineering*, 51, 8, 11-22
6.	Škoda, M. (2009) The importance of abc models in cost management, *Annals of the University of Petrosani Economics,* 9, 2, 263-274
7.	Lambert, S. J. and Chen, Kung H. (1996) Overhead cost pools, *Internal Auditor,* 53, 5, 62-65
8.	Cooper, R. and Kaplan, R. (1988) How cost accounting distorts product costs. *Management Accounting*, 69, 10, 20-27.
9.	Kaplan, R. and Anderson, S. (2007). Time-Driven activity-based costing: A simpler and more powerful path to higher profits. *Harvard Business School Press*, Boston
10.	Hevner, A.R., March, S.T., Park J. and Ram S. (2004) Design Science in Information Systems Research, *Management Information Systems Quarterly*, 28, 1, 75-105
11.	Kadocsa, G. (2006) Research of Comeptitiveness Factors of SME, *Acta Polytechnica Hungarica*, 3, 4, 71-84
12.	Object Management Group (2011) Business Process Model and Notation (BPMN) Version 2.0
13.	Antão, A. and Grenha, C. (2012) Avaliação Económica e Financeira do Setor das Farmácias (in portuguese)
14.	Dias, D., Lapão, L., Mira da Silva, M. (2012) Using Enteprise Ontology for Improving Emergency Management in Hospitals, Proceeding of the twenty fourth European Medical Informatics Conference (MIE 12) August 26 – 29, Pisa, Italy, IOS Press, 58-62

15. Kaplan, R. and Porter, M. (2011) How to solve the cost crisis in health care, Harvard Business Review, September.

16. Moody, D. and Shanks, G. (2003) Improving the Quality of Data Models: Empirical Validation of a Quality Management Framework, Information Systems, 28, 619-650.

17. Österle, H., et al. (2011) Memorandum on Design-Oriented Information Systems Research, European Journal on Information Systems, 20, 7-10.