THEORETICAL STUDY OF USING TIME-DRIVEN ACTIVITY-BASED COSTING SYSTEM FOR IMPROVING THE PERFORMANCE OF INDUSTRIAL UNITS

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ABSTRACT
The aim of this study is surveying the functions of time-driven activity-based costing (TDABC) in cost management of industrial units. In this regard, it has been tried to survey the activity-based costing from the beginning; also it has been tried to survey its effects on different parts of a unit. TDABC method is mainly based on using time and unlike activity-based costing (ABC), it does not detect activities at the first stage and does not allocate related costs to activities; rather, in this method the required resources are predicted regarding the required estimated time and cost per time unit directly for each subject of cost.

Keywords: Cost Accounting, Cost-Based Pricing, Time-Driven Activity-Based Costing

INTRODUCTION
It has been a while since the conventional accounting system has lost its ability and capability to meet the needs of modern management and help solving the problems in organizational environments. Effects caused by changes in technology, global trade, increased competition and rapid changes of clients’ expectations and demands and structural changes happened in the management attitude and created organizational models, in overall have caused people in charge and experts of management accounting knowledge and profession in different parts of universities and careers to combine theoretical and practical aspects of management accounting and to invent methods and techniques for meeting the new needs of organizations and managers and to solve organizational problems (Pourjahangiri, 2006).

Activity-based costing is one of the costing techniques related to used resources and the cost targets such as services and clients and the transitional costs could be detected and determined for each client and service. ABC is a framework of business performance criterion used in relation with other business processes for determining the cost of services or products. The conventional ABC method does not have the ability to preserve information and implement them in order to connect a big model of activities to the cost targets because of the need to collect information through interview. Time-driven costing is used for simplifying processes by the use of time for achieving the capacity cost rate in a way that the estimated cost per unit of time is achieved; and it is based on dividing total estimated costs by practical capacity of resources used in that period.

Activities are the set of measures and consuming resources and also resources are considered as the factors of business and economic activities. Importance and effect of activities on business has caused its information based systems such as accounting to take form based on these activities; and the framework of these systems is activity based methods such as activity-based costing; activity-based management and activity-based budgeting that are all cost management tools.

Time-driven activity-based costing (TDABC) system is the 2nd generation of activity-based costing system and is one of the most important modern phenomena in the field of accounting management which has resulted in emergence of a revolution in the field of calculating the total cost of products and services. Although activity-based costing system is still and currently used in different companies and institutions all around the world including Iran, there are still complications in implementing and maintaining this system; and it is tried to less use the efficiency, timeliness and modernity of this management tools and innovation.

Cooper and Kaplan were two scholars who had a significant effect on reflecting the failure of management accounting system in providing accurate cost information. Relation between activities and
costs was mentioned in late 1960’s and early 1970’s mostly by accounting authors. But the serious focus of universities and professional association on this relation started in 1980’s. This focus was caused by the creation of three main factors.

The 1st factor was occurrence of new changes in the world for introducing modern technologies, intelligent, expert and flexible information systems, and new production mechanisms in countries and especially in Japan. The 2nd factor was that in 1980’s the philosophy of mind of many company managers, especially big company managers was affected by significant changes and in addition to profitability, competition at the international level, increased customer satisfaction at international level, emphasis on product quality control and decreased costs were parts of the main and primary aims of managers. The 3rd factors was that a number of accounting authors seriously and extensively started to explain the net production environment, different roles of technology and managers’ new perspectives (Namazi, 2009).

Kaplan & Anderson (2004) started to mention the common problems of ABC system and introduced its 2nd generation under the name of time-driven activity-based costing system and also they elaborated on it in their recent book published with the same name in 2007. TDABC eliminates the difficulties of ABC. This system in accounting is used for determining the final exact cost of the products and services and access to companies’ actual profit. But its main application is in the field of activity-based management (ABM) and especially in cost control management, increasing customer satisfaction, technology management and determining the optimal amount of products and services produced by companies. By designing and implementing TDABC system, costs are better controlled, new customers are attracted and old customers are maintained, the possibility of budgeting the source capacity based on amount of orders is predicted and also more relevant information are provided for managers’ decision making.

In this regard only two factors are predicted:
1- Capacity cost rate in the studied cycle (time).
2- Capacity utilization in each processed distribution in the cycle (organization).

In the common ABC system costs of each activity are allocated based on the stimulus such as number, setting machines, amount of order, number of implementations etc. Nowadays because the organizations use enterprise resource planning (ERP) systems they can easily and quickly report all information and details related to orders.

Under these circumstances, TDABC could act better than ABC. In this system after determining the capacity cost rate in the cycle (organization), management must determine the amount of capacity utilization of the stimulus for each activity; and capacity in this method is measured based on the time it takes for the employees to complete the specific activity.

Here the aim is not telling that the time is accurately determined; rather its approximate time is enough for predicting the model. Thus, in this method, unlike ABC, there is no need for field study of employees regarding the percentage of time allocated to the related activities.

Using time as the cost driver in TDABC has two advantages:
1- One of the complicated stages of ABC which is initial allocation and allocating resource costs to activities is eliminated.
2- Since most of the important resources of an organization or cycle such as employees and machines have a capacity that could be measured by time; thus, TDABC makes measuring its capacity easier and it causes an equation based on time in order to summarize activities and their subclasses in one equation.

Surveying Research Literature

Quality of services is one the key factors for many individuals providing services; because this factors determines the customer satisfaction; also accurate determination of costs is very important (Peebles et al., 2001). Activity-based costing provides facilities for this aim. Many conducted researches regarding the activity-based costing and time-driven activity-based costing act toward improving the visibility of organizations’ costs. Many have admired ABC and many have criticized it because of difficulty in implementing and the accuracy of the model. Neumann et al., (2004) have supported ABC because of improving the IT service costing compared to its conventional method; which is related to costs allocated...
to resources and facilities. ABC allocates costs according to activity-based customer and services in which customer and services are used in relation to share of resources. Meanwhile, Lalonde & Pohlen (1996) showed the insufficiency of ABC for supply chain costing. They showed that ABC focuses on internal threads and thus the upper and lower elements of supply chain are out of the control of production organization.

Time-driven activity-based costing mostly deals with the factory and production environments rather than the service units that have no tangible output. Cost of activities related to producing a product and facilities allocated to production are considered as overhead in traditional costing. ABC techniques have managed to help methods related to activity costs of producing products and services. Kaplan & Anderson (2007) have detected the following subjects in relation to ABC:

- The process is costly and time-consuming.
- ABC model data are abstract and non-accreditation.
- Saving, processing and reporting data is costly.
- Most models are internal and they do not provide an integrated approach toward the company profitability.
- ABC model does not have the ability to change for compliance with environmental changes.
- The model is not theoretically correct when it ignores the used capacity.

This causes many companies to let go of ABC model (Szychta, 2010) or not to ever accept ABC model; and this has caused Kaplan & Anderson to provide time-driven activity-based costing model which compared to ABC model is direct and easily implemented and maintained.

ABC and TDABC models are the base of accounting for resource allocation helping the organization toward more evidence of costs. Implementing ABC and TDABC could have a significant effect on this matter that how the work is seen and done in the organization; and this could lead to significant changes in operational and product price procedures.

Many organizations ignore the effect of these techniques on their organizations. This matter is derived from the employees’ perception regarding the change and natural resistance against changes that all individuals show.

Reyhanoglu (2004) concluded that among the group who used ABC only 10% of them were successful. Operational services employees tend to show that they have used time and resources in their full capacity and no waste exists. On the other hand, managers tend to show that ABC does not significantly help the efficiency of operational costs. Sanford (2009) concluded that comparing a number of companies having ABC and a number of companies not having ABC, it could be said that companies with ABC had a better performance. This shows that just implementing ABC is not enough and some procedures must be followed in order to result in increasing value for the company. The key to success is ensuring that all employees have a clear image of the aims of the project and they should predict the advantages of this matter for the company and the individuals.

In late 19th century, ABC was used in many organizations, both public and private; and this was due to the ability of this system for showing the resources of hidden costs and highlighting profitability. During time, ABC was used for planning capacity and modelling. Accepting ABC must be based on good cost management techniques ensuring he following matters:

- It must increase value.
- It must detect the cost drivers for each activity.
- It must ensure that activities related to cost management are related to cost drivers.

It must be considered that ABC also considers the repeated resources so that the cost of each unit is accurately calculated. Traditional ABC has this problem that it cannot accurately calculate the repeated resources; because it is usually based on a rate of resources used in each activity; but TDABC could be used for this matter by the use of time integration method in order to dominate each activity (Kaplan & Anderson, 2007).

In an article with the aim of introducing the TDABC, Kaplan (2005) conducted a case study about this system in Kemps L.L.C. The researcher showed that TDABC system had provided the required based for
improving procedures, rationalizing the composition and diversity of products and modifying the non-profitable customer relationships.

In an article named modelling transport costs using TDABC, Bridgeman (2005) conducted a case study about this system in SONACC Logistics. TDABC model is used in an agricultural tools distribution company. By the use of this model the costs are led toward each trade and the company is converted from a sales-oriented company to a profit-oriented company.

Szychta (2010) showed that TDABC is capable of reaching high complexities and more accuracy of time used in organizations is when it is based on services; because TDABC uses time as a primary cost driver and time equation for different activities. Time is used for allocating resource costs directly to objects, e.g. transactions, orders, finished products, services and customers, which makes it possible to omit a complex step involved in conventional ABC, namely assigning resource costs to activities before allocating them to cost objects.

In an article named introducing the 2nd generation of ABC in 2007-2008, Mohammad Namazi introduced this system, the common problems of ABC, parameters of the new system and its calculation method. Fatemeh Mehdi (2009) has translated an article named TDABC; this article is written by Kaplan R & Anderson R and it surveys the problems of ABC system and introduces TDABC and methods for calculating its parameters.

Gholamreza Karami (2011) has translated an article with the aim of emergence of resource consumption accounting in the process of change of costing system. This article is written by Lowyt White. This research introduces the resource accounting as a tool emphasizing on management needs and it introduces a costing method created from the integration of ABC method and a German finished cost method called JPK. Also it shows the differences between this costing method, ABC method and TDABC method.

**Costing Systems**

In late 1980’s many accounting experts and managements criticized organization managers for using and implementing conventional accounting systems. The main problem and criticism of these experts was that costs provided by conventional costing system do not provide decision makers with accurate information about the finished cost of products and services and even by providing wrong information it leads to misleading managers in making decisions. Foster (1991) conducted a research among financial managers of a few big companies in the USA in order to survey the performance of conventional costing systems. The study results showed that conventional systems are unable to provide appropriate information for managers’ decision making. According to the results achieved from this research, 51% of surveyed organization managers believed that conventional systems do not provide adequate information for costing, and pricing the products; 45% of them stated that the information provided by these systems are not accurate and real and are not useful for decision making; 34% of them mentioned that due to lack of measuring the employees’ performance, conventional systems have resulted in their dissatisfaction; 27% of managers believed that provided information are not adequate and appropriate for analyzing the competition; and also 11% of them believed that these systems do not have compliance with organizational strategies (Adler, 1998).

From the overall view, the most important reasons of insufficiency of the conventional systems were:

1- Inability to provide the finished cost information especially in companies providing their customers with many different services. Since conventional systems do not consider the specific characteristics of each service in sharing costs, thus, it results in wrong cost allocation and lack of accurate calculation of finished cost of products.

2- Lack of separating the field of dissimilar costs- In conventional systems, common cost centers are used for collecting wage costs and overhead costs. This results in unrealistic allocation of costs to provided services.

3- Using a common or unit base for cost allocation- these systems usually use a share base for different cost allocations. One of these bases in using HR direct working hours. Since nowadays the complexity and rapid changes of technology have reduced the human intervention in work processes; thus, by using this base the cost sharing is not realistically conducted.
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4- Lack of providing accurate information regarding the finished cost and other information required for decision making - the conventional systems existing in organizations usually divide costing to two groups of direct and period costs; and they only consider the direct costs in calculating the finished cost; but in decision making there is a need to use both direct and period costs. Thus, relying on conventional methods does not provide the possibility of further analysis regarding the improvement of activities, reducing costs etc.

5- Conventional systems consider the advantages achieved from evolution of processes and improvement of methods as economizing the workforce; thus, they do not show the improvement of performances in operational processes.

6- Conventional costing systems do not show the real information from operation and costs process. In calculating the finished cost, these systems only consider the costs that are easily identifiable; and indirect costs do not have a role in calculating the finished cost.

7- In addition to insufficiency of conventional systems, growth of competition and complicated technology have intensified the need for using new costing methods; because for pricing products and services, making strategic decisions etc., organizations need to have access to correct information about the costs. It is clear that due to their nature, the conventional systems are not practical in this field.

ABC system is one of the modern product costing systems. This system is not an alternative for job order costing or step method; instead it could be used along with them to provide more accurate information regarding the costs and ultimately the economic decision making of the management; and this distinguishes it from conventional systems. That is why ABC phenomena is considered as one of the important and modern features of production and effects of technology domineering today’s industry; and it absorbs these effects to products or services as least as possible. Emergence of automation, electronic machines, robots and generally the advanced technology has significantly changed the production of structure of product costs (Namazi, 2005).

Although having an attractive and valuable structure, ABC model is not publicly accepted by organizations. Results of a research about the acceptance of managerial tools have shown that this acceptance was average regarding the ABC model. Such low acceptance rate for a model which provides an insight about the cost, profitability of services, processes, products and customers is very surprising (Kaplan et al., 2007). In fact for implementing ABC systems there is a need to act carefully and intelligently; because any king of negligence and not considering the conditions and factors affecting the implementation, installation and running the ABC system may result in taking distance from success and the aims (Talebnia et al., 2012). The most important reason for using ABC model is that the resources received from model do not justify the cost of using it; also another important factor is this thought in managers’ mind that it is far fetch that this model could improve the cost control (Muhammad & Colin, 2007).

Some companies did not accept ABC model or let it go after using it because of the organizational and behavioral resistance accompanied by emergence of any new idea; but most of the resistances against accepting and maintaining the model were rational. Creating most conventional ABC models is costly, their maintenance is difficult and changing them is hard. The accuracy of cost allocation which is conducted based on individuals’ subjective assessments about the percentage of their time consumed on different activities is doubtful. Also, many managers believe that the model does not have adequate accuracy for reducing the complexity of real operation. Ultimately, a very serious problem is created from the interviewing process. Most of the interviewees do not consider any percentage of their consumed time as unused; and due to this almost all conventional models calculate the cost drivers in a way that all resources are working with their full capacity; whereas these rates must be calculated at their practical capacity (Kaplan et al., 2007).

Briefly, using ABC model had the following problems: (Kaplan et al., 2007):

1- The interviewing and surveying process was time-consuming and costly.

2- The data for ABC models were subjective and difficult to validate.

3- The data were expensive to store, process and report.

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Most ABC models were local and did not provide an integrated view of enterprise-wide profitability opportunities. The ABC model could not be easily updated to accommodate changing circumstances. The model was theoretically incorrect when it ignored potential for unused capacity.

**Time-Driven Activity-Based Costing Concepts**

For solving a part of common problems associated with ABC system, Kaplan & Anderson (2004) introduced a new system called TDABC and elaborated on it in a book with the same name in 2007. Unlike ABC system, this system does not detect activities at the first stage and do not allocate the related costs to activities; as a result the primary perorating costs to activities does not happen. In this method, firstly managers or the management directly predict the required resources for each cost subject (services, products, customers etc.). Instead of determining the time required for doing activities based on interview with employees or questionnaires, they determine the cost resources based on time equation and directly and automatically allocate them to conducted activities and operations (Namazi, 2007-2008).

The aim of proposing TDABC is using an approach based on time of activities that could solve many difficulties of ABC system. The time factors is easily updated (based on changes in production process, diversity of orders and costs of production resources) and it easily has the ability to absorb data from enterprise resource planning (ERP) and customer relationship management (CRM) (Azizi, 2007). The solution for ABC problem is not ignoring it; because ABC has helped many companies in terms of production design with low cost and diversity of production, cost of products etc. Potentiality of this system in large scale is a significant opportunity for companies. The new approach called TDABC system only needs two estimations for allocating resources to cost subject:

Capacity cost rate.

Unit times of consumption of resource capacity by the activities by products, services and customers (Anderson & Stiwson, 2004).

This approach provides a practical detailed option for determining the control of costs and utilizing process capacity, profitability of orders, services and customers. Managers also receive accurate cost and profitability information and as a result they could determine the priorities related to improving processes, rationalizing the composition and diversity of products, pricing the customers’ orders and CRM in a way that it creates a win-win situation (Namazi, 2009).

**TDABC Advantages**

The conventional accounting methods usually determine the overhead costs by dividing it to products based on the profitability rate from resources such as performance of the machine or the space occupied. This becomes a problem when the output is intangible e.g. services; and usually the allocated overheads are incorrect (Cokins, 2001) which result in wrong estimations of the costs. The problem of cost allocation was solved by the introduction of ABC.

ABC let the companies accurately allocate overhead costs to products and services by the use of measuring the resource consumption in production of products or service provision. This measurement is conducted by listing the activities provided in a service-based organization and then the overall time is divided by these activities.

TDABC covers the constraints mentioned for ABC; and it is easier and less costly than the ABC and its implementation is rather more quickly. This model let the finished cost driver rates to be calculated based on practical capacity and resources time unit.

Most managers who have used ABC in their organizations find out that this approach is restrictive and inefficient; especially when some settings are harder and more complicated than other settings; or when processing and surveying some orders of the customers need more time and efforts compared to other orders. In these cases the simple counting down of the times each activity has been done is a wrong estimation of the resources required for doing a task. The new TDABC approach is considered as a simple and powerful method for measuring cost and profitability.

By the use of this method, managers spend less time and cost for collecting and maintaining data and instead they have more time for solving problems such as improving inefficient processes, detecting
unprofitable products and customers and unused capacity. In addition to having advantages resulted from ABC such as enhancing the profitability of products and customers, capacity utilization management and improving the production process, has the following applications as well: (Atefi, 2008)

- Connecting strategic planning to operational budgeting.
- Improving the process of decision making.
- Supporting other continuous improvement methods such as six-sigma method.
- Lean management and benchmarking.
- Eliminating the complicated and unnecessary activities of the value chain.

Luckily nowadays a solution exists for solving all problems related to ABC system. Compared to ABC, TDABC is easier, cheaper and more powerful. The new model uses two efficient frameworks that only need two subsets for direct allocation of resources to the cost sources. For example consider a section or process for dealing with customers’ orders. Firstly, at this stage, TDABC calculates all resources provided for this section or process which are employees, supervisor, equipment and technology. Then the model divides total cost on the capacity of that section (which means the available time in which employees are doing their work) in order to achieve the capacity cost rate. Secondly, this model estimated the required capacity of each cost subject (normally based on time) and it uses the capacity cost rate for progress and allocating resource costs of sections to cost subjects. For example, in the delivery section, model only needs the estimation of time required for processing the specific order.

In this model there is no need for the customers’ orders to be the same and equal. This model has the ability to change the time estimations based on the type of orders the same as manual or automatic orders, international orders, and orders for fragile or hazardous products and it simulated the real processes of implementation all over the organization. Thus, without creating an extensive demand for estimating and maintaining data by the use of process capabilities, could reflect more changes and complexities compared to a common ABC model. Instead of using inappropriate and naïve ABC models in complicated businesses, a company could use TDABC model for these complexities and describing activities (Atefi, 2008).

**Conclusion**

Expansion of trades and intensive competition indicate the beginning of a new period of life of domestic and international business; in such environment the winner is the company offering products with better quality and lower costs before its competitors. Technology changes are one of the unique features of a dynamic business environment; additionally, significant changes in competition, customers’ demands, globalization of production & sales, importance of quality, production with specific features and introduction of total quality management (TQM) and just in time (JIT) production are some other features of this period. The outcome of these changes is formation a highly competitive markets, complexity of activities, significant increase in the capital expenditures (indirect costs or overhead costs), forcing to decrease costs and finished costs. In such conditions, managers must have an extensive insight and must adopt appropriate strategies, ideas and required measures in order to use in these conditions (Rahnamay Roudposhti, 2009).

As it was said, conventional costing systems share the production costs based on volume drivers and they cannot make a rational connection between drivers and cost targets. Regardless of type of activities, these systems only use one type of driver. ABC was in fact invented for solving these problems and providing more accurate information; and with this assumption that there is a specific relation between activities and costs, it connects costs to different activities; and it shares the costs with cost driver of each activity. But since it only uses one driver for each activity, and it cannot provide a model for different drivers and specific activities, thus, the TDABC is provided as an alternative.

In this model the relation between conventional and modern costing systems was briefly discussed; and the advantages and disadvantages for each of the theorists’ views were stated. Regarding these discussion it could be stated that our country has a long way to move away from conventional systems and to use modern costing systems. In this regard there is a need for infrastructures and developing knowledge in
this field so that both people in universities and professionals are encouraged to move toward realizing these goals.

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