Experiences of Building Cost Models for Software Systems: An Industrial Case Study

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Abstract: - Internal operating environments of companies have changed drastically during the last two decades along the development and increased utilization of information technology. As a result, ERP -systems have become a norm to compete in the dynamic business environments. At the same time the amount and quality of operational data that is recorded in data warehouses has exploded. Effective utilization of this big data is increasingly becoming a key competitive advantage of growing number of companies. Time-driven activity-based costing is exploiting this opportunity by effectively turning vast amounts of operational data into meaningful measures of operational profitability and performance. This study uses participant observation method in a commercial bank case-study setting in order to test the alleged benefits of time-driven activity-based costing.

Key-Words: - Big data, ERP, TDABC, ABC, Performance management, Profitability and Cost Management

1 Introduction

During the 20th century, with advances in manufacturing technology, globalization and increased competition, product lines and marketing channels expanded rapidly [5]. With these changes in the operating environment companies started to shift from mass-production strategies to more customer-focused strategies. Companies created value by offering new services and creating customer loyalty. In the efforts to offer expanded variety, companies had to add resources for engineering, scheduling, receiving, storage, inspection, setup, materials handling, packaging, distributing, order handling, marketing and selling. Companies also diversified into more product lines, customers and channels by offering specialized features and services. [12]

Over time cost systems in place systematically and grossly underestimated the cost of resources required for specialty, low-volume products, and overestimated the resource cost of high-volume, standard products [10]. Activity-based costing was developed to address these challenges of distorted costs [5].

There are several contingent factors in play in the adoption of activity-based costing that affects the need of such a costing system. The importance and use of cost and profitability information in business decision [1,3,13], high indirect cost ratio [2,13] and product diversity [3,4,6,13,14] have been identified as key drivers for adoption. Krumwiede [13] as well as Cagwing and Bouwman [3] emphasize the importance of information technology sophistication to determine suitability for activity-based costing.

Many studies have reported adoption rates below 30 % [1,9].Considering the insight that activity-based costing gives for decision making, in terms of real cost and profitability of products and customers, the adoption rates have been surprisingly low. Implementation and maintenance difficulties of activity-based costing have been identified as one of the main barriers of broader penetration. A lot of this has been due to low interaction with company information systems [15].

To tackle these deficiencies, Kaplan and Anderson presented a new improved approach, time-driven activity-based costing (TDABC), in their November 2004 Harvard Business Review article. According to Kaplan and Anderson [12] the new approach gives companies an elegant and practical option to determine the cost and the capacity utilization of their processes and the profitability of orders, products and customers. The methodology is based on actual consumption of resources using automatic data feeds from information systems to provide managers detailed and accurate information for business decisions.

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2 Research Problem and Methods

This study uses action research approach for applying theory into practice. The aim is to find evidence whether time-driven activity-based costing can increase operational data utilization, costing accuracy and leverage cost accounting effectively towards performance management.

2.1 Underutilization of data

Companies have invested heavily on information systems especially since the late of 1990's in order to collect and record operational data of business processes [8]. Today companies are starting to realize the value of this data for business analytics and decision making. However, our assumption is that operational data is vastly underutilized especially in the area of cost and profitability management.

With participant observation methods in the limits of one case study, our first research problem is to identify if time-driven activity-based costing can improve operational data utilization and costing accuracy in profitability and cost management.

2.2 Tying operational processes to data feeds

Time-driven activity-based costing is alleged to be a true consumption based costing model utilizing actual business processes which are fed by operational data feeds for cost allocation purposes [12,15]. Tying actual business processes to cost modeling enables a transformation from cost and profitability management towards performance management. This enables identification of used and unused capacity, effectiveness of process phases, use of metrics and KPI's.

Within the case-study limits, our second research problem is to investigate whether time-driven activity-based costing can leverage into performance management by identifying capacity utilization and operational measures of process efficiency.

3 Time-Driven Activity-Based Costing

Time-driven activity-based costing requires two estimates: the cost per time unit of capacity and the unit times of activities. First, managers estimate the practical capacity of the resources supplied. Most resources are measured in terms of time availability or other similarly measurable units. Second, managers determine the time it takes to carry out one unit of each kind of activity. By multiplying the two estimates of capacity cost and time required by an activity, cost-driver rates can be calculated. These standard cost-driver rates can be applied in real time to assign costs to individual customers as transactions occur. [11]

Time equations are the main innovation in time-driven activity-based costing which makes it possible to capture real-world complexities in business operations and increase the accuracy of the cost model. Time equations reflect how order and activity characteristics cause processing times to vary. This enables adding complexity and accuracy to the cost model without increasing the number of activities and thus complexity of the cost model itself. [11]

Time-driven activity-based costing was designed to ease the maintenance and updating of the cost model. When adding more activities department personnel do not need to be interviewed. The easy updating of the cost system makes time-driven activity-based costing suitable for dynamic environments and a good candidate for corporate agility [7].

4 Using TDABC in practice

The company selected for the case-study is a commercial bank operating in Nordic Europe. In respect of confidentiality, neither the name nor actual financial figures are presented. However, the case study results represent the actual observations made during the research.

The bank was interested to gain new insight and objectivity for internal accounting, and for that reason a pilot study was conducted in spring 2012 to visualize the benefits that time-driven activity-based costing could provide. Performance Analyzer 5G from Acorn Systems was selected for profitability and cost management, as they are considered the market leader and pioneer of TDABC software offering.

The business controller of the bank took responsibility for leading the project internally and working externally with investigators. By co-working with the business controller one department was identified, Credit Decisions, to be modeled with time-driven activity-based costing methodology in order to investigate the research questions. Figure 1 illustrates the design of their current conventional activity-based costing model.

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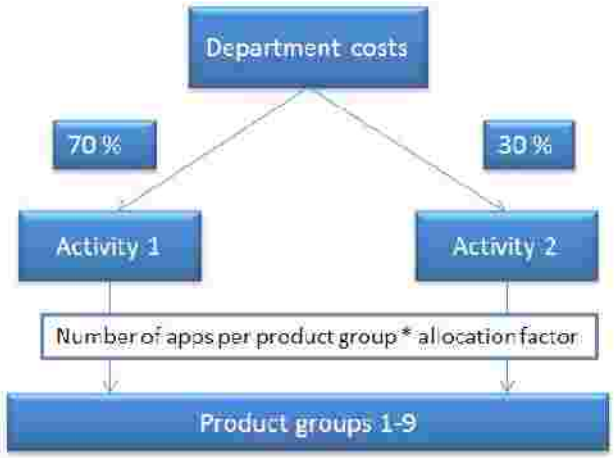

Fig. 1, Current ABC cost model

The conventional ABC model in place is based on work estimates for resource and cost allocation purposes from the department level to activities. The number of applications handled monthly is recorded for each product group. The cost rate per application is determined by multiplying the number of applications handled by predetermined allocation factor for each product group. Therefore, this current model does not utilize actual operational data to capture process variations and their impact on cost and profitability.

For purposes of the case-study, time-driven activity-based costing model was developed to model the cost flow of the department. Figure 2 illustrates the design of the new time-driven activity-based costing model.

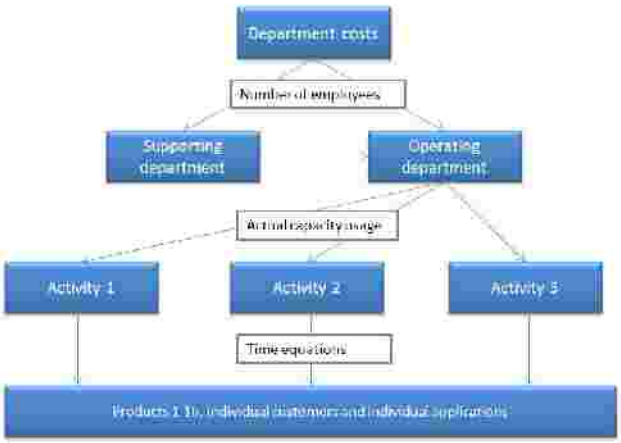

Fig. 2, New TDABC cost model

The developed TDABC model first allocates resources and costs to functional and supporting departments. The department has some of the personnel not participating in actual application handling; these resources represent the Management and Back Office supporting sub department. Other resources are allocated to operational sub department. Three separate activities were identified that handle different products and therefore operate under different process steps. The department resources to these three activities were allocated based on the actual time used by each activity. The final step in cost allocation was conducted by time equations. The time equations are modeled according to the actual process maps of each activity. For each product there are several possible attributes driving costs, based on real transaction data gathered from the company's information systems. The cost model allocates cost to all individual products and customers.

The chosen unit of analysis, Credit Decision, has 38 employees working in the department supporting 16 different products. Back office is a supporting function for credit decisions. Operating sub department, consisting 25 employees, is a functional team handling credit applications. Resources supplied for the department were 765 000 euros and the practical capacity of the functional unit was 456 000 minutes. The practical capacity of minutes available was determined by subtracting holidays, absences, trainings, meetings and breaks from theoretical capacity. The capacity cost rate is calculated as follows:

$$\text{Capacity cost rate} = \frac{765\,000\,€}{456\,000\,min} = 1{,}68\ €/\text{min}$$

Analyzed time period was one quarter, during which the department handled 131 850 applications. The team processed 55 % of the applications manually and 45 % received automatic processing. Figure 3 presents a process map of one activity which supports three products. From the illustration we can see that this one process alone generates 84 different variations for the process (2 x 3 x 7 x 2). Process time cycles vary from 0 minutes to 16 minutes depending on the application attributes. The two extreme process variations are illustrated by the two arrow lines in the figure. Considering that the unit supports 16 products, total variations with similar process mapping generates 448 different variations. Therefore, it can be stated that diversity and complexity are highly present with the chosen unit of analysis.

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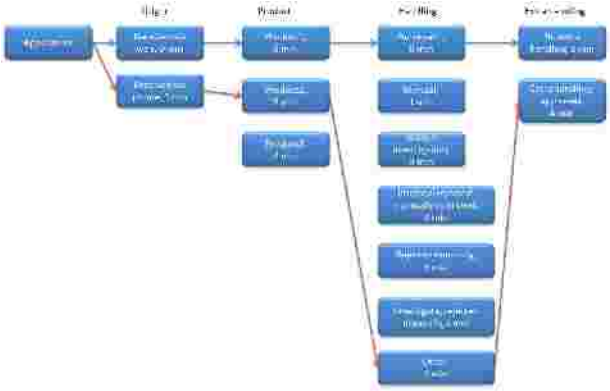

Fig, 3. Credit decision process example

Altogether three different process maps were created to model each of the activities within the time-driven activity-based costing model. The process maps characterize the actual work done in the department. The processes were broken down to process steps and all steps were given a time unit that represents the average time it takes to process the step. Once the process maps were created, investigation was conducted together with the IT-department to make sure that all the process steps can be fed by actual transaction data from the information system. All the process steps were validated against data warehouse, and in cases with no data available the process step was aggregated to another process step.

Process mapping and data gathering from the information system are prerequisites for the creation of time equations that drive costs to individual cost objects. By utilizing process mapping, time equations (see figure 4) were formed for application handling.

If(([Transaction].[Origin]== " Phone", 3, 0)+
if([Product].[ProductID]=="Product2", 5, 0)+
if([Product].[ProductID]=="Product3", 3, 0)+
if([Transaction].[Proposal]== "Automatic" AND
[Transaction].[Decision]== "Automatic", 0, 0)+
if([Transaction].[Proposal]== "Manual" AND
[Transaction].[Decision]== "Manual", 1, 0)+
if([Transaction].[Proposal]== "Investigate" AND
[Transaction].[Decision]== "Investigate", 3, 0)…

Fig. 4, An example of a time equation

Time-driven activity-based costing provides versatile information for business decision purposes. The preliminary and main desire of the company was to gain objective capacity utilization information for performance management purposes. The following paragraphs describe some of the new information produced for business decision purposes. The first task was to compare the product group costs calculated with TDABC methodology to the costs calculated with current ABC cost system in place. Figure 5 shows the costing difference between the two cost systems.

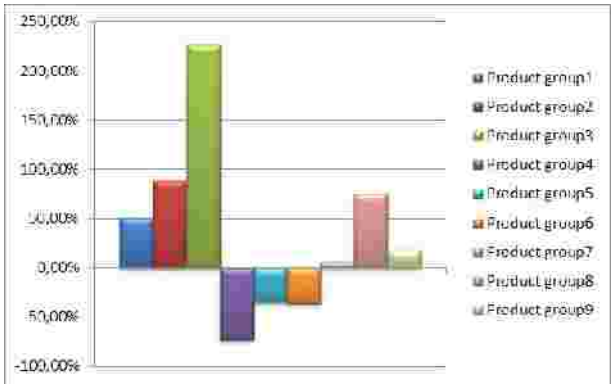

Fig. 5, Difference in product cost between the two costing methodologies

It can be seen that there are substantive differences in product group costs between the two approaches. Time-driven activity-based costing is a true consumption based model because it utilizes actual process maps and individual process steps to allocate costs. On the contrary, the conventional activity-based costing system in place is based on work estimates and averages. Thus, the precision of the cost information is essentially more accurate with time-driven activity-based costing methodology.

The results enabled cost and efficiency visibility all the way to individual application level; costs and processing time were allocated to all 131 850 applications. Detailed level of cost information enables business development in several areas. Given the new information, best practice processes and application handling procedures can be identified, which can lead to business policy unification and new guidelines, establishing incentives for selling partners (i.e. customers) to choose effective procedures for application preparation and submission and overall performance management. Figure 6 displays an example how customers require resources to handle credit decision applications from the Credit Decision department.

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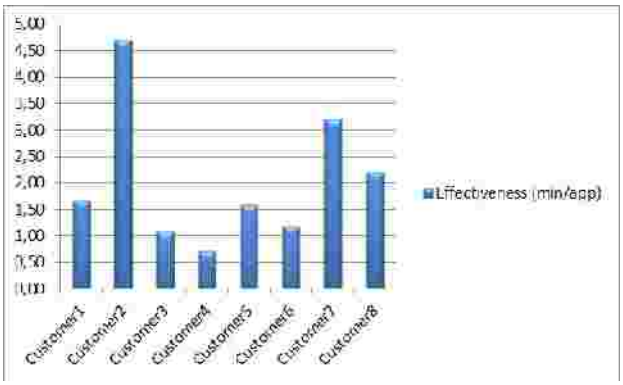

Fig. 6. Cost-to-serve

It can be seen that customer 2 has the highest cost-to-serve ratio; it takes 4.7 minutes to process one application from this customer. On the contrary, customer 4 has the lowest cost-to-serve ratio, taking only 0.7 minutes to process one application. Thus, customer 2 requires nearly seven times the work compared to customer 4. Closer transaction level investigation revealed that all of the customer 2 application requests originated by phone or fax and they were manually processed. Customer 4, on the other hand, submitted all of its applications through web portal, and 65 % of the applications were automatically handled.

One of the dimensionalities of time-driven activity-based costing is that it provides objective information about capacity utilization. The used and excess capacity of the operating sub department is shown in table 1.

Table 1, Capacity utilization

	FTE				Rate	Cost		
Name	Available	Used	Unused	Utilization	100.00% Capacity	Used Capacity	100% Capacity	Excess Capacity
Credit Decision	25.0	15.4	9.6	61.7%		471,922 €	765,432 €	293,450 €
Activity1	3.6	2.2	1.4	61.7%	1.68 €	67,459 €	109,401 €	41,942 €
Activity2	15.4	9.5	5.9	61.7%	1.68 €	291,562 €	472,837 €	181,275 €
Activity3	6.0	3.7	2.3	61.7%	1.68 €	112,962 €	183,194 €	70,233 €

The table shows that 61.7 % of the resources supplied were used to handle credit decision applications. Thus, the operating sub department had 9.6 full time employees and 293 450 euros worth of excess capacity. This visibility makes capacity and performance management possible. For instance, excess resources could be transferred to bottleneck departments. Furthermore, management can decide to allocate only used capacity to products and customers. Thus, management has the possibility to avoid death spiral decisions.

Process time cycles varies from 0 minutes to 16 minutes depending on the application attributes. The department serves nearly 2 000 different selling partners that all place varying applications for handling. Total process variations with all of the 16 products generated 448 different process patterns.

The transaction data was provided from two separate information systems. All the data needed to feed the process steps was available and the data quality was good. Transaction data availability and data quality enabled easy building of the time-driven activity-based costing model.

5 Conclusion

Internal operating environments of companies have changed drastically during the last two decades along the development and increased utilization of information technology. As a result, ERP -systems have become a norm to compete in the dynamic business environments. At the same time the amount and quality of operational data that is recorded in data warehouses has exploded. Effective utilization of this big data is increasingly becoming a key competitive advantage of growing number of companies.

Time-driven activity-based costing is exploiting this opportunity by effectively turning vast amounts of operational data into meaningful measures of operational profitability. TDABC is providing a common language between business operations and transactional data which enables modeling actual business operations for performance management purposes.

In the commercial bank case-study, we addressed the problem of underutilized operational data by building a time-driven activity-based costing model for Credit Decision department. The company is currently utilizing conventional activity-based costing and having difficulties related to subjectivity of the method, laborious maintenance and restricted accuracy and dimensionality. As the case study results indicate with time-driven activity-based costing the Credit Decision department's operations are measured using objective data from information systems, enabling the identification of idle capacity and ineffective processes. Furthermore, the granularity of the information provides far more accurate and diverse view of reality in terms of product, customer and channel profitability.

Once the departments' operations are modeled and tied to transactional data, updating and running the model becomes highly efficient. This eliminates the need of monthly or quarterly subjective surveys of time usage and manual update of weighting coefficients. As of period end, TDABC model can use automatic data feeds to supply the model with occurred transactions, making the model easy to maintain. However, when handling large amounts of data to support multiple business dimensions and all

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the possible combinations of data, the requirements for the profitability and cost management software system become demanding. In our case-study Acorns Systems PA5G proved to support complex calculations and multidimensionality very effectively, also enabling capacity costing.

This case-study is based on one department of the bank for which data availability was easily accessible. Within those limitations we can conclude that time-driven activity-based costing increased operational data utilization and costing accuracy. Furthermore, the case study provided evidence that time-driven activity-based costing can be leveraged towards capacity and performance management. As a result of the study, the management can now identify lead times for individual transactions, point out inefficient process steps and burdensome resource demands from third parties. This provides actionable information for setting metrics for performance measurement.

Turning this into a companywide model would require integrating data from multiple separate systems as the company does not operate with one integrated ERP -platform. This would make the initial implementation slightly more laborious compared to an ideal situation. Acknowledging the limits of the case-study, data availability from other departments was not investigated. It is likely, that variations of data usability exist between the departments. With these marginal data availability departments, the implementation would need to require fewer and more simpler drivers in the beginning. Later, as key drivers are identified by process mapping, data collection can be developed to fully model the process. However, data should not be collected only for costing purposes. Cost-benefit ratio must be kept in mind when enhancing the cost model. Company should aim for improving data collection only if it’s seen valuable for process and business improvement.

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