ABSTRACT

This paper reports on the development of a Time Driven Activity Based Costing (TDABC) model in a small-sized road transport and logistics company. Activity Based Costing (ABC) leads to increased accuracy benefiting decision making, but the costs of implementation can be high. TDABC tries to overcome some of the disadvantages and seems particularly useful for the road transport and logistics sector. We find that small firm can benefit from TDABC because of the use of simplified parameters. Still, the lack of quantitative data on cost drivers remains a problem. To enhance the accountability and efficiency of TDABC, a thorough redesign of the recording system is recommended.

KEYWORDS

Time-Driven Activity-Based Costing, Logistics Costs Management

INTRODUCTION

The road transport sector, confronted with the severe impact from the economic crisis and the volatile fuel prices, has experienced a sharp decline in 2009 (International Road Transport Union, 2009). Although the severity varies from country to country, it is obvious that road transport and logistics firms are under pressure to review their cost structure and to find an effective cost management system which relates the company’s performance to its strategic goals. Among the recently popular cost management techniques is activity-based costing (ABC), which can consequently be used to help the manager for strategic decision-making, process improvements, cost reductions, innovative pricing, budgeting, outsourcing evaluations etc. (Cardinaels et al. 2004, Kaplan and Anderson 2007, Stapleton et al. 2004). However, recent surveys document the slow diffusion of ABC in practice (Gosselin, 2007) due to the fact that traditional ABC systems are expensive to build, complex to sustain and difficult to modify (Everaert and Bruggeman 2007, Kaplan and Anderson 2007). In response, Kaplan and Anderson (2004) started to promote Time-driven Activity-Based Costing (TDABC), a simplified version of ABC, making it better capable of capturing the complexity of real-life settings while requiring less time and financial efforts. Since TDABC reduces the burden of updating cost models, it is enthusiastically implemented in a variety of industries such as financial, medical, educational service and wholesaling companies (Kaplan
and Anderson, 2007, Pernot et al., 2007, Everaert et al., 2008, Demeere et al., 2009). TDABC is an interesting alternative for road transport and logistics companies. The complexity caused by the variation in resources required by different shipping arrangements can better be captured by TDABC than by traditional ABC models (Kaplan and Anderson, 2004). While most studies on ABC/TDABC in the transport and logistics sector investigate medium-sized to large companies, this paper focuses on TDABC in a small transport and logistics firm. We describe the development of a TDABC model for a small road transport and logistics company in Thailand and discuss the problems encountered during the TDABC development process and the benefits provided for managerial decision making. We therefore contribute to the literature by demonstrating the opportunities of improved ABC systems for small enterprises in the logistics sector.

THEORETICAL BACKGROUND

The traditional Activity Based Costing and Time Driven Activity Based Costing approaches

The use of ABC in the transportation and logistics sector has been documented for about two decades. Tsai and Kuo (2004) apply ABC to the airline industry and calculate the cost per unit (seat/kilometer and ton/kilometer) for an individual flight. Koch and Weber (2008) utilize ABC for revenue and cost controlling and planning at Stuttgart Airport. Baykasoglu and Kaplanoglu (2008) study the resource and activity cost drivers and make use of the Analytical Hierarchy Process (AHP) to structure overhead cost allocation in a land transport company. Themido et al. (2000) present the management implication of ABC for a third party logistics company in Portugal by renegotiating the services for loss-making customers and offering alternative delivery patterns for varying prices. Goldsby and Closs (2000) document the use of ABC in the reverse logistics of beverage products where distributors decided to coordinate their processes and outsource them to an independent third party logistics provider, resulting in a total saving of $11.4 million annually. While these studies highlight the success stories of ABC, the inherently tedious and costly design and maintenance of the models plus the restricted capacity to expand to large scale operations have impeded the widespread adoption of ABC (Kaplan and Anderson, 2004, 2007). Kaplan and Anderson (2004) relate the problems to the way in which people traditionally construct ABC models. First, a traditional survey to estimate the percentage of time which employees spend on activities works well in the limited setting of a single department but difficult to apply on a larger scale. Second, as few individuals report that a significant percentage of their time is idle or unused (Kaplan and Anderson 2004), the cost driver rates are calculated based on the assumption that resources are working at full capacity, with the consequence that they are usually overstated. Third, the ABC model is updated infrequently because of the costs of reinterviewing and resurveying, resulting in the rapidly inaccurate costs of process, product and customer.

Under TDABC, the efforts of regularly interviewing employees and the ambiguous estimation of the percentage of time dedicated to individual activity in ABC are replaced by estimating two parameters: 1) the estimate of the time required to perform each activity and 2) the estimate of costs and capacities employed in each department. Time estimation is expressed in a time equation, taking into account the different consumption rates for the same activity in a different context. Employees are not surveyed on how they spend their time. Instead, managers first directly estimate the practical capacity of the resources supplied as a percentage of the theoretical capacity (Kaplan and Anderson 2004). For the road transport company 'time spent on loading the trucks' varies significantly with the arriving time of trucks and the location of the warehouses at which cargos are loaded. Instead of creating multiple activities to accommodate the variations in time consumption, the time equation introduces 'interactive' variables for the arriving time and the warehouse location. Accordingly, the time equation enables managers to capture the different amounts of time consumed by trucks for an individual trip. This characteristic of TDABC contributes to an accurate allocation of time (and hence costs) of the services of a company and allows easy updating of the cost system when products or service offerings change, or when production and service processes are redesigned.

ABC and TDABC in small and medium-sized enterprises

Implementation of ABC is more frequently found in large organizations than small and medium-sized enterprises (Gosselin, 2007). It is often perceived as an inappropriate tool for SMEs due to the harsh experiences of managers who tried to implement the system in large companies and had to invest a massive effort during the implementation process (Hicks, 1999). In fact, there are several restrictions for SMEs. First, the corporate accounting system fails to provide the necessary information needed for strategic planning and decision making (Baxendale, 2001), resulting in the insufficient information such as quantitative information on the cost drivers to support the modeling of the time equations. Second, the resource poverty such as limited technical, financial and human resources might impede the company from implementing the system (Roztocki et al., 2004). This scarcity of resources raises concerns for SMEs that the benefit of improved cost information does not justify the required effort which include the costs of consulting, possible productivity decrease during the implementation process, and the maintenance of additional data (Needy et al., 2003). Bharara and Lee (1996) also mention the resistances to change as staff were reluctant to fill in the time sheets and to maintain the databases with the numerous numbers of activities and drivers.
TDABC seems useful for small transport and logistics firms than the traditional ABC in several respects. First, the inherent complexity of logistics activities can be captured with limited resources since only the managers are involved in providing detailed cost information. These managers directly estimate the resource demands imposed by each transaction, product and/or customer, thus avoiding a complicating step to survey time estimated by all employees (Kaplan and Anderson 2004, Everaert and Bruggeman 2007). In addition, since the scale of the firms is limited, we expect that generic spreadsheet tools will be sufficient to support the cost calculations.

THE CASE STUDY CONTEXT

Set-up of the case study
This case focuses on the small-size transportation and logistics company in Thailand. The name of the company is disguised as ‘RC Transport’ for reasons of confidentiality. Similar to other small scale operators, the company relied on a few customers. This limited the role of the company to being a price-taker on the market. Accordingly, profitability depended largely on the cost level. The application of TDABC was expected to provide beneficial cost information and suggest tentative strategic actions to the management team. To build the TDABC model, we required data to estimate the two parameters: the cost per unit for the consumption of resources, and the time consumed by the activities in the processes. Data was collected by different means, including the gathering of relevant documents, interview with the management team, and the observation of the operations at the official site. Time estimates and cost drivers were provided by the managers.

Company background
RC Transport provides transport and distribution services to several domestic destinations in the Central and North regions in Thailand. There are five routes classified as the forward and backward hauls. The forward hauls comprise of three routes: Sriracha-Lampoon, Sriracha-Chiang Mai and Sriracha-Mae Hongson. The backward hauls are Lampoon-Bangkok and Lampoon-Sriracha. Cargoes are dispatched to super stores, wholesale stores and retail stores. Super stores and wholesale stores tend to order a full truckload amount (FTL) while the retail stores order the less than truckload (LTL) shipment sizes which necessitate cross-docking at the company’s warehouse in Chiang Mai. The company outsources the distribution to Mae Hongson and Chiang Mai retail stores to the local truck companies in order to minimize the capital sunk costs. To cope with the uncertain demand, the company has decided to ally with two other companies to form a truck pool which are referred to as the ‘joint trucks’. The own and joint trucks are parts of the variation incorporated in the time equations since they consume different time and cost effort.

DEVELOPMENT OF THE TDABC MODEL

We develop the TDABC model by first identifying the resources and practical capacity. Next we estimate the time needed for the activities and the time drivers, and finally we identify the time equations. The TDABC procedure is presented in Figure 1.

Resources and practical capacity
There are five resource pools - planning, accounting, transportation and warehousing units, and five resource types - personnel, building and facilities, vehicles, warehouses and ‘corporate sustaining expenses’ which are not related to any of the previously mentioned. We assume that employees and vehicles work up to 80% of their available time. For the transportation unit, resources are separated into vehicles and labor due to the different actual working hours and the different utilization rates. Practical capacity is assessed by multiplying the normal working hours of the employee with the number of employees in the functional units and the number of working days per year. The result indicates the practical working hours in a year. Capacity cost rates are finally derived by dividing the total costs in the functional units by these practical working hours.
Time estimates for the activities and time drivers

There are six operational processes: shipment preparation, loading, transportation, unloading, warehouse operations and invoicing/auditing. Time estimates for activities are primarily based on interviews with the management team. The figures are assessed first hand by the managers. For uncertain figures, they consult with the operators to obtain the practical time. This “top down” approach provides a quick access to the data and reduces the frustration felt by employees to assess the exact operational time. Time drivers are attained by interviewing supervisors and managers on activities and their time consumption. It comprises a small set of critical drivers which can be obtained with moderate effort. The initial stage is to map the detailed activities within the processes, along with the estimated time for those activities. We re-examined the time appraisals - by asking ‘why’ - in an attempt to identify the drivers influencing the duration of the activities. The received information confirms the time variation in the processes related to the service.

Modeling the time equations

We make use of the linear models introduced by Everaert and Bruggeman (2007) to construct the time equations. The models comprise of three parameters: activities $j$, processes $k$ and capacity cost rates $i$. Costs per trip for individual route $r$ ($TC_r$) are derived from the total time consumed by all activities in the processes multiplied by the cost per unit of the relevant functional units.
\[ TC_r = \sum_{i=1}^{N} \sum_{j=1}^{M} \sum_{k=1}^{L} T_{jk} C_i \]

Where
- \( T_{jk} \) = total time (hours) consumed by activity \( j \) in process \( k \)
- \( C_i \) = cost per hour of the functional unit \( i \)
- \( L \) = number of processes
- \( M \) = number of activities
- \( N \) = number of functional units
- \( r \) = individual service route

Each time equation \( (T_{jk}) \) represents the total time in a process. Time drivers are expressed by the variables \( X_p \) which are the mix of continuous, discrete and indicator types. The generic form of the equation is shown below.

Total time in the process \( (T_{jk}) \)
\[ = \sum (\beta_p \cdot X_p) \quad ; p \in j, k, r \]
\[ = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots + \beta_p X_p \]

Where
- \( \beta_p \) = time estimated for activity \( j \) in process \( k \) for route \( r \)
- \( X_p \) = time drivers for activity \( j \) in process \( k \) for route \( r \)

**IMPLICATIONS OF THE INTRODUCTION OF THE TDABC MODEL**

*Insights from the identification of costs and profits*

The Mae Hongson route has the highest expenditure due to the storage cost to consolidate the orders to reach the full truckload size. This requires an average of five days of storage. The Chiang Mai retailers and wholesalers routes rank second and third followed by the Bangkok route of which the proportionally highly costs are related to the waiting time before unloading as trucks arriving in Bangkok are retained for four hours on the average. To the contrary, the lower costs of the Lampoon and Sriracha services resulted from the short distance and the few drops along the routes.

**FIGURE 2**
**PROFIT AND LOSS FOR SERVICE ROUTES AND DESTINATIONS**

Most service routes and destinations are profitable except for the Chiang Mai retail, Mae Hongson and Bangkok routes. The Lampoon route yields the highest profit. However, its contribution to the overall profit is limited due to its small volume. Alternatively, the Chiang Mai routes, despite the lower yield, are the main source of revenue for the company as it contains 43% of the overall cargo carried in a year. Losses occurred in the unprofitable routes are subsidized by profits earned from the profitable ones. The breakdown of revenue and cost details by service routes enables the manager to concentrate its efforts on the right services.
Cost improvement and resource utilization suggestions

From the TDABC analysis, the management team sees two options: cost reduction and resource utilization improvement. The comparison, as shown in Figure 3, reveals the distinct areas where the accumulated time and costs increase considerably when the activities are performed. These are transport, warehouse and invoice/accounting activities. Reducing transportation costs are attained from renegotiating the freight rate with the truck drivers and eliminating the waiting time before loading and discharging. For warehouse operations, reducing the storage time would improve the overall time consumption and costs. Since the necessity to storage is caused by the insufficient amount to complete a full-truck load, the manager may seek additional cargo in order to stimulate more frequencies and drop the storage time to the slightest duration.

A relatively low utilization rate occurs in transportation unit (24% for labor and 61% for truck) while the planning unit is virtually utilized (86%) and the warehouse and accounting capacities are overly exploited. The low utilization rate in transportation results from the waiting time for the next voyage (6 hours in average) and the excessive labor. Seeking additional cargo and additional drop points would prolong the journey time and consequently reduce the waiting time. To solve the excessive labor problem, the manager turns to the new payment where the remuneration is paid as the lump sum per loading per truck to remove the excessive capacity. For the accounting units, accounting software is brought into use in order to bring down the process durations and overtime workloads.

DIFFICULTIES WITH TDABC IN SMALL ENTERPRISES

Problems encountered during the TDABC implementation are the lack of essential quantitative data to support the buildup of time equations, the time estimate for non-continuous or unpredictable activities, and the allocation of time to the consolidated services. The insufficient data occurs when there is no record keeping of the daily transactions. The difficulty to estimate time is found in the non-continuous activities such as the collection of order bills or consignment notes following consignee endorsement. To solve these problems, a more formal time-tracking system and redesigned book-keeping are required to enhance the measurement accuracy. Regarding the allocation of time to the consolidated services, the time equation in TDABC models usually contains duration of a single destination while in practice a journey regularly combines several destinations to utilize the entire space in the truck. Simply summing the transportation time of all trips for each single destination may lead to the inaccurate time consumption and hence resource cost allocation. The redesign book-keeping and time-tracking are the solution to this problem as well since managers are able to collect the real information with regard to the journey time and the actual amount of cargo in each trip.
CONCLUSION

This paper reviews the implementation of ABC and TDABC in the transport and logistics activities and describes the development of TDABC in a small-sized road transport company in Thailand. It is aimed to manage the complex cost calculation in the transportation and logistics services arising from the diversity of services offered. It supports the previous recommendation that logistics is a typical sector that can benefit from TDABC (Kaplan and Anderson, 2004). The system is able to provide the cost details which are applicable to the service routes and to different destination types. It reveals the loss-generating routes and identifies the cause of loss, and accordingly introduces the roadmap for the potential cost reduction. The system illustrates the utilization of company resources, and simultaneously provides the amount of the opportunity loss occurred when resources are underutilized. It provides the evidence that TDABC models are able to be built and maintained with normal spreadsheet as the extensive data is less a problem for small-scale firms.

A number of difficulties are found despite the benefits. For a small scale operator, it is not uncommon to see that a large share of the required model inputs had to be estimated, as frequently occurs in the transaction drivers. To enhance the accuracy of the model, the developer should make it clear from the start what kind of data shall be collected during the operations. In addition, a formal time-tracking system should be implemented. It is not necessary to invest in a state-of-the-art technology. Sometimes, a manual record such as a log book and time stamping machines are good enough. This paper complements the previous findings that TDABC is applicable as well in small and medium businesses as in the larger ones despite the difficulties.

REFERENCES


