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Application of activity-based costing to a land transportation company: A case study

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ABSTRACT

Although there are many studies in the literature that explain modern costing approaches including activity-based costing (ABC), the number of studies that present real life applications is very few. This is especially true for logistics and transportation applications. One of the main difficulties in land transportation companies is to determine and evaluate true cost of their operations and services. If used and implemented properly, ABC can be very helpful for transportation companies to determine cost of their operations with higher correctness. In this paper, an application of ABC to a land transportation company that is located in Turkey is presented in detail. In order to improve the effectiveness of the ABC an integrated approach that combines ABC with business process modeling and analytical hierarchy approach is proposed. It is figured out that the proposed approach is quite effective in costing services of the land transportation company compared to the existing traditional costing system which is in use.

1. Introduction

Present age of rigorous international competition and rapidly improving technologies and improving information systems has forced companies to use new business management techniques (Baykasoğlu and Kaplanoğlu, 2006c). Market structures of products and services enforced companies to manage their costs according to business competition. Under severe competition, companies need to become leaner, responsive and agile, with ever-increasing efficiency and effectiveness (Agrawal and Mehra, 1998). In order to retain the competitive status, a company should be able to provide high-quality services/products in a short period of time with lowest possible cost. In order to be able to provide lower costs, accurate cost information is critical for every aspect of business, and it affects the pricing policies and performance reviews (Gupta and Galloway, 2003). This is not a critical issue for only manufacturing companies, it is also vital for service sector companies including logistics and transportation companies. In a rigorous business environment, manufacturing and supply services have become very hard to maintain satisfactory returns or profits. Therefore, the role of cost estimation for products and services has become more critical. Before the modern business management times, accounting was being just used to record the costs of products and/or services. However, the important role of cost estimation and cost information appeared after the advent of modern business management techniques. This is because traditional cost accounting systems were not able to satisfy the needs of modern business management. This is especially because the traditional cost systems are known to distort the cost information by using traditional overhead allocation methods (Qian and Ben-Arieh, 2008). However, decision makers, assuming information is relevant, prefer more accurate product cost information to less (Charles and Hansen, 2008). As a result, a gap has emerged between the accounting information gathered and the modern business management.

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Many business management concepts have been developed since the global competition had become serious. Organizations have started to practice their improvement of competitiveness. In order to achieve this goal they have started to use modern and advanced process and cost management techniques such as activity-based costing, kaizen costing, total quality management, process improvement, etc. All these kinds of techniques are being used for the sake of process improvement and for increasing the competitiveness of the organizations. Competition for logistics and transportation companies is severe and they are under the pressure of demanding business conditions. Logistics are becoming more and more important because the cost of logistics has a considerable proportion in the total cost of products. Physical distribution cost estimates range from 7.93% to 30% of sales (Davis, 1991). This is generally because of increasing product and/or service differentiations. Therefore, the proportion of logistics costs attract interests of researchers because the improvement of logistics cost has a direct impact on the total cost of products.

Majority of costs occurred in logistics come from the indirect costs of the services provided (Baykasoğlu and Kaplanoğlu, 2006a–c). As the customer needs change drastically and delivery time of goods decrease, the complexity of the logistics processes increase and thereby the indirect cost proportion of the logistic operations increases, even for some organizations, the overheads amount may exceed the amount of direct costs. Therefore, overhead proportion of the total costs of logistics cannot be overlooked during the cost control. The studies performed by "Council of Logistics Management" and "Institute of Management Accountants" presented that firms had increasingly asked logistic managers to plan and manage complex operations and networks while reducing cost and enhancing service (Pohlen and La Londe, 1994). This is a natural consequence of the importance of logistic operations within an organization.

Among all the costs (resources used), the true cost of transportation services provided must be determined accurately. On the other hand, the true costs of the transportation services are not so easy to determine at a first glance because many logistics costs remain buried in overheads and logistics managers do not have adequate visibility or control over their costs (Pohlen and La Londe, 1994) and the cost estimation of the transportation services have not been carried out by using sophisticated costing methods. The cost data recorded has been generally assigned to transportation services directly. However, for an adequate decision support more is needed than just cost assignment. There is a need for an instrument that is capable of linking logistical process information to financial information (Van Damme and Van Der Zon, 1999).

In practice, there are some alternative means to find the cost of logistics services provided. Traditional cost accounting method is widely used in order to find the cost of the logistics services provided. Direct product profitability (DPP) and customer profitability analysis (CPA) are some other mentioned means of logistics costing. The DPP methodology attempts to identify all of the costs associated with a product or an order as it moves through the distribution channel (Themido et al., 2000) and CPA tries to identify the true costs associated with servicing an individual customer (Christoper, 1992; Cooper and Kaplan, 1991). However, strict market conditions of logistics necessitate a different cost approach, which combines process conditions, the business costs and process performances. Although there are many studies in the literature which explain modern costing approaches including ABC, the number of studies which present actual case studies are very few. This is especially true for logistics and transportation services. If used and implemented properly ABC can be very helpful for transportation companies to determine true cost of their operations and services.

According to Nachtmann and Al-Rifai (2004), ABC helped many manufacturing and service organizations to improve their competitiveness by enabling them to make better decisions based on an improved understanding of their product cost behavior. There are many applications of ABC in manufacturing organizations and about their decision processes (Zhuang and Burns, 1992; Dhavale, 1993; Koltai et al., 2000; Özbayrak et al., 2004; Kirche et al., 2005; Satoglu et al., 2006) and some applications in logistics organizations and logistics related activities such as holding cost determination (Berling, 2008). Stapleton et al. (2004) discussed advantages, disadvantages and difficulties of ABC for logistics and marketing in general. Goldsby and Closs (2000) illustrated application of ABC to reverse logistics activities performed across supply chain organization without presenting details of implementation. Van Damme and Van Der Zon (1999) presented a logistics management accounting framework to support logistics management decisions without presenting an actual implementation. Liberatore and Miller (1998) proposed a framework for integrating ABC, analytical hierarchy process (AHP) and balanced scorecard for logistic strategy development and monitoring. Pohlen and La Londe (1994) carried out a survey of leading-edge firms within USA in order to present trends for implementing ABC. They concluded that there is a trend towards implementing ABC in logistics and most firms expect the ABC applications in logistics to produce results similar to those experienced in manufacturing. However, we did not find many applications and implementations of ABC in transportation companies, especially in Turkey we did not come across with any real application. The work of Themido et al. (2000) is one of most detailed study on the application of ABC to logistics. They presented application of ABC for costing the service provided by a third-part logistics operator in Portugal to one of its clients.

In this paper, an application of ABC-based costing model to a land transportation company is presented. In the case study most of the costs elements of the transportation company are evaluated through the ABC-based model. In the costing model, SIMPROCESS is used for process modeling and AHP methodology is employed to determine cost driver parameters similar to Schniederjans and Garvin (1997). The results obtained from the ABC-based model are compared with the results of company's present costing system in order to present merits in applying a more sophisticated costing system.

2. Some notes on ABC

ABC has been revealed recently and used rarely by the service sectors especially by the logistics sector. ABC has appeared during the 1980s' with the studies of Cooper (1988a, b), Cooper and Kaplan (1988) and Johnson and Kaplan (1987). Cost calculation of the products and/or services in traditional costing is based on the determination of direct costs and indirect costs and then summing them to find the individual cost of each element. Traditional costing involves collecting indirect costs from departments and then allocates them to products or services (Tsai and Kuo, 2004). The overheads distribution to the products and/or services is performed by a single-volume cost driver and there is generally only one stage for allocation of the overheads to the cost objects. Using single-volume cost driver in order to allocate indirect costs to the cost object might not be a sufficient method for a detailed cost analysis in many circumstances. Direct labor or raw material usages are frequently considered as a cost driver in traditional costing and a single cost driver is generally used for the distribution of overheads. In addition to this, traditional cost accounting (TCA) may lead some cost distortions due to some lack of cost calculation. There is a consensus about distortion of product costs when the accounting is performed with TCA especially for the organizations where the proportion of overheads to total costs is fairly high (Baykasoğlu et al., 2003; Tsai and Kuo, 2004; Gunasekaran and Sarhadi, 1998). On the other hand, the main premise behind ABC is to classify overheads or indirect costs and to allocate them to end products or services based upon the activities required to produce these products (Raz and Elnathan, 1999). The allocation of the indirect costs to product and/or services differs from the TCA. ABC assumes that cost objects (products, product lines, processes, customers, channels, markets and so on) create the need for activities, and activities create the need for the resources (Tsai and Kuo, 2004). The accuracy of ABC can vary according to its focus. The focus might be on the product, customer or a combination of both. Resources include indirect costs of the organizations and they are allocated to the activity centers (Fig. 1). Resource drivers are used during allocation of the resources to the activity centers (Fig. 1).

Like many other traditional costing approaches, ABC also makes backward-looking in order to support forward decision making. However, in some cases there might be disagreement over which costs to be included in an analysis, especially where fixed costs are involved. The usage of multiple cost drivers in ABC brings the advantage of detailed cost estimation; on the other hand selection of the proper cost driver is a challenge for a good ABC analysis. Another difficulty of ABC analysis is the decision which must be made about the costs types. Direct costs and indirect costs should be determined precisely.

Resource driver is an allocation rate of an individual resource and shows the resource consumption levels of the activities. This procedure comprises the first stage of ABC.

After finding the costs of the activities (cost pools), ABC plans to distribute them to cost objects. Some drivers are used for the allocation of costs of the activities to the cost objects in a similar manner of first stage cost allocation. The meaning of "driver" in the second stage of ABC has the same meaning with the first stage cost driver of ABC. Cost objects are loaded by the activity cost pools by the predetermined second-stage cost drivers. As a result of activity cost pool allocation to the cost objects, cost consumptions of each cost objects are found. The unit cost of each cost object is then found by dividing the total allocated cost by the product amount.

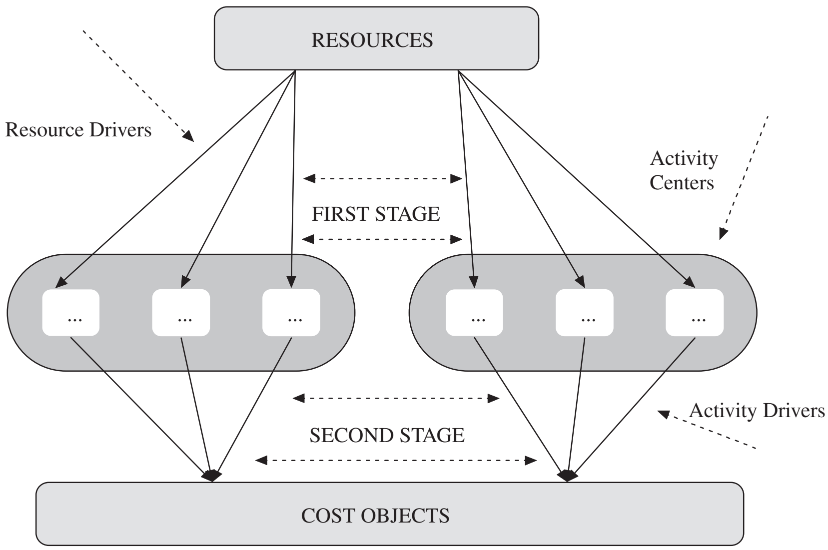

Fig. 1. Cost assignment procedure in ABC (Tsai and Kuo, 2004).

2.1. Advantages and some disadvantages of ABC for logistics implementations

Many business opportunities appeared after the development of ABC. Some of the numerous advantages of ABC over its traditional counterpart were mentioned in the literature as follows (Stapleton et al., 2004):

- ABC has helped firms across the world to become more efficient and more effective.
- ABC provides a clear picture of where resources are being spent, customer value is being created, and money is being made or lost.
- ABC offers a better alternative to labor-cost-based product costing.
- ABC identifies value-added activities.
- ABC eliminates or reduces non-value added activities.

Although using ABC brings many advantages from the viewpoint of management, implementation of ABC to service organization especially to logistics pose several challenges which do not generally exist for ABC applications in manufacturing. There are several reasons of this challenge of ABC implementation to logistics which are (Rotch, 1990):

- Output is harder to define.
- In many cases determining activities and cost drivers is not straightforward.
- Data collection and measurements is more complicated than manufacturing.
- Activity in response to service requests may be less predictable.
- Joint capacity represents a high portion of total cost and is difficult to link output related activities.

In other words, the output of the processes of the logistics organizations cannot be represented as easily as the outputs of manufacturing organizations. Activities performed in a manufacturing organization are generally known with certainty, but they cannot be easily defined in many service and logistics organizations. Another challenge of the application of ABC to logistic organizations is the complexity of logistic work processes (Baykasoğlu and Kaplanoğlu, 2006b). The complexity of the business processes increases the load of ABC calculations.

3. An introduction to the company, case study and the proposed modeling approach

The main services of the company where the case study was performed consist of export services from Gaziantep to European countries and import from European countries to Turkey. Transit services are also provided by the company. The company was established in 1936. The company presented a sharp growth rate after year 2000. The company owns 122 trucks and it is presently one of the biggest logistics company (land transportation service provider) in the southeast of Turkey. According to the definitions of *third-part logistics* (TPL) of Marasco (2008), the company can be thought as a TPL. Company's main operations consist of planning (truck assignment and organization, route planning, load consolidation, etc.), customer relations/marketing, land transportation (import, export and transit), warehousing, accounting, maintenance and support services.

In the present case study, costs of the transportation services of the company are tried to be determined for a 9-month time period. Twenty-eight different services including both exports and imports that were performed within the time period of 9 months are identified. The transportation services which are provided by the logistics company are assumed as truckloads. Therefore, the volumes of the loads consolidated into the vehicles are neglected. As a result the cost calculation is made so as to find standard costs of each route (it is whether export or import). In other words the cost objects of this case study are the truckloads of the logistics company. Belgium export, Belgium import, Germany export, etc. are some examples of the cost objects. Direct cost of each transportation for the 9-month duration had been recorded. In this case study, direct costs represents the fuel consumptions and other transportation costs.

It is aimed to determine all major activities and their relationships by making use of process modeling study. Dynamic process modeling which enables discrete event simulation is preferred in order to make estimations for the utilization of several activities. The company itself also wanted to have a process model (map) of their processes for better work assignment, effective organization and cost estimation. Actually effective application of ABC necessitates the development of process model of the company. A team whose members are from the company and authors was established to carry out the process modeling study. Hierarchical process maps of the company processes were developed after detailed analyses by the team by making use of SIMPROCESS software. In the process modeling study, first the major company's resources were determined. Operations personnel, truck drivers, truck maintenance personnel are some examples of the resources which are used in logistics services. Secondly, activities of company were determined and thirdly the precedence relationships of the activities were determined by interviewing with personnel. Some snapshots from this hierarchical process map are presented in Figs. 2–4. In Fig. 2, a section of the overall process map (model) is depicted. The process chain under the IMPORT PROCESS sub-process is depicted in Fig. 3. The activities under the IMPORT PROCESS, OPERATION sub-process are shown in Fig. 4. All of these maps (models) were verified by interviews with branch managers and labor who were actually carrying out day-to-day operations.

Developed process models increased the efficiency of ABC implementation considerably. Process models were also used for many different purposes in the company like training (Baykasoğlu and Bartık, 2005). The present case study is carried out within a systematic framework where process modeling plays an important role. The simplified diagram which presents the steps of ABC implementation is shown in Fig. 5. In the following sections of the paper details of the application are presented.

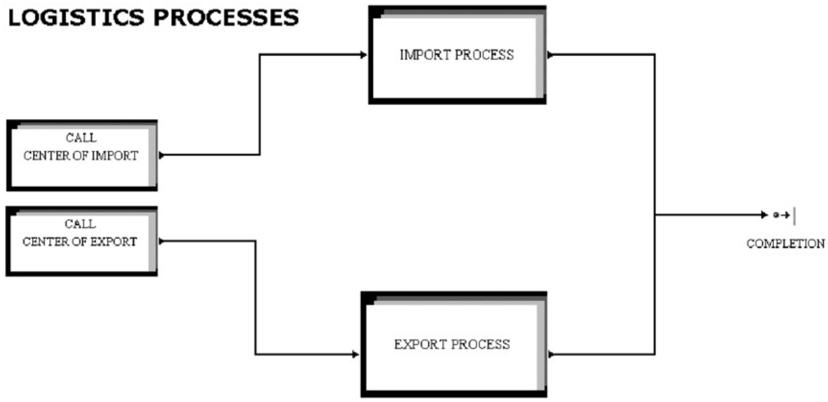

Fig. 2. A snapshoot from the overall process map of the company.

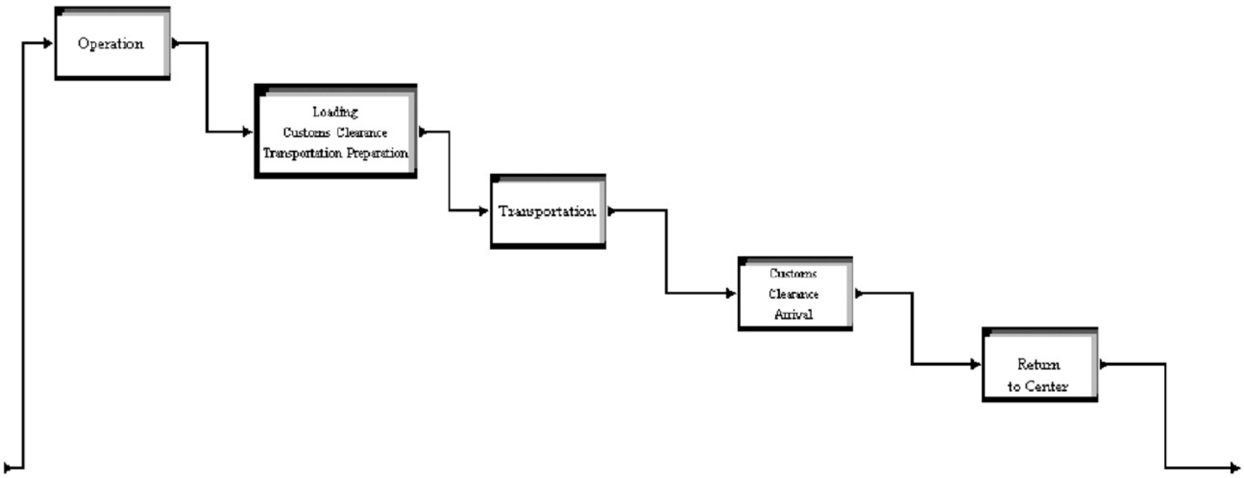

Fig. 3. A snapshoot from the IMPORT PROCESS.

4. Costing transportation services of the company

4.1. Determining the activities

It is well recognized in the literature that one of the most difficult tasks in the development of an activity-based cost system is the identification and design of the activities that should be included in the processes (Tatsiopoulos and Panayiotou, 2000). According to QJ;Nachtmann and Al-Rifai (2004) the initial step of ABC analyses is the identification of overhead categories. Ben-Arieh and Qian (2003) designated "identification of resources" as the first step of ABC process. In this study the initial step is the "determination of the activities and processes of logistics services" similar to studies of Kaplan and Atkinson (1998), Stapleton et al. (2004), No and Kleiner (1997), Gunasekaran and Singh (1999) and Schniederjans and Garvin (1997).

In practice, a large number of activities are performed to produce the end products and/or services. The identification of activities and the level of details of activities is a critical step in the design of an ABC system because the cost of the system and the accuracy of the product cost depend upon this step (Gunasekaran and Singh, 1999). In many applications of ABC, the number of activities listed for ABC analyses is not so detailed because of the expensiveness of activity information gathering. The cost of an extremely elaborate and expensive ABC system may outweigh the benefits it produces. Ultimately, the best cost allocation system is the one that balances the cost of errors with the cost of measurement (Stapleton et al., 2004). This is kept in mind in determining and analyzing the activities of the company.

In parallel to the proposed ABC application framework as depicted in Fig. 5, first of all the main processes, sub-processes and all related activities of the company are determined as also mentioned in Section 3. The main processes and sub-processes of the company are shown in Table 1. The main import and export activities of the company are presented in Tables 2 and 3. All data relevant to processes and corresponding activities such as activity duration, precedence, resource consumption rate, etc. are also collected during this stage.

The activities which are presented in Tables 2 and 3 are approximately complete list of logistics related activities

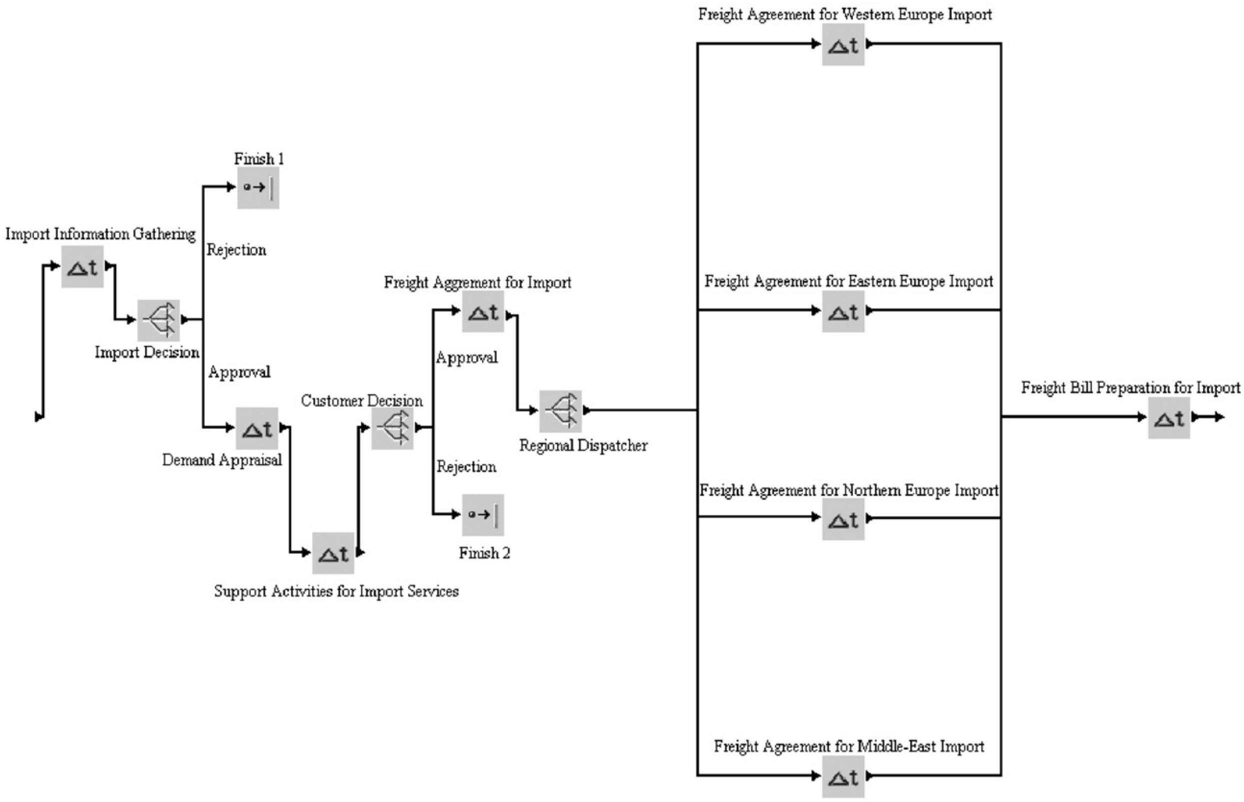

Fig. 4. A snapshoot from the OPERATION sub-process (the chain of activities).

of the company. Some of the similar activities are grouped during the study in order to increase the effectiveness and reduce the cost of implementing ABC. For example, the "export information gathering" activity which is given in Table 2 and "import information gathering" activity which is given in Table 3 are grouped and given in Table 4 with a title "taking information of demand". In other words, the activity groups are obtained by grouping both export and import activities. The grouping of the activities of Table 2 and 3 are performed intuitively according to their similarity. The activity list which is shown in a sequential order in Table 4 will be the base for ABC calculations.

4.2. *Determining the support resources and their cost analysis*

Second step of ABC application is the determination of the resources used in logistics services. Activities utilize resources and they make up processes. Therefore, as soon as activities and processes of the company are identified resources should also be determined. This is actually the logic behind the process modeling as mentioned and depicted by Baykasoğlu (2001) (see Fig. 6). SIMPROCESS software also uses a similar logic in process modeling (Jones, 1995). The support resources used in the company for the operations include the trucks, operations personnel, operations building, computers, office utilities, etc. In the company, overheads are mostly related to support resources used to perform transportation services. Carrying out a preliminary cost analysis is very useful before performing ABC study (Thyssen et al., 2006; Kaplan and Atkinson, 1998). In the present case study, direct costs and overheads are determined before applying ABC. All the cost terms, which are considered as overheads, are shown in Table 5. As stated previously, direct costs represents the fuel consumptions and other transportation costs in the present case study (*this information is collected from company's accounting department*) which are not included in ABC analysis. Direct costs were assigned to the cost objects after carrying out ABC.

There are many different types of overheads in the company; therefore, overheads are grouped based on their similarity to each other. Ninteen overhead categories are identified and presented in Table 5 along with their dollar value (for the case study period) and their corresponding cost drivers.

After generating process model of the company and obtaining the resource costs the next step is to carry out ABC.

4.3. *Determining the first-stage cost drivers and their coefficients*

The consumption rates of the activities can be clearly stated with the question of: "The resources are consumed by the activities according to what?" The answer for this question is: "according to *first stage cost drivers*". At the third step of ABC, *first stage cost drivers* are determined.

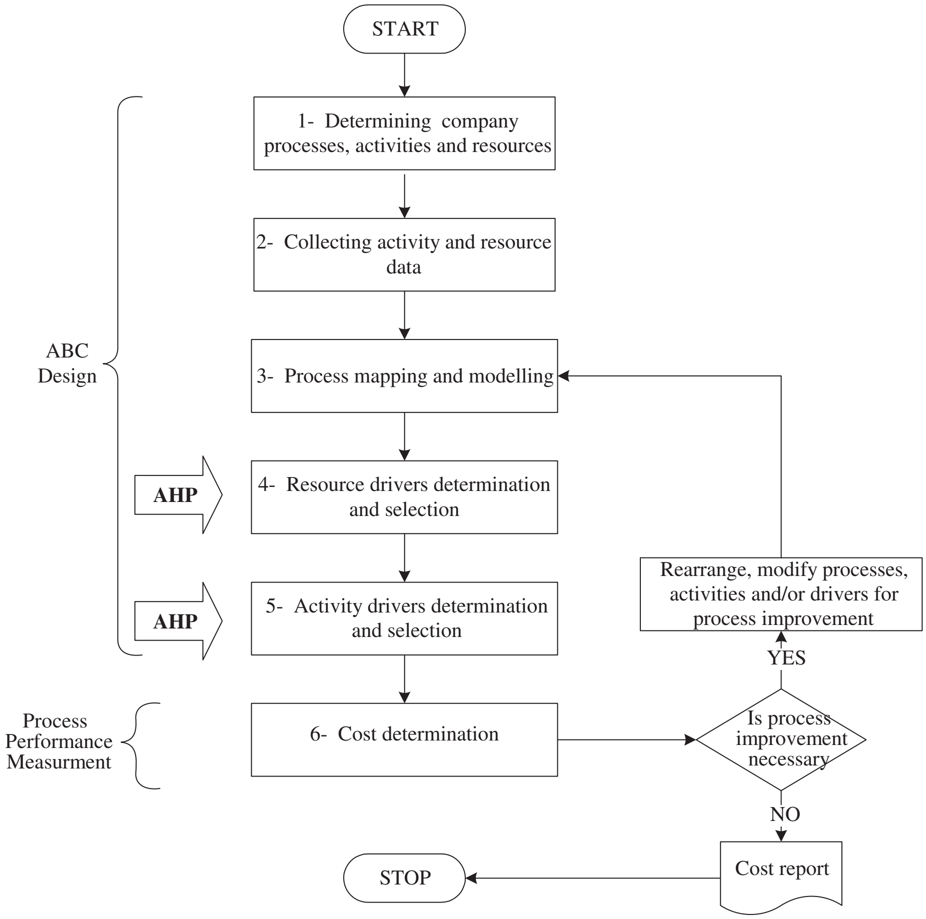

Fig. 5. ABC application framework.

Table 1
Main processes and related sub-processes

Main processes	
Export process	Import process
Sub-processes	
1. Operation	1. Operation
2. Loading, customs clearance, transportation preparation	2. Loading, customs clearance, transportation preparation
3. Transportation	3. Transportation
4. Customs clearance arrival	4. Customs clearance arrival
	5. Returning to center

Cost driver selection is a considerably difficult step of ABC (Goldsby and Closs, 2000). The careful selection of activity and cost drivers in ABC is the key to achieving the benefits of this cost system (Schniederjans and Garvin, 1997). There are many different ways of obtaining the cost drivers. In this study, first stage cost drivers are determined by brainstorming meetings with the departmental managers. A more systematic way of determining first-stage cost drivers might be to employ questionnaires similar to the applications of Tornberg et al. (2002). The first-stage cost drivers which are used during this study are shown in Table 5. Resource consumption coefficients of some activities are known exactly and given in the preceding pages of the paper. However, consumption rates of some activities cannot be easily estimated, therefore analytic hierarchy process (AHP) is employed as a method to allocate the overheads to activities as presented in the framework (Fig. 5). AHP is a technique for considering data or information about a decision in a systematic manner (Golden et al., 1989; Saaty, 1980, 1988). Researchers have shown that AHP helps to bring consistency in selection problems whose decision criteria is expressed in subjective measures based on managerial experience (Bryson, 1996). There are many applications of AHP in the literature; however, there are not many applications of AHP for ABC analysis. Partovi (1991)'s work is one of the rare applications of AHP to ABC.

In the present work, cost of "building electricity", "building water" and "building cleaning" are grouped (see Table 5) because of their similarity. As it can also be seen from Table 5, the driver for this group is "area used". Cost driver for the cost group of "tax of building" and "insurance of building" is also determined as "area used". However, the certain values of the usages of the activities are not known with certainty. Therefore, costs of these groups are distributed to the related activities with the

Table 2
Main activities for export process

Operation	Loading, customs clearance, transportation preparation	Transportation	Customs clearance arrival
Export information gathering	Document collection from customer for export	Transportation activities for each of the export transportation services	Customs clearance arrival of export transportation
Demand appraisal and bidding for export	Preparation of vehicle bag for export	Collecting transportation information during export transportation	Informing customer about arrival of export freight
Support activities for export services	Customs clearance documents preparation for export	Informing customers about vehicle and freight during export transportation	
Freight agreement for Western Europe export	CMR and other documents preparation for export	Unloading	
Freight agreement for Central Europe export	Delivery of documents to customs clearance personnel		
Freight agreement for Northern Europe export	Truck goes to loading for export		
Bill of freight preparation for export	Loading for export		
	Return to center after export loading		
	Customs clearance of export		
	Submissions of truck documents of export		
	Truck maintenance before export transportation		
	Fuelling before export transportation		

Table 3
Main activities for import process

Operation	Loading, customs clearance, transportation preparation	Transportation	Customs clearance arrival	Returning to center
Import information gathering	Submissions of truck documents for import	Transportation activities for each of the import transportation services	Informing customer about arrival of import freight	Returning after import
Demand appraisal and bidding for import	Loading import transportation freight	Collecting transportation information of import	Customs clearance arrival for import	Truck maintenance after import
Support activities for import services	Inform customer about loading of import freight	Informing customer about vehicle and freight of import		Driver accounting after import
Freight agreement for western Europe import	Customs clearance for import freight	Unloading		
Freight agreement for Eastern Europe import				
Freight agreement for Northern Europe import				
Freight agreement for Middle-East Import				
Freight bill preparation for import				

help of AHP. The activity-related personnel and managers of the company were interviewed to obtain a systematic and deliberative cost allocation via AHP. The rank of priorities derived from AHP is used as a driver coefficient for the allocation of the overheads to the activities. Table 6 shows the activities which use the mentioned cost group (overheads, "area used"). The activities (given in Table 6) are used for structuring pair-wise comparison matrix. The number of activities given in Table 6 is less than the number of activities given in Table 4. This is because Table 6 consists only the activities which consume the overheads whose driver types is "area used" as mentioned previously. The pair-wise comparison matrix which is shown in Table 7 is obtained by making interviews with the operations personnel.

In order to obtain the ranking (resource consumption rates) of the activities, the AHP procedure is applied (Saaty, 1980). Overhead consumption coefficients are obtained by using the Expert Choice program. The raw data collected from the departmental managers are used to find the rank of the activities by putting them into Expert Choice software. The resulting rank of the activities is obtained with an overall inconsistency of 0.09 (see Fig. 7). An inconsistency ratio of 0.10 or less is considered acceptable, therefore the coefficients given in Fig. 7 can be used as resource allocation coefficients. For example, the overhead consumption coefficient for the first activity (*Taking Information of Demand*) is determined as 0.165 and it is 0.044 for the seventh activity (*Preparing and Sending Arrival Notification to Customers*).

Another driver in Table 5 which is not known with certainty is "transaction duration". It is the driver of 10th and 12th elements of overheads (see Table 5). The activities use this cost group and their consumption coefficients are given in Fig. 8. The overall inconsistency is smaller then 0.10, therefore the coefficients given in Fig. 8 can be used as resource allocation coefficients.

4.4. *Resource allocation to the cost pools*

The fourth step of ABC method is the allocation of resources to activity cost pools after determining the first-stage cost driver coefficients. Activities consume resources according to their cost drivers. Each activity which is mapped in the process model is matched with required resources. The corresponding resource consumption rates for each activity are also defined. Helberg et al. (1994) and Nachtmann and Al-Rifai (2004) made overheads allocation to cost pools with the help of an allocation matrix. Helberg et al. (1994) performed allocation by making use of a 100-scale. In this study, allocation of the resources to cost pools are performed with an allocation matrix (1-scale). Table 8 represents the allocation coefficients for each of the overhead cost group (*19 overhead groups see* Table 5). The coefficients that are given in Table 8 are obtained by either activity information or the AHP technique (Section 4.3). For example, the first column of Table 8 is obtained by using the data of transportation. Ninty-seven percent of the total kilometers run by the vehicles is for "transportation" activity and 3% of the total kilometers is for "departure of vehicle to customer" activity. This is known from the historical data of the company. Many of the coefficients which are given in Table 8 are obtained in a similar manner. However, the coefficients which are not known with certainty are obtained by using AHP technique (see Figs. 7 and 8), and their results are put into the respective columns of Table 8. Column 6, 10, 12, and 14 are obtained by using AHP.

Each element of Table 5 is allocated to the 17 different activities by using the coefficients given in Table 8. For example, the cost consumption of the first activity ("taking information of demand") is found as follows:

$$0.1000 \times 107{,}526 + 0.1000 \times 121{,}203 + 0.1648 \times 10{,}007 + 0.1931 \times 24{,}504 + 0.1000 \times 24{,}150 + 0.1931 \times 5621 + 0.1648 \times 9538 + 0.1000 \times 30{,}053 + 0.1000 \times 80{,}257 \cong 45{,}356 \text{ (The difference here is coming from rounding-up)}$$

All of the coefficients found in Section 4.3 are deployed to the table in order to allocate the cost groups of Table 5. The overheads are distributed and the total

Table 4
Activities in groups

1. Taking information of demand
2. Transportation rate determination
3. Preparation of freight agreement
4. Vehicle scheduling and preparation
5. Departure of vehicle to customer
6. Preparation of loading notification
7. Customs clearance
8. Other transportation documents preparation
9. Submission of documents and advance pays
10. Vehicle refueling
11. Transportation
12. Collecting transportation information
13. Informing customers about vehicle and freight
14. Preparing and sending arrival notification to customers
15. Customs clearance-arrival
16. Vehicle maintenance
17. Driver accounts calculation

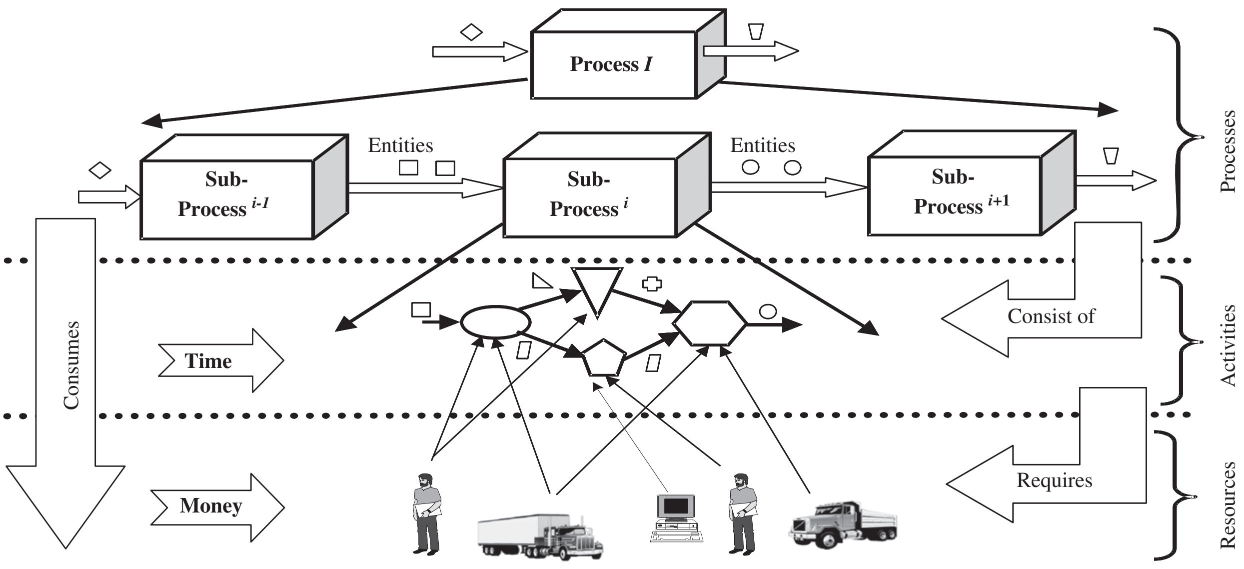

Fig. 6. Process modeling logic (adapted from Baykasoğlu, 2001).

Table 5
Overheads of the company

Overheads	Amount ($)	First-stage cost drivers
1. Vehicle depreciation costs	1,144,008	Distance (km)
2. Employees insurance costs	107,526	Number of personnel
3. Indirect labor Staff training	121,203	Number of personnel
4. Withholding tax Return of tax	50,523	Number of transportation
5.Motor vehicle tax Vehicle insurance Vehicle license costs Vehicle traffic control costs Vehicle maintenance	311,866	Number of vehicles
6. Tax of building Insurance of building	10,007	Area used
7. Truck driver license costs	72,516	Number of vehicle drivers
8. Replacement part of vehicles costs Tire costs	63,213	Distance (km)
9. Customs costs Tickets bought during transportations	17,863	Number of transportation
10. Telephone bills	24,504	Transaction duration
11. Refectory expenses	24,150	Number of personnel
12. Representation expenses Car park expenses Mailing expenses Photocopy costs	5,621	Transaction duration
13. Warehouse costs	18,092	Amount of freight (kg)
14. Building electricity costs Building water consumption Building cleaning expenses	9538	Area used
15. Personnel transportation service costs Urban transport of staff costs Urban transport fuel consumption Other fuel consumptions	30,053	Number of personnel
16. Aero plane ticket expenses Foreign travel expenses	5902	Number of customer
17. Conveyance lawyer costs Consultancy costs Other counseling costs Banking costs	191,676	Number of customer
18. Advertising Documents expenses Stationery costs Newspaper expenses Computer maintenance costs	32,370	Number of transportation
19. Donations Other costs Motoring fine costs	80,257	Number of personnel
Total	2,320,889	

Table 6
Activities which use "Area Used" as a driver

1. Taking information of demand
2. Transportation rate determination
3. Preparation of freight agreement
4. Vehicle scheduling and preparation
5. Preparation of loading notification
6. Other transportation documents preparation
7. Preparing and sending arrival notification to customers
8. Driver accounts calculation

Table 7
Pair-wise comparison matrix

Activities	1	2	3	4	5	6	7	8
1[a]	1.00	1.00	2.00	0.50	2.00	1.00	5.00	3.00
2	1.00	1.00	1.00	0.50	2.00	1.00	3.00	2.00
3	0.50	1.00	1.00	4.00	1.00	1.00	2.00	2.00
4	2.00	2.00	0.25	1.00	3.00	2.00	2.00	4.00
5	0.50	0.50	1.00	0.33	1.00	0.33	2.00	2.00
6	1.00	1.00	1.00	0.50	3.00	1.00	5.00	2.00
7	0.20	0.33	0.50	0.50	0.50	0.20	1.00	0.33
8	0.33	0.50	0.50	0.25	0.50	0.50	3.00	1.00

[a] Taking information of demand (see Table 6).

cost consumptions of the activities are determined (see Table 9).

At this point of the study, advantages of using ABC as a costing method come to scene. Mainly because, resource distribution to the activity cost pools helps to the managers to evaluate resource consumptions of value-added and non-value added activities. If a non-value added activity consumes too many resources in comparison to value-added activities then this activity is a candidate for improvement, replacement or elimination.

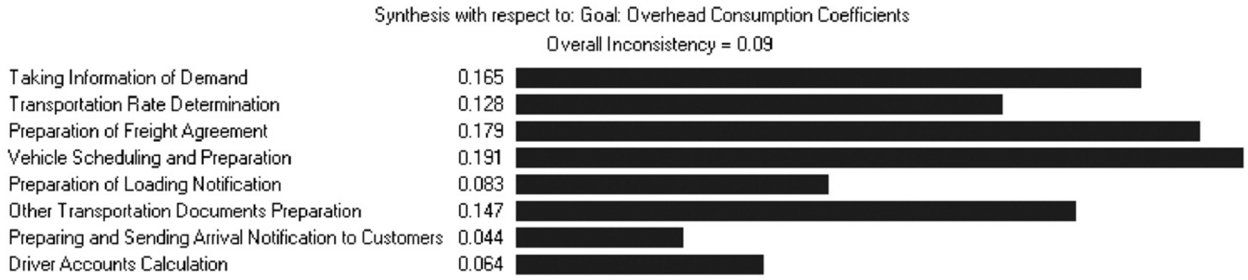

Fig. 7. Overhead consumption coefficients of the activities.

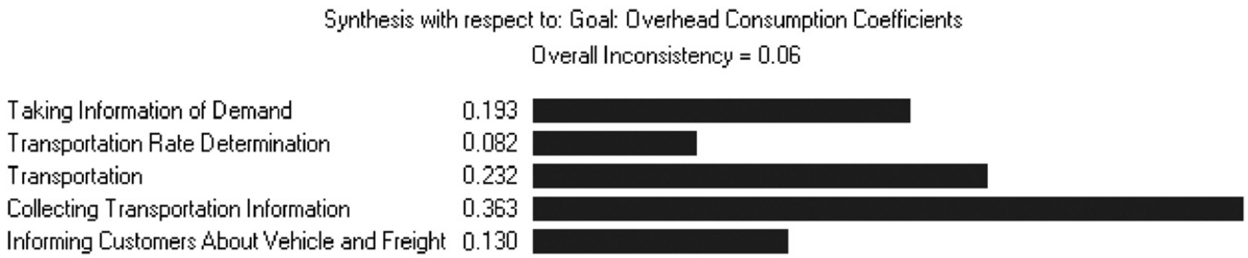

Fig. 8. Overhead consumption coefficients of the activities.

Table 8
Allocation of coefficients

Activities	Consumption coefficients of overhead cost groups																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Taking information of demand		0.10	0.10			0.16				0.19	0.10	0.19		0.16	0.10				0.10
Transportation rate determination		0.05	0.05			0.13				0.08	0.05	0.08		0.13	0.05				0.05
Preparation of freight agreement		0.05	0.05			0.18					0.05			0.18	0.05	0.50	0.50		0.05
Vehicle scheduling and preparation		0.15	0.15			0.19					0.15			0.19	0.15				0.15
Departure of vehicle to customer	0.03							0.03											
Preparation of loading notification		0.05	0.05			0.08					0.05			0.08	0.05				0.05
Customs clearance		0.10	0.10								0.10				0.10				0.10
Other transportation documents preparation		0.05	0.05			0.15					0.05			0.15	0.05	0.50	0.50		0.05
Submission of documents and advance pays		0.05	0.05								0.05				0.05				0.05
Vehicle refueling		0.05	0.05								0.05				0.05				0.05
Transportation	0.97			1.00	1.00		1.00	0.97	1.00	0.23		0.23	1.00					1.00	
Collecting transportation information		0.05	0.05							0.36	0.05	0.36			0.05				0.05
Informing customers about vehicle and freight		0.05	0.05							0.13	0.05	0.13			0.05				0.05
Preparing and sending arrival notification to Customers		0.05	0.05			0.04					0.05			0.04	0.05				0.05
Customs clearance-arrival		0.05	0.05								0.05				0.05				0.05
Vehicle maintenance		0.10	0.10								0.10				0.10				0.10
Driver accounts calculation		0.05	0.05			0.06					0.05			0.06	0.05				0.05

Table 9 also introduces the second-stage cost drivers. They are all determined by interviewing with the departmental managers. For example "transportation duration" is selected as a second-stage cost driver for the allocation of the activity cost pool "taking information of demand". "Number of transportation" is selected as a second-stage cost driver for the activity cost pool of "preparation of freight agreement". Second-stage cost driver coefficients are obtained by using the historical accounting data (for a 9-month time period) of the company which is given in Table 10. "total number of transportation" column of Table 10 is used as a second-stage cost driver for the activity cost pool "preparation of freight agreement".

4.5. *Cost pool allocation to cost objects*

As a final step of ABC, the cost pools are allocated to cost objects according to their activity cost pool usages. At this step of ABC, the allocated costs of activities are allocated to the cost objects, namely to the transportation services. Second-stage cost drivers are presented in

Table 9
Total cost consumptions of the activities and their second-stage cost drivers

No.	Activities	Overheads ($)	Second-stage cost drivers
1	Taking information of demand	45,356	Transportation duration
2	Transportation rate determination	23,123	Transportation duration
3	Preparation of freight agreement	120,449	Number of transportation
4	Vehicle scheduling and preparation	58,212	Number of transportation
5	Departure of vehicle to customer	36,217	Number of transportation
6	Preparation of loading notification	19,772	Transportation duration
7	Customs clearance	36,319	Number of transportation
8	Other transportation Documents preparation	119,819	Transportation duration
9	Submission of documents and advance pays	18,160	Number of transportation
10	Vehicle refueling	18,160	Transportation duration
11	Transportation	1,681,226	Distance × freight amount
12	Collecting transportation information	29,080	Distance
13	Informing customers about vehicle and freight	22,089	Distance
14	Preparing and sending arrival notification to customers	19,028	Number of transportation
15	Customs clearance-arrival	18,160	Number of transportation
16	Vehicle maintenance	36,319	Distance
17	Driver accounts calculation	19,403	Number of transportation
	Total	2,320,889	

Table 10
Second-stage cost driver data

No.	Transportation services	Total number of transportation	Total amount of freight carried (ton)	Transportation duration (days)	Total distance (km)	Total distance × freight amount (km × ton)
1	Belgium Exports	49	825	375	183,989	151,881,256
2	Belgium imports	119	2130	1366	457,878	975,386,006
3	England exports	19	283	195	71,244	20,183,671
4	England imports	11	164	132	42,125	6,901,155
5	France exports	107	2253	1072	345,451	778,375,116
6	France imports	92	1036	1054	327,575	339,326,658
7	Germany exports	73	1208	644	270,096	326,177,564
8	Germany imports	114	1731	1192	400,597	693,582,097
9	Greece exports	36	639	178	68,269	43,637,268
10	Greece imports	46	1,027	204	83,140	85,348,531
11	Holland exports	7	118	64	23,120	2,722,611
12	Holland imports	5	67	46	15,700	1,044,600
13	Iran imports	10	147	63	32,741	4,801,500
14	Ireland exports	2	28	19	7,800	218,205
15	Italy exports	12	256	113	31,535	8,074,764
16	Italy imports	11	177	113	26,778	4,741,514
17	Norway exports	12	24	112	48,124	1,145,977
18	Norway imports	35	690	819	165,540	114,222,600
19	Poland exports	107	2,196	923	361,219	793,207,557
20	Poland imports	23	382	164	81,482	31,092,065
21	Russia exports	66	1258	864	217,296	273,380,706
22	Russia imports	31	628	441	86,929	54,568,524
23	Spain exports	2	49	21	6,551	321,141
24	Spain imports	1	17	11	2,778	48,337
25	Sweden exports	4	43	49	17,046	730,747
26	Sweden imports	38	582	700	172,171	100,187,321
27	Ukraine exports	13	252	96	40,448	10,201,228
28	Ukraine imports	3	56	31	8410	472,667
	Total	1,048	18,266	11,061	3,596,032	4,821,981,384

Table 9. The second-stage cost drivers data are represented in Table 10.

The unit allocation coefficients are found by dividing each element of Table 10 by the sum of its column. For example, 0.047 of "total number of transportation" of Belgium export (see Table 11) is found by $49/1048 \cong 0.047$ (see Table 10).

The unit vectors of Table 11 are used to distribute the related activity costs to the cost objects. For example, the allocation of the first activity cost pool (Taking Information

Table 11
The unit allocation coefficients of the second-stage cost derivers

No.	Transportation services	Total number of transportation	Total amount of freight carried (ton)	Transportation duration (days)	Total distance (km)	Total distance × freight amount (km × ton)
1	Belgium exports	0.047	0.045	0.034	0.051	0.031
2	Belgium imports	0.114	0.117	0.123	0.127	0.202
3	England exports	0.018	0.016	0.018	0.020	0.004
4	England imports	0.010	0.009	0.012	0.012	0.001
5	France exports	0.102	0.123	0.097	0.096	0.161
6	France imports	0.088	0.057	0.095	0.091	0.070
7	Germany exports	0.070	0.066	0.058	0.075	0.068
8	Germany imports	0.109	0.095	0.108	0.111	0.144
9	Greece exports	0.034	0.035	0.016	0.019	0.009
10	Greece imports	0.044	0.056	0.018	0.023	0.018
11	Holland exports	0.007	0.006	0.006	0.006	0.001
12	Holland imports	0.005	0.004	0.004	0.004	0.000
13	Iran imports	0.010	0.008	0.006	0.009	0.001
14	Ireland exports	0.002	0.002	0.002	0.002	0.000
15	Italy exports	0.011	0.014	0.010	0.009	0.002
16	Italy imports	0.010	0.010	0.010	0.007	0.001
17	Norway exports	0.011	0.001	0.010	0.013	0.000
18	Norway imports	0.033	0.038	0.074	0.046	0.024
19	Poland exports	0.102	0.120	0.083	0.100	0.164
20	Poland imports	0.022	0.021	0.015	0.023	0.006
21	Russia exports	0.063	0.069	0.078	0.060	0.057
22	Russia imports	0.030	0.034	0.040	0.024	0.011
23	Spain exports	0.002	0.003	0.002	0.002	0.000
24	Spain imports	0.001	0.001	0.001	0.001	0.000
25	Sweden exports	0.004	0.002	0.004	0.005	0.000
26	Sweden imports	0.036	0.032	0.063	0.048	0.021
27	Ukraine exports	0.012	0.014	0.009	0.011	0.002
28	Ukraine imports	0.003	0.003	0.003	0.002	0.000
	Total	1.00	1.00	1.00	1.00	1.00

Table 12
Allocation of the activity costs to the cost objects

No	Transportation services	Activity costs distribution ($)																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	Belgium exports	1538	784	5632	2722	1693	670	1698	4062	849	616	52,955	1488	1130	890	849	1858	907
2	Belgium imports	5601	2856	13,677	6610	4112	2442	4124	14,797	2062	2243	340,077	3703	2813	2161	2062	4624	2203
3	England exports	800	408	2184	1055	657	349	659	2112	329	320	7037	576	438	345	329	720	352
4	England imports	541	276	1264	611	380	236	381	1430	191	217	2406	341	259	200	191	426	204
5	France exports	4396	2241	12,298	5943	3698	1916	3708	11,613	1854	1760	271,387	2794	2122	1943	1854	3489	1981
6	France imports	4322	2203	10,574	5110	3179	1884	3188	11,418	1594	1730	118,309	2649	2012	1670	1594	3308	1703
7	Germany exports	2641	1346	8390	4055	2523	1151	2530	6976	1265	1057	113,725	2184	1659	1326	1265	2728	1352
8	Germany imports	4888	2492	13,102	6332	3940	2131	3951	12,912	1975	1957	241,823	3240	2461	2070	1975	4046	2111
9	Greece exports	730	372	4138	2000	1244	318	1248	1928	624	292	15,215	552	419	654	624	690	667
10	Greece imports	837	427	5287	2555	1590	365	1594	2210	797	335	29,758	672	511	835	797	840	852
11	Holland exports	262	134	805	389	242	114	243	693	121	105	949	187	142	127	121	234	130
12	Holland imports	189	96	575	278	173	82	173	498	87	76	364	127	96	91	87	159	93
13	Iran Imports	258	132	1149	556	346	113	347	682	173	103	1674	265	201	182	173	331	185
14	Ireland exports	78	40	230	111	69	34	69	206	35	31	76	63	48	36	35	79	37
15	Italy exports	463	236	1379	667	415	202	416	1224	208	186	2815	255	194	218	208	319	222
16	Italy imports	463	236	1264	611	380	202	381	1224	191	186	1653	217	165	200	191	271	204
17	Norway exports	459	234	1379	667	415	200	416	1213	208	184	400	389	296	218	208	486	222
18	Norway imports	3358	1712	4023	1944	1210	1464	1213	8872	607	1345	39,825	1339	1017	636	607	1672	648
19	Poland exports	3785	1930	12,298	5943	3698	1650	3708	9998	1854	1515	276,559	2921	2219	1943	1854	3648	1981
20	Poland imports	673	343	2643	1278	795	293	797	1777	399	269	10,841	659	501	418	399	823	426
21	Russia exports	3543	1806	7586	3666	2281	1545	2287	9359	1144	1419	95,317	1757	1335	1198	1144	2195	1222
22	Russia imports	1808	922	3563	1722	1071	788	1074	4777	537	724	19026	703	534	563	537	878	574
23	Spain exports	86	44	230	111	69	38	69	228	35	35	112	53	40	36	35	66	37
24	Spain imports	45	23	115	56	35	20	35	119	17	18	17	23	17	18	17	28	19
25	Sweden exports	201	102	460	222	138	88	139	531	69	80	255	138	105	73	69	172	74
26	Sweden imports	270	1463	4367	2111	1313	1251	1317	7583	659	1149	34,931	1392	1058	690	659	1739	704
27	Ukraine exports	394	201	1494	722	449	172	451	1040	225	158	3557	327	249	236	225	409	241
28	Ukraine imports	127	65	345	167	104	55	104	336	52	51	165	68	52	55	52	85	56

Table 13
ABC cost result

No.	Transportation services	Total overheads ($)	Direct costs ($)	Total costs ($)	Total number of transportation	Unit costs ($)
1	Belgium exports	80,341	125,649	205,990	49	4204
2	Belgium imports	416,166	239,911	656,077	119	5513
3	England exports	18,668	52,490	71,158	19	3745
4	England imports	9552	26,818	36,370	11	3306
5	France exports	334,996	194,906	529,902	107	4952
6	France imports	176,450	182,051	358,501	92	3897
7	Germany exports	156,172	178,966	335,137	73	4591
8	Germany imports	311,405	253,070	564,475	114	4952
9	Greece exports	31,713	40,273	71,986	36	2000
10	Greece imports	50,259	42,905	93,164	46	2025
11	Holland exports	4998	15,012	20,010	7	2859
12	Holland imports	3242	5086	8328	5	1666
13	Iran imports	6869	9811	16,680	10	1668
14	Ireland exports	1277	2646	3923	2	1961
15	Italy exports	9626	21,137	30,763	12	2564
16	Italy imports	8037	11,392	19,429	11	1766
17	Norway exports	7593	34,790	42,383	12	3532
18	Norway imports	71,489	101,593	173,081	35	4945
19	Poland exports	337,504	249,292	586,796	107	5484
20	Poland imports	23,331	48,078	71,409	23	3105
21	Russia exports	138,802	78,677	217,478	66	3295
22	Russia imports	39,802	35,345	75,147	31	2424
23	Spain exports	1323	2965	4288	2	2144
24	Spain imports	620	1473	2093	1	2093
25	Sweden exports	2916	8232	11,148	4	2787
26	Sweden imports	65,256	95,017	160,272	38	4218
27	Ukraine exports	10,548	26,174	36,721	13	2825
28	Ukraine Imports	1937	2953	4889	3	1630

of Demand) is conducted by using "transportation duration" as a second-stage cost driver. First column of Table 12 is found by multiplying the 1×1 matrix of "taking information of demand" (see Table 9) with a 1×28 matrix of "transportation duration" column of Table 11. Table 12 represents the allocation process of the activity costs to 28 different transportation services.

After allocating each activity cost to cost objects with their related cost distribution coefficient the total cost consumption of every cost object can be determined (see Table 13). The resulting cost estimates are obtained after summing the total overheads and total direct costs for each cost object and then dividing by the total number of transportation. The average of the overheads and direct costs are found and used as a unit cost for each cost element because every cost object is assumed as standard for each transportation service.

5. Cost of the transportation services with TCA

5.1. Direct cost determination

In this case study, direct cost for each service is found by dividing the total direct cost of services to the number of service given during the 9-month time period. For example, total direct cost used for Belgium exports is $125,649. Unit based direct cost of this transportation services is found as ($125,649)/(49 transportation) = $ 2564 for each transportation. Direct costs of other services are found in a similar manner.

5.2. Indirect cost determination

With the standard and traditional costing methods indirect cost of each cost object is derived by a singe volume cost driver (Nachtmann and Al-Rifai, 2004; Tsai, 1998; Helberg et al., 1994). As Gupta and Galloway (2003) stated, traditional cost accounting uses single cost driver (direct labor or machine hours) as the basis for allocating overhead costs in manufacturing organizations but in service organizations like logistics, the traditional cost accounting drivers does not work properly. Logistic operations does not include a direct labor hours for its services or any type of raw materials. Therefore, cost driver for this case study is determined by the accounting staff as the "*number of transportation*". For the time interval of 9 months, 1048 transportation services are given for both export and import (see Table 10). By using TCA, the indirect costs are allocated to each 28 different services via the total number of transportation. Unit based indirect costs are calculated by the following equation:

$$\text{Overhead allocated to each unit of service} = \text{Total Overhead}/\text{Selected Cost Driver} \quad (1)$$

The total overheads of the company are $ 2,320,888.5 for the predefined time period of 9 months. With the help

Table 14
Traditional costing results of transportation services

No.	Transportation services	Direct costs ($)	Total number of transportation	Unit direct costs ($)	Indirect cost ($)	Total cost ($)
1	Belgium exports	125,649	49	2564	2215	4779
2	Belgium imports	239,911	119	2016	2215	4231
3	England exports	52,490	19	2763	2215	4977
4	England imports	26,818	11	2438	2215	4653
5	France exports	194,906	107	1822	2215	4036
6	France imports	182,051	92	1979	2215	4193
7	Germany exports	178,966	73	2452	2215	4666
8	Germany imports	253,070	114	2220	2215	4435
9	Greece exports	40,273	36	1119	2215	3333
10	Greece imports	42,905	46	933	2215	3147
11	Holland exports	15,012	7	2145	2215	4359
12	Holland imports	5086	5	1017	2215	3232
13	Iran imports	9811	10	981	2215	3196
14	Ireland exports	2646	2	1323	2215	3538
15	Italy exports	21,137	12	1761	2215	3976
16	Italy imports	11,392	11	1036	2215	3250
17	Norway exports	34,790	12	2899	2215	5114
18	Norway imports	101,593	35	2903	2215	5117
19	Poland exports	249,292	107	2330	2215	4544
20	Poland imports	48,078	23	2090	2215	4305
21	Russia exports	78,677	66	1192	2215	3407
22	Russia imports	35,345	31	1140	2215	3355
23	Spain exports	2965	2	1483	2215	3697
24	Spain imports	1473	1	1473	2215	3687
25	Sweden exports	8232	4	2058	2215	4273
26	Sweden imports	95,017	38	2500	2215	4715
27	Ukraine exports	26,174	13	2013	2215	4228
28	Ukraine imports	2953	3	984	2215	3199

Table 15
ABC and TCA comparison

No.	Transportation services	ABC costs ($)	Traditional costs ($)	Difference percent (%)	Transportation price ($)	Profit/loss (Traditional) ($)	Profit/loss (ABC) ($)
1	Belgium exports	4204	4779	13.7	4592	−187	388
2	Belgium imports	5513	4231	−23.3	4373	143	−1140
3	England exports	3745	4977	32.9	5895	918	2150
4	England imports	3306	4653	40.7	4784	131	1478
5	France exports	4952	4036	−18.5	3455	−582	−1498
6	France imports	3897	4193	7.6	4623	429	726
7	Germany exports	4591	4666	1.6	3678	−988	−913
8	Germany imports	4952	4435	−10.4	4372	−62	−579
9	Greece exports	2000	3333	66.7	2177	−1157	177
10	Greece imports	2025	3147	55.4	1297	−1851	−729
11	Holland exports	2859	4359	52.5	6429	2069	3570
12	Holland imports	1666	3232	94.0	4514	1282	2848
13	Iran imports	1668	3196	91.6	1165	−2031	−503
14	Ireland exports	1961	3538	80.4	7800	4262	5839
15	Italy exports	2564	3976	55.1	3289	−687	725
16	Italy imports	1766	3250	84.0	5530	2280	3764
17	Norway exports	3532	5114	44.8	4340	−774	808
18	Norway imports	4945	5117	3.5	9805	4687	4859
19	Poland exports	5484	4544	−17.1	3402	−1142	−2082
20	Poland imports	3105	4305	38.7	2519	−1786	−586
21	Russia exports	3295	3407	3.4	5843	2437	2548
22	Russia imports	2424	3355	38.4	1698	−1657	−726
23	Spain exports	2144	3697	72.4	4104	406	1959
24	Spain imports	2093	3687	76.2	4224	537	2131
25	Sweden exports	2787	4273	53.3	4526	253	1739
26	Sweden imports	4218	4715	11.8	9382	4667	5165
27	Ukraine exports	2825	4228	49.7	5231	1003	2406
28	Ukraine imports	1630	3199	96.3	1605	−1594	−25

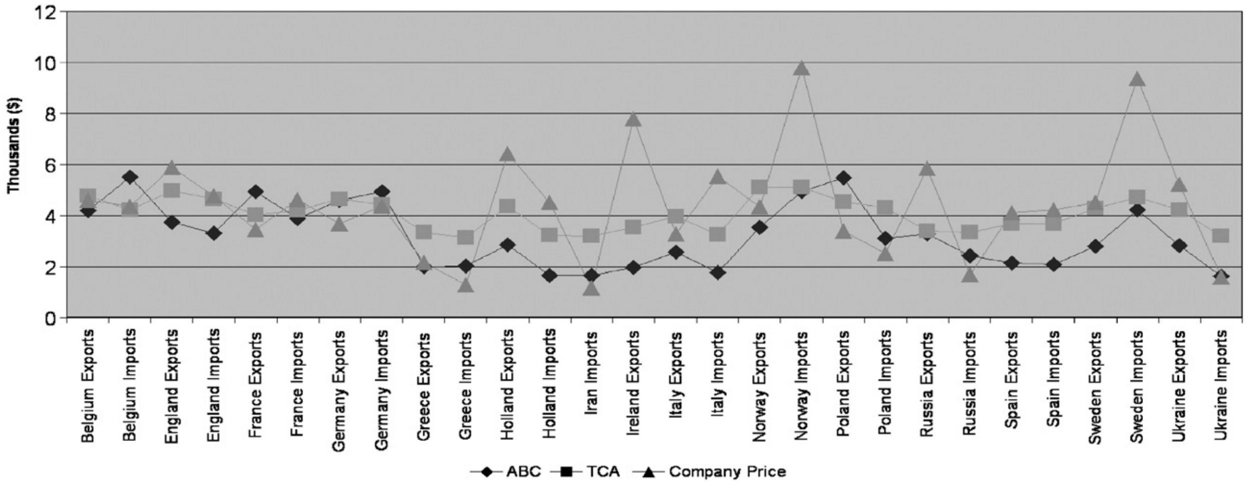

Fig. 9. ABC, TCA cost estimations and the transportation price.

of Eq. (1), the average overhead for each service can be calculated as: ($2,320,889)/(1048 transportations) = $2215/transportation.

After determining the direct and indirect costs of each service, total costs are found by summing up the allocated indirect cost and average direct cost of each cost object. Table 14 presents the costs of each cost object with its corresponding cost data.

In Table 15 a direct comparison of results obtained from ABC and TCA are given. For example, there is approximately 14% difference between ABC and TCA for Belgium exports service, etc. Although the company seems doing profitable service according to the traditional cost accounting while transporting freight from Belgium to Turkey (Belgium import), ABC claims opposite. There seems $143 profit for "Belgium import" according to the TCA, but ABC illustrates an $ 1140 loss for the same service. ABC and traditional cost estimations along with the transportation company's prices are represented in Fig. 9 in order to present differences. As it can be clearly seen from the figure there are considerable differences between ABC and TCA.

6. Conclusion

In this paper, an application of ABC method to a land transportation company is presented. In the present ABC model, SIMPROCESS is used for process modeling and AHP methodology is employed to determine cost driver parameters. Detailed explanations are given in the paper in order to present how an ABC-based approach can be used for costing services of a land transportation company. The results obtained from the ABC analyses are also compared with the traditional cost accounting practice of the company in order to see if there is a difference. It is observed that there is a considerable difference between the current cost assignment procedures of the company and the results obtained from ABC. The present traditional cost accounting procedures of the company was not able to properly distribute overheads to its services. The paper makes a useful contribution to the logistics literature by presenting how ABC along with business process modeling can be applied to a land transportation company through a detailed case study.

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