DOKUZ EYLÜL UNIVERSITY
GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES

ACTIVITY BASED COSTING AND AN APPLICATION IN A COMPANY IN AEROSPACE INDUSTRY

by

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ACTIVITY BASED COSTING AND AN APPLICATION IN A COMPANY IN AEROSPACE INDUSTRY

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M.Sci THESIS EXAMINATION RESULT FORM

We have read the thesis entitled **"ACTIVITY BASED COSTING AND AN APPLICATION IN A COMPANY IN AEROSPACE INDUSTRY"** completed by **AHMET SERDAR AKSU** under supervision of **INSTRUCTOR DR. GÖKALP YILDIZ** and we certify that in our opinion it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Science.

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ACTIVITY BASED COSTING
AND AN APPLICATION IN A COMPANY IN AEROSPACE INDUSTRY

ABSTRACT

This thesis aims at showing the weak points of the costing method used in a public organization which carries out production in aerospace industry and determining the convenience of Activity Based Costing (ABC) as an alternative costing method for this enterprise. In this thesis, firstly, traditional costing system is mentioned and the details of ABC are explained. Secondly, to make these subjects clear, the selected enterprise's current costing system is analyzed and critics about the system are presented. Lastly, ABC, which is thought as an alternative to the current costing system, is applied phase by phase. At the first phase of implementing ABC, resources are defined and the expenses related to these resources are determined. At the second phase, activities are defined and the costs of these activities are calculated by using the expenses which belong to the resources. At the last phase, the costs of the products are calculated by using the activities and activity costs. At the end of the thesis, the comparison is made for the results of ABC and the current costing method. The results show that the ABC creates a correct perspective to product costing in comparison to the current costing system.

Keywords : Activity Based Costing, Traditional Costing Methods, Product Unit Cost, Aerospace Industry.

FAALİYETE DAYALI MALİYETLEME
VE HAVACILIK SEKTÖRÜNDEKİ BİR ŞİRKETTE UYGULAMA

ÖZ

Bu tez, havacılık sektöründe hizmet veren bir kamu kuruluşundaki maliyet hesaplama yönteminin zayıf noktalarını göstermeyi ve alternatif bir yöntem olarak düşünülen Faaliyete Dayalı Maliyetleme'nin işletme için uygunluğunu belirlemeyi amaçlamaktadır. Tezde, öncelikle geleneksel maliyet hesaplama yöntemleri ele alınmış ve Faaliyete Dayalı Maliyetleme tüm detaylarıyla açıklanmıştır. İkinci olarak, konuyu daha anlaşılır hale getirmek için işletmeye ait mevcut maliyet hesaplama sistemi analiz edilmiş ve sisteme ilişkin kritikler sunulmuştur. Son olarak, mevcut maliyet hesaplama yöntemine bir alternatif olarak düşünülen Faaliyete Dayalı Maliyetleme aşama aşama uygulanmıştır. Uygulamanın ilk aşamasında kaynaklar tanımlanmış ve bu kaynaklara ait giderler tespit edilmiştir. İkinci aşamada, faaliyetler tanımlanmış ve kaynaklara ait giderler kullanılarak bu faaliyetlere ait maliyetler hesaplanmıştır. Son aşamada ise faaliyetler ve faaliyet maliyetleri kullanılarak ürünlere ait maliyetler hesaplanmıştır. Tezin sonunda ise Faaliyete Dayalı Maliyetleme ve mevcut maliyet hesaplama yöntemlerine ait sonuçların karşılaştırması yapılmıştır. Elde edilen sonuçlar Faaliyete Dayalı Maliyetleme'nin mevcut hesaplama yöntemine göre daha doğru bir bakış açısı ortaya koyduğunu göstermektedir.

Anahtar sözcükler : Faaliyete Dayalı Maliyetleme, Geleneksel Maliyet Hesaplama Yöntemleri, Ürün Birim Maliyeti, Havacılık Sektörü.

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CHAPTER ONE
INTRODUCTION

The 21st Century is moving ahead with important steps on the way of "being an information age". Improvements in technology have affected not only our daily life but also the inner and outer structure of the companies. New production environments have been born, the world has become a global bazaar due to the advances in transportation, and the rivalry has gained a global dimension. These improvements are the processes which triggers and follows each other. Global rivalry though, is the basic factor that manages and controls the companies. Consequently, today's companies have to succeed in the musts of global rivalry in order to provide their continuities in long term period. To manufacture products at the low cost and high quality and to present high speed customer services are vital needs for these companies.

While companies are switching to advanced manufacturing technologies, accounting systems also should fit in this alteration. This is important especially for cost accounting because there is a straight relation between costing systems and manufacturing structures of the companies. When this relation is lost, costing system can not accomplish functions being expected from itself. Traditional cost accounting systems being used today were improved in the beginnings of 20th century. Inspecting the manufacturing model in these years, because there was a structural organization related to manpower, it is noticed that a cost accounting system that takes manpower as the basis was established.

The technological improvement being experienced today and global rivalry brought a must in a transformation from manufacturing due to traditional manpower to a manufacturing structure of capital dense. This alteration in the manufacturing environment in companies has changed the costing system's structure. In companies with the increased level of automation, while the importance of direct labor cost in manufacturing costs decreases, the importance of indirect labor and the other indirect manufacturing costs increase.

Companies now face up not only with a new manufacturing environment but also with a new costing structure. In this case, the cost accounting should renew itself parallel to these improvements under consideration. However, it is noticed that the alterations have not been reflected to costing systems. For the consequence, some inharmonious between manufacturing structure of the companies and techniques of costing have been experienced.

The most important problem of traditional cost accounting systems is the issue of the distribution of indirect manufacturing costs which appears to be important in recent manufacturing environments. Traditionally, in the distribution of general manufacturing costs to products, some measures such as direct manpower time, direct manufacturing labor cost, the amount of manufacturing and machining time are being used. However, these do not reflect the structure of indirect costs that appear in new manufacturing environment, and thus cause some errors in product costs. Especially in countries that perform manufacturing in new areas, the increase in the complaints about costing systems has caused appliers and academic environments to search for some solutions in this field.

With the studies prepared within the USA, towards the late 1980's, Activity Based Costing (ABC) has been improved. The method that is noticed to be giving more accurate cost data in recent environments of manufacturing began to be used in time in other countries rather than the USA.

With the global rivalry, the importance of having accurate cost information has increased. Companies in Turkey which are trying to integrate with Europe should not remain at the back in the global rivalry by following these kinds of developments being experienced in every field in the world. The delays that appear in following and applying these developments will affect the national economics and population prosperity in negative direction.

The aim of this thesis is to take a control on how traditional cost becomes inadequate in new manufacturing environments and on what kind of solutions the

ABC brings out in this topic. Additionally in this thesis, the problem areas of current costing system have been determined and the consequences in applying ABC have been evaluated.

This thesis consists of five chapters. In Chapter Two, basic concepts relevant to costing systems, such as cost, cost system, manufacturing cost etc. have been explained and traditional costing systems have been taken up in detail. Then, the insufficiencies of traditional costing systems have been given.

In Chapter Three, ABC have been taken into consideration and explained in six main headings. Under these headings, the development of the system, the objectives and properties, the definition and basic concepts, their differences from traditional systems, the process of cost distribution, the features of the companies to use the system, the superior properties of it and the critics being directed to the system take place.

In Chapter Four, general information about the company in which the case study was performed has been given and the insufficiencies of current cost accounting system have been explained. The steps mentioned in Chapter Three have been followed in order to implement ABC in the company. By using the cost measures obtained after performing calculations, the average unit costs of selected products have been calculated, and the effects of activities on these costs have been determined. At the end of the chapter, the analyses and evaluations on the costing systems and the unit costs of selected products have been presented.

In Chapter Five, evaluations of the application area and critics about ABC and traditional costing systems have been presented.

CHAPTER TWO
TRADITIONAL COSTING SYSTEMS

2.1 Introduction to Traditional Costing Systems

2.1.1 Cost and Costing Systems

Cost is a term indicating the total of inputs that belong to the production activities performed at a certain period of time in an enterprise. In other words, cost is the expression by means of amount or money, for the sacrifices to be able to produce product or service. For the cost to be formed, the existing resources need to be consumed or spent (Yükçü, 1999).

Costing system is a technique used in the calculation of expenses that appear in production process. Costing system is formed by the use of some calculation methods together, related to the costs' scope, attribute and the type of calculation. The costing systems in enterprises perform the following three functions (Köker, 2003).

- First of all, they carry out the financial reporting. They distribute the expenses between products sold and the products in inventory by dividing the production costs into periods.
- They provide feedback to the employees and the managers about the effectiveness of processes and the control of costs.
- They are used in calculation of costs of the activities, products, services and the customers.

2.1.2 The Definition and Elements of Production Cost

Production is the procedure of transforming raw materials and work-in-processes (WIP) into product by using manpower and machine and by the help of other production inputs (such as electricity, energy, vapour etc.). As can be seen from the definition, three basic cost elements must be together to produce products. These are

Direct Material Cost, Direct Labor Cost and Indirect Manufacturing Cost, respectively. The production cost of any product can only be calculated by knowing these cost elements. Direct material costs and direct labor costs are kind of costs which can directly be allocated to production cost. In contrary, the relation between indirect manufacturing costs and products is indirect and general. For this reason, these are indirect costs and the method to be used in allocating these costs to products is very important for the precision of the product cost (Horngren et al., 2003).

- **Direct Material Cost:** Briefly defined as "It is the cost of all raw materials and work-in-processes (WIP) constituting the basic structure of the final product". Direct materials are the raws materials and WIP included in the body of the product, in other words, that constitute the basis. The cost of these are easily established and directly allocated to the product cost. For instance, flour in production of bread, lumber in production of furniture, and fabric in production of clothes are the direct materials of products.
- **Direct Labor Cost:** The cost of labor which can change the shape, the structure and the attribute of raw materials and WIP, that form the main structure of the product and that are connected directly to the products manufactured. Because these costs are being directly related to the product cost, it is also possible to determine how much direct labor cost is spent in the manufacturing of each product. For the examples of direct labor cost, the salaries of workers who work by the sewing machines in a clothing facility or workers who work on the assembly line in an automotive factory can be given.
- **Indirect Manufacturing Costs:** These are all the production costs which are different than direct material costs and direct labor costs, and which are done for the manufacturing of products that are the subject of the enterprise. These costs show a big variation within the enterprise and they either are not related to the manufactured products or, even if they are, it is not practical to determine that relationship. For examples of these kinds of costs, depreciation, costs of heat and energy, costs of maintenance and repair, costs of rent can be given. But the point is that, enterprise's costs like managerial, sales and financial expenses are

not included in these costs. Because for a cost, in order to be called as indirect manufacturing cost, it should be an expense related to production.

As new manufacturing environments come into view, the most important change in production cost appears to be in labor costs. By the applications of high technologies and automation in production systems, manpower is recently replaced with machines and robots. As another expression, work is substituted with capital in industrial applications. For the manpower switches from manufacturing processes to technical support services, while profound decrease has been experienced, the indirect costs inside the indirect manufacturing costs have been increased. In addition, with this change, because of the tendency from manpower to machine, important increases in depreciation costs have appeared (Güner, 2002).

2.1.3 Accounting Systems

The costing system provides the data needed from its sub-systems like cost and managerial accounting systems as well as with financial accounting system. Particularly, cost accounting has an important role for the enterprises which are performing production.

In today's enterprising life, where the ascending rivalry exists, the fast developments in production technologies and the fluctuation in currency and material costs are being experienced, the ability of controlling costs, the measurement and increase of productivity and improvement of production times depend on the success of the costing system in providing the data needed on time and precisely. Somewhat apart, in decision making of the price, in production of new products, in abandoning the production of some products and in taking precautionary measures for the rival products, the use of correct information available will be possible by the real and correct product costs provided by cost accounting system.

In literature, there are three types of accounting system using by managers (Horngren et al., 2003):

- **Management accounting** measures and reports financial and non-financial information that helps managers make decisions to fulfill the goals of an organization. Management accounting information is used to choose, communicate, and implement strategy and also to coordinate product design, production, and marketing decisions. Management accounting focuses on internal reporting.
- **Financial accounting** focuses on reporting to external parties. It measures and records business transactions and provides financial statements that are based on generally accepted accounting principles. Managers are responsible for the financial statements issued to investors, government regulators, and other parties outside the organization.
- **Cost accounting** provides information for management accounting and financial accounting. Cost accounting measures and reports financial and non-financial information relating to the cost of acquiring or utilizing resource in an organization. Cost accounting includes those parts of both management accounting and financial accounting in which cost information is collected or analyzed.

2.2 Traditional Cost Accounting Systems

The environment, lack of automation, including labor-intensive process and certain amount of standard production are called traditional production environment. In such production environment, the duty of cost accounting system is however, to calculate the product cost with the help of some cost calculation methods. Methods which are used by this type of enterprises are called traditional cost accounting methods.

At the beginning of 20^{th} century to now, important changes in production environments have been experienced. The environmental effects in production facilities have increased and the decision making processes have become more complex. Nevertheless, cost accounting systems have not managed to keep in step with these changes and are still applied with the same technics today's. At this point, the methods of cost accounting systems are not able to provide an answer to some basic principles

especially like the allocation of indirect manufacturing costs to products, and like providing cost data needed by contemporary production philosophy. The gradual increase in the ratio of indirect manufacturing costs in total production costs is believed to be a factor expanding the disabilites of traditional costing systems (Çavuşoğullari, 2003).

The more proper and real an enterprise designates the cost of the product or service it produces, so it will have more healthy decision making mechanism. Therefore, in such a tough rivalring environment, it will bring out the opportunity for the enterprises to gain important advantages by making correct decisions. For this reason, enterprises should use appropriate cost accounting methods not only inside but also outside of their environment.

2.2.1 Traditional Cost Accounting Concept

Costing systems, in which the enterprises in the traditional production medium are used, are called traditional cost accounting. Traditional production environments are those in which a small amount of standard products are produced, the production is performed mostly by the help of manpower and where there is not that much automation. In these environments, the basic duty of the cost accounting is to calculate the products' costs for the stock pricing and for the preparation of financial tables. Nowaday's, these kinds of production environments are being preserved and also the comprehension for the traditional cost accounting still goes on. Being fallen behind these changes, cost accounting has not managed to renew itself, besides the changes being experienced (Cagwin & Bouwman, 2002).

The current cost and management accounting systems were built up, within the beginning of 20^{th} century, for different production environments rather than recent environments. These systems were designed to closely monitor the ratio of the direct labor cost in product, which constitutes an important part of production cost. For this reason, the indirect manufacturing expenses mentioned here, are often allocated to products by using measures related to direct labor.

In order to obtain the data relavant to production costs, the cost accounting has built up some methods. These methods, which they are called as costing systems, vary due to the attribute of the enterprise and to the information demanded by managers. Thus, every enterprise must choose a costing system which is appropriate to its own organization structure, capable of matching the needs and capable of solving the problems.

2.2.2 Traditional Costing Systems

According to the product's and enterprise's situtation, there are several costing methods. In an enterprise, the method used for calculating the unit costs depends not only on the attributes of the products but also on the size, organizational structure and production techniques in an enterprise. However the most important factor determining the cost methods of the enterprise is the production types. The existence of mass production (homogeneous, similar products) or special production (heterogeneous, variable products) plays a characteristic role in choosing the production techniques.

There are two basic costing methods according to the production structures of enterprises; the first one is Process Costing Method and the second one is Job Costing Method. However, these methods are occasionally used in combination (hybrid costing) with respect to the structure of the enterprise (Horngren et al., 2003).

In this basic distinction, different methods of cost calculating also exist. The time and scope to evaluate cost magnitudes to be used in process and job costing methods constitute the other cost methods. Thus, the costing methods in enterprises are shown in Figure 2.1.

As can be seen in the figure, basically the way of monitoring costs are determined by means of job and process type costing methods and, the numbers to be used (actual, estimated and standard) or the costs to be considered (variable or full) by means of the decision on one of the other methods. A costing method is together composed of the usage of some methods of cost calculation relavant to the scope, attribute and the way

of calculation of the costs. As another expression, the union of several cost calculation methods brings out the costing systems. For this reason, in order to talk about costing systems, it is necessary to put all together by taking at least one method from each of the methods grouped from different angles. For example, an enterprise may use standard numbers, while monitoring costs according to job costing method, and may only take variable costs into consideration. In this case, the costing system of the enterprise is called Variable Standard Job Costing Method (Yükçü, 1999).

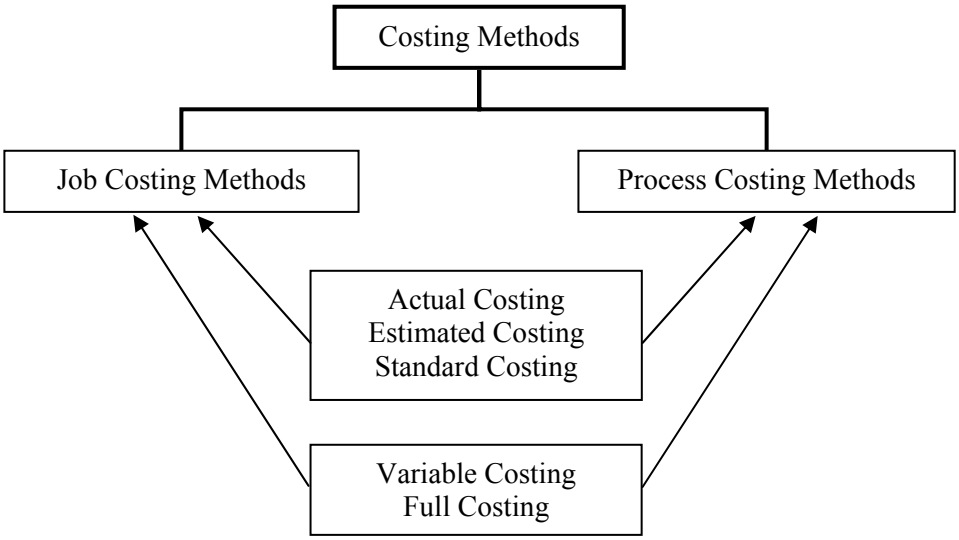

Figure 2.1 Costing methods in enterprises.

Job costing method is rather used when the production of different and heterogeneous products is in discussion. On the contrary, process costing method comes into discussion in enterprises continuously performing mass production and producing homogeneous products. Consequently, process costing method is opposite of job costing method.

2.2.2.1 Costing Methods According to the Scope of the Costs

2.2.2.1.1 Full Costing. With this method, all the cost factors, fixed or variable, are used in the production cost. The increase in fixed costs due to technological improvements brings out the fact that more fixed cost exists in product. However, short term decisions do not generally include fixed costs. For this reason, by applying the

variable costing method, enterprises try to overcome the ineffectiveness of full costing on short term decision process (Siciliano, 2003).

Full costing depends on the basis of transferring to the stocks of all the expenses of periodic production by allocating them to costs of the products produced. The cost of the product produced by this method is the sum of direct material cost, direct labor cost and indirect manufacturing costs. First the direct costs, and then the indirect costs are allocated to the unit of which the cost to be calculated, by using some distribution measures. This method is the most commonly used one in our country. Full costing is a technique generally having the acquiescence in exterior reporting and in determination of tax quantity.

2.2.2.1.2 Variable Costing. It is a costing method which depends on the basis of allocating the cost expenses varying due to only the production and sale volume (which does not change according to the production direction), to cost of the product produced. In variable costing method, while all the direct costs and the varying part of the indirect costs are calculated as production cost, the constant indirect costs are assumed as term cost (Siciliano, 2003).

Variable costing method is an effective method on decision making of several management issues. Since it is possible to get benefit from contribution lot and variable cost, this effectiveness appears particularly in short term decisions. However, within the long time, all the costs have the variable characteristics. For this reason, in long term analysis, full costing returns more correct results.

There are weak parts as well as strong parts in variable costing system. The variable costing system divides costs into two as variable and fixed cost. This, makes short term pricing and the realization of decisions depending on the cost-profit-volume models (belonging to the method itself) easier, too. But, the prices obtained by variable costing method can not match with all the prices that came true in the enterprise and the system may fake investors.

2.2.2.2 Costing Methods According to the Establishing Time of Costs

2.2.2.2.1 Actual Costing. It is a method to allocate the expense made by the enterprise for any cost object to the costs. The value added to production costs is not related to market value. Since the actual cost is a realized cost, it is also called as historical cost.

2.2.2.2.2 Estimated Costing. Estimated cost is a forecasting about actual cost value to prevent any delay in cost calculations in the situations that actual cost value must be known. By forecasting the amount of delayed cost, estimated expenses account is debited and allowance of real cost is credited. When the amount of real cost is defined, the allowance account is debited. At the end of the year, the equality of debits and credits is occurred or allowance account is closed by transferring the entries to the balance of the revenue and expense accounts.

2.2.2.2.3 Standard Costing. It is a method which provides to forecast the actual amount of costs before doing activity by scientific methods and keeping records according to these costs. Considering application conditions, it is a system that has some application difficulties, such as, causing high cost and requiring meticulous work. In order to apply this system, firstly it is necessary for that enterprise to have an adequate organization. In addition, managers should believe in the benefits of the system and should be ready to spend an appropriate budget to have the system go on working. However, the production methods must have such a priority to provide the application of standards (Doğan, 1996).

In cost accounting systems, the indirect manufacturing expenses are allocated to products using previously evaluated ratios. The same method is also applied in standard costing method. The main difference between real and standard costing methods is at the measurement of direct material and direct labor costs. In real costing method, while direct material and direct labor costs to be used in production of a product is measured, in standard costing method; these expenses are previously determined for the production of every unit of a product to be produced. These are called the standard

direct material cost and standard direct labor cost. When the amount of product produced in a certain period of time is multiplied by these costs, the standard direct material and the standard direct labor costs are found. In addition of indirect manufacturing costs to these, the total standard cost of a product is found. Standard costing method may be found in a large area by helping the planning and control functions of managers (May, 2003).

2.2.2.3 Costing Systems According to the Production Type

2.2.2.3.1 Job Costing Method. It is a system only composed of monitoring, from the beginning of production to the end, the costs that are to be endured for orders physically separable from each other, recording and collection of them (Çavuşoğuları, 2003). Ship and aircraft manufacturing facilities, construction enterprises, casting shops, furniture manufacturers, and locomotive and machine producers may be given examples of enterprises which possibly use job costing method.

The basic objective of this method is to be able to calculate separately and to supervise the cost of every order. In job costing method, a code number is given each order to be manufactured and a cost card for this order is created. All the costs about this order are collected on this card. Among these, the direct material and direct labor costs are directly remarked on that card created for the order. Cost of the order is calculated by allocating indirect manufacturing costs by using a distribution method and several cost drivers.

Job costing method helps managers especially in distinguishing works as profitable or not and in providing an effective control on expenses. This method presents cost data in an applicable manner to managers. However, the control of these costs, particularly in detail, is expensive for enterprises.

2.2.2.3.2 Process Costing Method. It is the costing method belongs to the production system which is continuously and serially established at processes that are following each other to obtain products massively homogeneous or resembling to each other and

that are bounded. The total cost of every process is composed of the sum of costs inherited from the previous process and costs formed at that process. Unit cost is calculated by dividing this total cost by the number of units produced at that process. At the last phase, costs related to final products form the product inventory costs (Horngren et al., 2003).

In process costing method, "units of equivalence" appears to be an important concept. Units of equivalence are the unfinished products that indicate fictitious products which have been finished. They are used to divide the costs into WIP and final products. The quantity of equivalent units is the definition of WIP by means of finished product. However, the treatment of finished products and WIP equally is not a correct approach. For this reason, the problem is tried to be solved by defining WIP by means of finished products. Any product completed has been exposed to the 100 percent of the production process. The costs are being divided by determining the ratio of how much of the processes the WIP has been passed from. In order to be able to determine the product costs, the total cost of the process must be divided by number of units being processed in the process (Doğan, 1996).

Calculations in process costing system can be done in two ways. These are; the average costing and the First In First Out (FIFO) methods. In phase type, when FIFO method is used, in the beginning of the term, stocks of WIP are recorded seperately and the cost of them is calculated differently from the products taken into production within the term. Conversely, in situations when the average costing method is used, the cost time has no importance. In this method, the WIP in the beginning of the month and the new ones taken into production within the month do not make any difference and they are all added together (Horngren et al., 2003).

2.2.2.3.3 Hybrid Costing. Nowaday's we notice that the traditional production structure is changing, and a hybrid model of production is being formed. This hybrid production environment carries the features of both jobshop and continuous production. As the basic costing systems, considering that the process and the job costing systems represent two extreme points, Hybrid Costing, between these two, will be a system

carrying the properties of both process and job costing systems. It is a costing system where the high technological manufacturing environments which the volume to be produced is large, the parties of production is rather heterogeneous, the production time is short and the contribution of direct labor is very small (Horngren et al., 2003).

The computer integrated environments give the opportunity to flexible manufacturing, so, many different heterogeneous products can be produced without any loss of capacity. Job costing system is not suitable for this structure. On the other hand, enterprises with high technological capability do not desire to be dependent upon long manufacturing of the products of resembling kind because of high flexibility. However, the continuous manufacturing of the same products is an important feature for process costing (Horngren et al., 2003).

As it can be seen, there is a need for a hybrid costing system in such environments. In hybrid system, process costing system will be used while standard product parts are being produced, and the cost of every production group will be established due to the job costing system.

2.2.3 Cost Flow in Traditional Costing Systems

Cost accounting methods and techniques are closely related to manufacturing systems. For this reason, the cost flow in entreprises is being performed parallel to the physical flow of the manufacturing. This situation has been shown in Figure 2.2 and Figure 2.3 by taking the process and the job costing systems into consideration.

While the factors of direct costing like direct material and direct labor costs are allocated to production, indirect cost factors firstly are gathered in indirect manufacturing cost account. It is impossible to establish a direct relation between these costs and products, because the indirect manufacturing costs are common costs for all products. Expenses collected in indirect manufacturing costs during the term, are made related to the production account using some distribution measures (Güner, 2002).

The cost of a product is calculated by allocating of basic costs to products directly and indirect manufacturing costs to products with the procedure of distribution. The costs of the items, which become "Products" after the completion of manufacturing, are revolved into product stock account. The ones which manufacturing is not completed yet, remain as the cost of WIP until their manufacturing is completed. When the sale from product stocks is accomplished, the cost of the related products are transferred to "account of the cost of goods sold" and controlled.

2.2.3.1 Cost Flow In Job Costing Method

Job Costing is a method used for the ability to determine separately of the costs of every product or product group, in enterprises that perform production in certain parties or that produce different kinds and attributes of products at every party (Horngren et al., 2003).

Basically in job costing method, production costs are traced separately for every products or product groups. There are separate production accounts for every product or product group. For this reason, in job costing method, costs are gathered in products themselves. The cost flow in job costing method is accomplished as in Figure 2.2.

2.2.3.2 Cost Flow In Process Costing Method

In this method, the basis is to calculate the costs that belong to some certain process, rather than to calculate the costs of products or product groups as it is in job costing method. The total cost of every process is composed of the sum of costs inherited from the previous process and costs formed at that process. Unit cost is calculated by dividing this total cost by the number of units produced at that process. At the last phase, costs related to final products form the product inventory costs. The cost flow in process costing method is accomplished as it is seen in Figure 2.3 (Doğan, 1996).

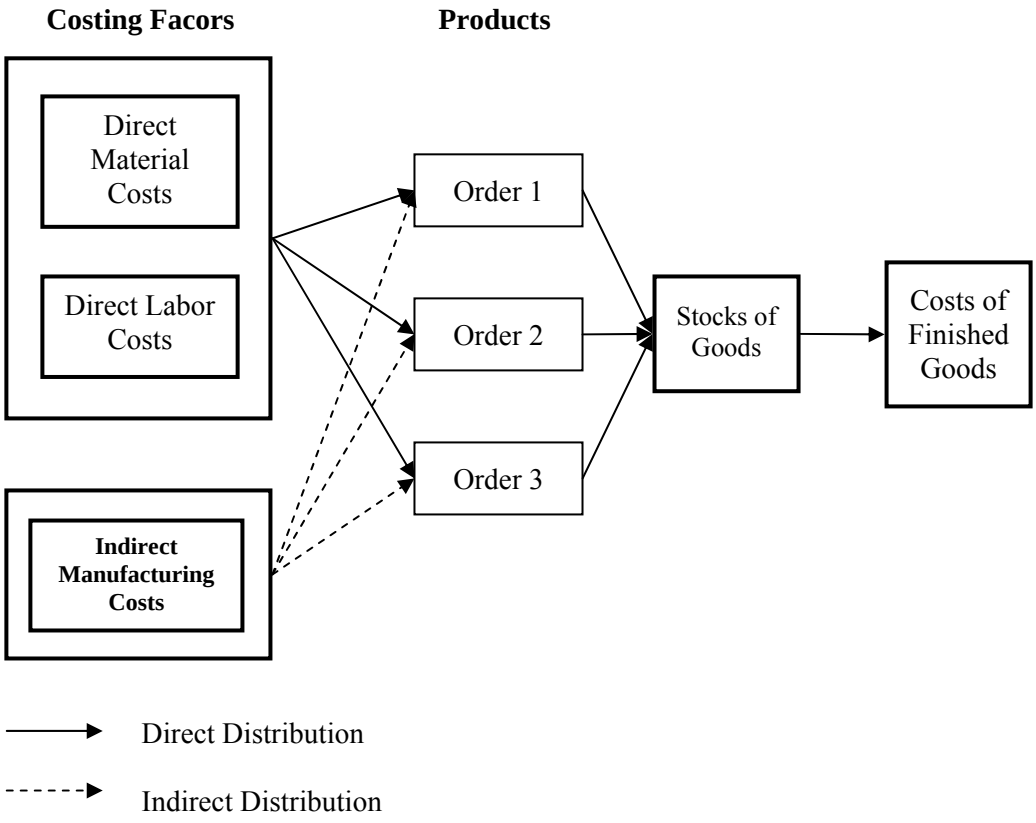

Figure 2.2 Cost flow in job costing method

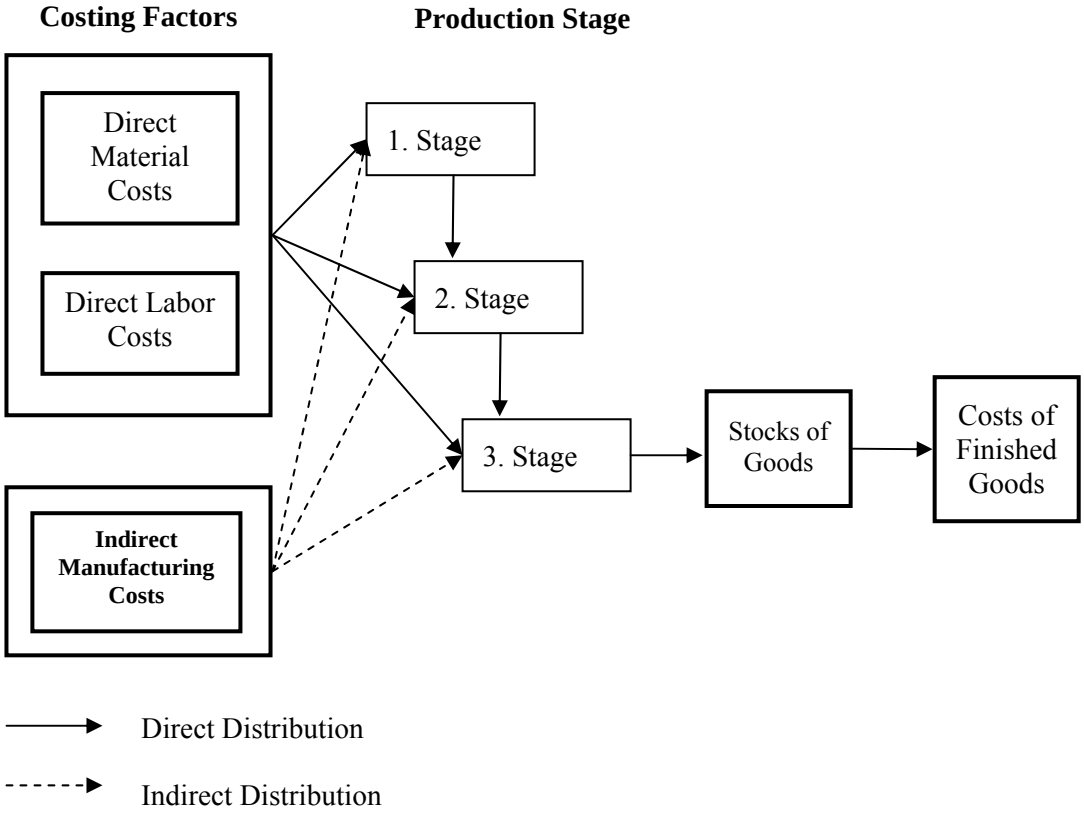

Figure 2.3 Cost flow in process costing method

2.2.4 Cost Distribution Process in Traditional Costing Systems

As seen in Figure 2.2 and Figure 2.3, for both methods, to allocate the indirect manufacturing costs to product cost, a distribution process is needed. As another expression, while direct material and direct labor costs are directly related with product cost, the indirect manufacturing costs are indirectly allocated to product costs by a distiribution process. Before switching on to the traditional distribution process, it will be useful to emphasize on why a cost distribution is needed. For this aim, it is needed to inspect the indirect manufacturing costs closely (Horngren et al., 2003).

2.2.4.1 Indirect Manufacturing Costs

Indirect Manufacturing Costs are a cost factor that collects all the production costs inside except direct material and direct labor costs. It is not possible to make them related with the cost of the product, because these costs are indirect costs, and common at the same time, for all products manufactured. For this reason, a relation between costs and products can only be established by a distribution process. Indirect manufacturing costs generally are gathered in three main groups. These are indirect material, indirect labor and the other indirect production costs, respectively (Horngren et al., 2003).

2.2.4.1.1 Indirect Material. Though far from direct material class, these are the materials which are necessary for the completion of the product and carry less value than direct material. While some of this type is in the physical structure, but some of them not, and it is hard to determine how much indirect material is used for every product. Indirect materials are divided into two as auxiliary materials and materials of enterprise.

Auxiliary materials are the ones which are included in the structure of the product, having a small share by means of value in the structure of the product. Despite they form the basic structure of the product, these materials are the ones that assist in the product's transformation from material to product. For example, sewing thread and bud

in cloth, glue and paint in furniture, and screws and bolts in machine are materials of auxiliary.

Materials of enterprise are those which is not included in the product's structure and composed of different types for every enterprise. For example, cleaning materials, electric cables, materials of labaratory, and spare parts are materials of enterprise.

2.2.4.1.2 Indirect Labor. These are labor costs that are not directly related to product but are the ones that assisted production. All of the labor costs except direct labor cost are collected in this group. Indirect labor is divided into two as labor of auxiliary and management. Labor of auxiliary are the salaries of workers (such as cleaning workers, workers of maintenance, security personnel) that asist in the proper continuation of the production. The labor of management is though composed of those like foremen, engineer or chef of jobshop who supervises the production (Horngren et al., 2003).

2.2.4.1.3 The Other Indirect Manufacturing Costs. These costs lie in the scope of all quantitatively indirect manufacturing costs except indirect materials and indirect labor. Depreciation, expenses of communication, rents, tax can be given as the examples of the other indirect costs of production.

2.2.4.2 The Necessity of the Cost Distribution

As it can be seen from the classification above, all the costs indirectly related with production are collected in a pool named indirect manufacturing. These costs are the ones not directly related to production but are vital for the continuation of the production. For a direct relation between these costs and products can not be established, it is very hard to directly find out the amount that matches with every product. The inability in establishing a relation directly makes it a necessity of indirect relation from cost accounting point of view. This -the establishing a relation for costs with products by using some measures- is the cost distribution.

Cost distribution is performed by using some measures named as “cost driver”. Since the cost drivers used are an important factor affecting product costs, is necessary that these keys are in a logical relation with the costs to be distributed. To choose inappropriate cost drivers may lead to wrong results. For this reason, the distribution of costs and the decision of cost drivers to be used in this distribution are very important for product costing. Since the measures used are subjective, cost drivers used for the distribution of costs can not provide the measurement of real cost of a product. (Homburg, 2004).

If only one type of product is being manufactured in an enterprise, the allocating of indirect manufacturing costs to products do not end up with so many problems. Since all direct and indirect costs are only of that product, there will be no need for dividing up these costs. In reality, most of the enterprises do have wide scope of products and these products together become the reason to the formation of indirect manufacturing costs. In this case, the distribution of indirect manufacturing costs to products appears to be a necessity.

2.2.4.3 Traditional Cost Distribution Process

In cost accounting, the distribution of costs is under consideration everywhere that includes indirect and common costs. From the angle of costs to be distributed, the determination of which costs are direct or indirect is very important. Because indirect manufacturing costs collect under the headline “Indirect Manufacturing Costs”, cost allocation means indirect manufacturing cost allocation.

2.2.4.3.1 Three Step Cost Distribution. From the truth that the indirect manufacturing costs can not be allocated to products, traditional cost accounting tries to establish an indirect relation between these costs and products. With this aim, it classifies enterprises into expense centers. Expense centers are composed of production centers and service centers. Production centers are the enterprise units (like machine jobshop, assembly, and painting) that are directly related to the manufacturing products. The service centers are the ones (like maintenance, energy department, warehouse, and

quality control section) supporting the product centers to continue their activities. Costs that belong to those can not be allocated directly to product costs, inspite of the fact that they are a part of product cost (Doğan, 1996).

In traditional three step cost distribution process, indirect manufacturing costs are first distributed to service centers and production centers. The distribution of costs from service centers to production centers is performed in the second step. In the last step, the indirect costs that are collected in production centers are allocated to products by using cost drivers.

When a cost factor is being distinguished as direct or indirect, it makes differences due to product or cost place. As another expression, when a cost becomes indirect by means of product, it may be direct by means of cost place. The traditional cost accounting starts the cost distribution with the distribution of indirect costs (according to product and cost places) to cost centers. This is called the first distribution. With the first distribution all the indirect costs are gathered in the relevant cost centers. Thus, the total cost of the cost centers is composed of the sum of the direct costs of cost centers' own and the costs allocated by the first distribution. After first distributon all the costs gathered in service centers are distributed to production centers. This is the second distribution. At the end of that distribution, costs being indirect according to product are collected at production centers and are being closer to products. These costs are distributed to products by third distribution. The process of allocating of costs in third distribution is performed by the help of cost drivers. Thus, the indirect manufacturing costs belonging to products are calculated. Traditional three step cost distribution process is shown in Figure 2.4 (Çavuşoğulari, 2003).

In correctly determining the product cost, the distribution process of the indirect manufacturing costs and the distribution measures meanwhile are very important. Nowaday's, when the increasing share of the indirect manufacturing costs in total production cost is under consideration, this importance is getting increased. The choice of the distribution measures also affects the precision of production cost. For this

reason, a straight relation between the chosen distribution measures and costs to be distributed must be existed.

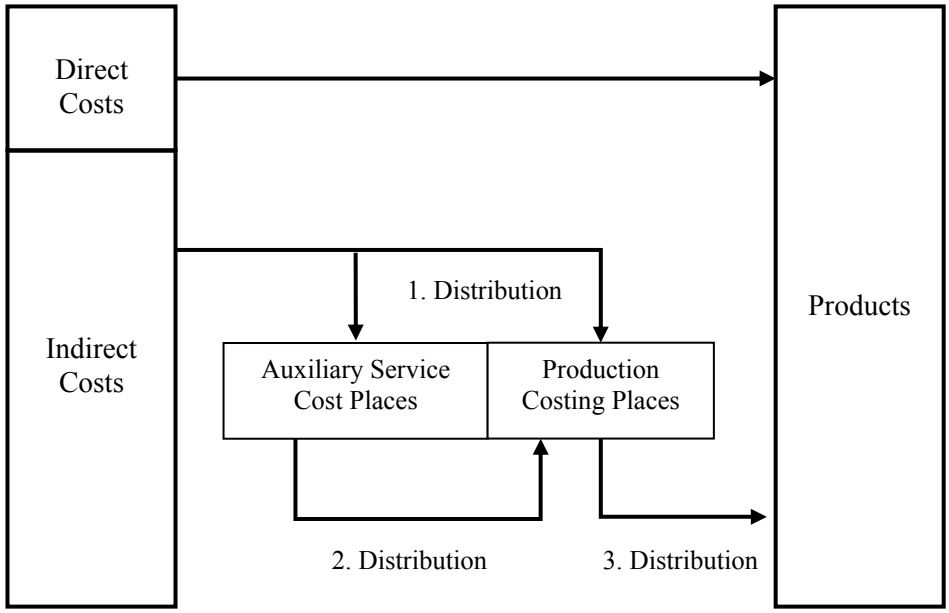

Figure 2.4 Traditional three step cost distribution process

Traditional cost accounting has emphasized in third distribution, generally on the distribution measures about labor costs (direct labor hours and direct labor costs) by assuming that costs about labor constitute a big share in indirect manufacturing costs. In addition to these, production amount, machine hour and direct material costs are the other distribution measures being used. However, for the third step cost drivers being used the most are direct labor hour and direct labor costs.

2.2.4.3.2 Two Step Approach in Cost Distribution. Cooper and Kaplan, divides the distribution process which traditionally consists of three steps, into two steps and names this as "Two Step Distribution Process". Considering the aim of every distribution step, it can be seen that in fact it is a process composed of two steps. Therefore, in first step the indirect costs are allocated to cost centers, and in second step the costs collected in cost centers are allocated to products. The objective of first step is to collect all the indirect manufacturing costs of both the service departments that support production and production departments in production centers (Güner, 2002).

First step cost distribution is generally performed for two aims. In first one, costs distributed to cost centers are used to evaluate the performance of the managers of these centers. The second one is performed, for determining the costs to be allocated to products in second step and that belong to cost centers, thus, to carry out the aim of stock valueing.

First step cost distribution varies from simple to complex in application. Simple systems, can allocate the costs of the service centers only by using one or more drivers (direct labor, m^2, the number of workers). The activity here is to distribute rather than to allocate. Because these drivers can not reflect truely the ratios of production centers' benefitting from service centers. In more complex systems, at first step, a direct cost allocating is tried to be done by using real measures related to the service expenses of production centers. In this case, the number of cost distribution needed for the first step is being decreased.

2.2.5 The Insufficiency of the Traditional Costing Systems

Lately a hard competition has been appeared not only between nations but also between enterprises and managers have been focused on production activities in order to get an advance in this competition. For this consequence, new process and flow technologies, new storage and material handling techniques and new approaches in manufacturing, engineering, and design have been discovered.

Generally, there is a direct relation between the technique of calculating product costs and the production structure of the enterprises. When this relation is lost, cost accounting can not accomplish the functions that are expected from itself. Across the new improvements, it has been noticed that the cost accounting systems developed years ago have been inadequate today's environment and, in this subject, traditional costing methods have been exposed to serious critics.

The improvements appeared in computer technologies and automation and the applications of those in manufacturing, have increased the importance and weight of

costs like depreciations due to technology, energy, engineering and expert manpower. As a consequence of that, as the share of indirect manufacturing costs in production costs have been increased, the share of the direct labor has been decreased. In many industrial branches, it is easily seen that day by day more and more enterprises abandoned the labor entry and that added this cost to indirect manufacturing costs as indirect labor. Since, to monitor the relation of direct labor with products needs a time consuming and expensive trace.

Although there are differences in applications at first and second steps of traditional three step cost distribution process, the third step (the allocating from cost centers to products) is mostly the same in traditional costing systems. At the last step, most systems use only one cost driver (direct labor hour or direct labor costs) for all cost centers. However, there are situations like when more than one cost driver are being used. In these systems, direct labor hour or cost for labor oriented processes, machine hour for machine oriented processes, and material costs for indirect costs related to material are used, as cost driver. Although traditional systems using these cost drivers seem to be different from each other, there is an important common point of them. All of these cost drivers distribute costs proportioned to the amount of product manufactured.

However, a lot of indirect manufacturing cost is related with activities like machine setup, preperation to manufacturing, planning of manufacturing, inspection of materials and products, transportation, purchasing, computer applications, warehousing, and over-labor. Whatever assorted the products are, however little parties the production is divided into, and however complex it is, it is seen that most of the product costs change according not to the amount of production but to the density of these activities.

If a costing system collects all the indirect manufacturing costs (indirect costs) in a pool of costs and distributes these costs using measures due to the amount of production, the result will be able to fake. In this case, the indirect manufacturing costs will be allocated little to products low volumed but with complex formation. The costs

of the simple structured and high volumed products however, will be higher than they should be.

Generally, although there is an agreement on the subject of the insufficiencies of traditional cost accounting, the determinaton of which points are insufficient is also important. When looking at this point of view, traditional costing systems are criticized on the following topics (Doğan, 1996):

- The insufficiency of the management on covering their needs,
- The incapability of reflecting the production process completely,
- The valueing of the performance with wrong measures,
- The data provided is much general,
- The incapability of measuring source consuming (material, labor, capital) precisely and the inability of being realistic in allocating source costs,
- The being too late in data providing,
- The being not trustable for the data it provides,
- The being encouraging in too many stocks,
- The preparing fictitious cost distributions,
- The inability of providing data in production planning and programming for the orient of future.

These critics show that the traditional costing and management accounting systems can not provide data in time and precisely. Cost distribution that is an important part of costing process and that is the factor affecting the precision of production costs, lies in the basis of this.

CHAPTER THREE
ACTIVITY BASED COSTING SYSTEM

The traditional costing methods depending on the amount of production on distribution of the costs are becoming inadequate in the new production mediums. Therefore the need to review cost accounting techniques related to indirect manufacturing costs both on planning and control and on financial reporting, has arose. As a result, Activity Based Costing (ABC) system which does not stick only to the amount of production and which assigns the costs to goods and consumers depending on the operations conducted has been developed.

ABC's origins lie with Cooper and Kaplan who, in conjunction with Harvard Business School, published cases of ABC adoption in the mid-1980s based on experiments in American companies such as Schrader Bellows, John Deere, and Weyerhaeuser (Major & Hopper, 2005, p.207).

3.1 General Information On Activity Based Costing System

ABC, which has been generated as a result of the inadequacy of the traditional costing systems, is accepted as costing method that managers benefit from in different areas.

In the end of 1940s, a system called "Machine Burden Unit System" by Caterpillar Company has been developed in order to assign costs to the goods in a more just way. In this system, indirect production costs are divided in to two groups as costs changing with the use of machine and costs changing with indirect labor. Product costs are calculated according to the certain operations conducted during the production process and their costs (Doğan, 1996).

The root of ABC today, is based on the practices made by General Electric. This system named "Operational Cost Analysis" has been developed by the finance and

accounting personnel of the firm in order to provide better information for the management of the indirect costs (Çavuşoğullari, 2003, p.20).

Until 1980s, the problems resulting from traditional systems were known by most of the firms, however nothing has been done on this matter. In 1986 Activity Based Cost method has been introduced by Robin Cooper and Robert S. Kaplan and has been implemented first in John Deere Company. This method has been developed as a new costing approach against the inadequacy of the traditional methods. Initially, it has been thought as method to determine and control indirect costs but later on it has become a structure with a wider context (Doğan, 1996). Cooper and Kaplan introduced ABC as a more relevant alternative to the cost assignments and product costs provided by traditional costing systems (Grasso, 2005, p.12).

This method has been proposed as a solution to the indirect manufacturing cost assignment problems. ABC differs from conventional costing in its treatment of non-volume related overhead costs. Many significant overheads are related to specific activities which are relatively independent of production volume (Tatsiopoulos & Panayiotou, 2000, p.37).

ABC has been promoted and adopted as a basis for making strategic decisions and for improving profit performance for over a decade. In addition, ABC information is now also widely used to assess continuous improvement and to monitor process performance. Although ABC has found rapid and wide acceptance, there is significant diversity of opinions regarding the efficacy of ABC (Cagwin & Bouwman, 2002, p.1-2).

3.1.1 Development of the Activity Based Costing System

ABC is a new costing approach used in solving certain problems that can not be solved by traditional costing methods. These problems have resulted from the rapid changes occurring in manufacturing industry. ABC has continued its development in

this direction. The phases that the method has gone through in its development process can be analyzed in three levels (Güner, 2002);

- ***First Level:*** Covers pre-1980. In this period, traditional cost accounting has been used. These methods have used only a few cost drivers in the distribution of indirect manufacturing costs. Additionally, traditional cost accounting systems have been thought to serve financial accounting and have not been used for strategic purposes. In the aforementioned period, ABC concept was not fully established and was perceived as a complicated system.
- ***Second Level:*** ABC system was created first in this period and has been taken into consideration in 1980s. In this period, method's general characteristics and differences between the traditional and new method have been defined. However the method was not generalized and there were differences in applications.
- ***Third Level:*** It has come into with the wide use of computers. In this period, general approaches of ABC have been defined. Consequently, the differences between the old method and the new method have been showed clearly. The most important characteristic of this method is that it is an important tool for managers to make the right decisions by providing more accurate product cost information.

3.1.2 The Characteristics and Purposes of Activity Based Costing System

Costing systems of the businesses have three principal functions. The first one is to apportion expenses between goods and stocks by distributing production costs on products in every level. The second one is to provide economic feedback to the managers and employers on the efficiency of the processes and on control of the costs. The last one is to use the cost information to calculate the costs of activities, goods, services and consumers.

The primary purpose of a cost accounting method is to provide right and reliable information to the management. This accurate and reliable information will increase

the profitability of the business and will result with better management. In this sense, costing system can be seen as a planning and control system (Joshi, 2001, p.88).

The principle purpose of ABC is to determine more accurate product costs. ABC tries to assign overhead costs to cost objects more accurately than traditional costing systems. Therefore it is often argued that ABC can support medium and long-term decisions, such as make-or-buy, pricing and special orders decisions, or product portfolio decisions. ABC is even considered as a strategic costing system (Homburg, 2004, p.332).

ABC has continued to provide relevant and accurate information about cost management. In addition, because the ABC system focuses on activities rather than products, it helps to prevent distorted product cost information that can arise from the use of traditional costing systems. The basic assignments of the ABC model are to identify the activities of an organization, calculate the cost of each activity, and then cost the product based on activity consumption (Lee & Kao, 2001, p.72).

Additionally, it is seen that businesses use this method in different ways such as in productivity design, designing of the production process, indirect manufacturing costs value analysis and spotting unnecessary actions.

According to the research results, the reasons why firms use ABC are given below (Major & Hopper, 2005);

- Cost management,
- Activity performance evaluation and improvement,
- Taking decisions about goods and services outputs,
- Goods and services costing,
- Budgeting,
- Consumer profitability analysis,
- Stock evaluation,
- Designing new goods and services.

These special results are actually the results of the information created by ABC. Therefore, we can say that ABC serves for two motives: (1) provide detailed information on all business activities and their consumption and costs, (2) provide accurate cost information for managers to use in the decisions to be made.

ABC is focused on business activities to achieve the purposes stated above and to do the functions of both cost and management accounting.

3.1.3 Literature Review

The literature can be classified by the tools which were used for reaching to the objective. Cagwin & Bouwman (2002), Tsai & Kuo (2004), Ben-Arieh & Qian (2003), Goebel et al. (1998), Sievänen et al. (2004), and Lere (2000) used ABC in general for performance analyzing and decision making in their studies.

Cagwin & Bouwman (2002) investigated the improvement in financial performance that was associated with the use of ABC, and the conditions under which such improvement was achieved. Internal auditors furnished information regarding company financial performance, extent of ABC usage, and enabling conditions that have been identified in the literature as affecting ABC efficacy. Confirmatory factor analysis and structural equation modeling were used to investigate the relationship between ABC and financial performance. Results showed that there indeed was a positive association between ABC and improvement in ROI (return on investment) when ABC was used concurrently with other strategic initiatives, when implemented in complex and diverse firms, when used in environments where costs were relatively important, and when there were limited numbers of intra-company transactions.

Tsai & Kuo (2004) illustrated how to calculate accurate costs, including the operating costs for individual airplanes and flights, as well as the costs per available seat kilometers, and per available ton kilometers using ABC. It also identified the

main activity items and drivers of each airplane and flight. A case study was used to illustrate the calculation of production variance, marketing variance and expected idle passenger capacity in the airline industry. This was useful information when the purchase or lease an airplane under the conditions of idle capacity.

Ben-Arieh & Qian (2003) presented a modified ABC method that found the cost of the design and development phase. The method is demonstrated using a sample part that is produced in a shop specialized in product development (one of a kind production). The method presented is based on a detailed analysis of the activities that participated in the design and development phase. These activities are modeled using the IDEF0 convention. The cost of the product is found using activity cost drivers consumed by the product. The activities' cost driver rates are found using cost centers that directly served those activities. The cost centers in turn are loaded with the direct and indirect costs of the whole facility.

Goebel et al. (1998) described the usefulness of ABC to marketers at various levels of decision making: unit level, product level, channel level, and segment/customer level. Examples are provided to illustrate the potential for improved marketing decision making when ABC is utilized versus traditional accounting systems.

Sievänen et al. (2004) determined the extent and the reasons for variation in the profitability of a product. The underlying hypothesis was that all products were not profitable. Furthermore, it was assumed that ABC would indicate greater differences in the profitability of products than the previously used marginal costing system. The research was conducted in a company in the metal industry that manufactures and assembles industrial goods. First, the activity chains were modeled and the activity-based costs were calculated. Second, the activity-based cost of the final products was compared with the selling prices to determine the profitability. The results show that the profitability varies significantly. The most profitable 20% of the products generated more than 150% of the profits and 50% of the net sales. Finally, the study

identified the characteristics of the most profitable products and discussed the reasons for the profitability.

Lere (2000) explained the differences between traditional cost behavior, which divides costs into variable and fixed categories, and ABC, which divides these same costs into those that vary with unit-level activities, batch-level activities, and product-level activities and facility-level costs. Describes how recognition that cost may vary with something other than volume can make ABC a powerful tool for industrial marketers in three ways: yielding cost estimates to use in pricing that reflect significant differences among product specifications; providing the industrial marketer with guidance as to which product specifications may be adjusted in negotiations to yield significant cost reductions; and indicating areas in which to change company operations to yield cost reductions that will allow the company to satisfy customer wishes better.

Lee & Kao (2001), Özbayrak et al. (2004), Takakuwa (1997), Beck & Nowak (2000), Spedding & Sun (1999), Rasmussen et al. (1999), and Homburg (2004) carried out cost management, cost estimation, analyzing and decision making to integrate ABC and simulation.

Lee & Kao (2001) analyzed the operational costs of a wholesale fish market in Taiwan, using both the ABC model and the simulation technique. The objective of the research was to compute the processing cost per kilogram of fish. They concluded by providing relevant and accurate information about cost management of the wholesale fish market, comparing ABC with traditional costing methods, and discussing key related issues.

Özbayrak et al. (2004) estimated the manufacturing and product costs by using ABC method in an advanced manufacturing system that was run under either material requirements planning (MRP) or just in time (JIT) system. They reported and discussed the implementation of the ABC alongside a mathematical and simulation model to estimate the manufacturing and product cost in an automated

manufacturing system. The potential effects of manufacturing planning and control strategies implemented on financial structure of the manufacturing system were initially analyzed. ABC has been used to model the manufacturing and product costs. An extensive analysis has been carried out to calculate the product costs under the two strategies. The comparison of the two strategies in terms of effects on the manufacturing and product costs were carried out to highlight the difference between the two strategies.

Takakuwa (1997) constructed a simulation model for a Flexible Manufacturing System (FMS). He developed a procedure for cost accounting which obtaining the unit cost of the product through simulation experiment. It was shown that precise cost accounting can be performed before actual manufacturing activities, if kinds of designated products and their production quantities were specified. Including costs as well as times on every operation provided an effective implementation of cost modeling methodologies on the factory floor. Cost analysis and cost accounting before performing actual operations were performed for a random-access type of FMS. A procedure for cost accounting was developed for obtaining the manufacturing costs by utilizing simulation results. It was also concluded that cost reduction could be achieved by increasing operation time per day, by analyzing the contents of the manufacturing costs.

Von Beck & Nowak (2000) linked ABC and discrete-event simulation to provide an improved costing, planning, and forecasting tool. Numerous point cost estimates were generated by the ABC model, using driver values obtained from a discrete-event simulation of the process. The various cost estimates could be used to produce confidence interval estimates of both the physical system and underlying cost structure. Rather than having a single point estimate of a product's cost, so it was possible to produce the range of costs to be expected as process conditions vary. This improved cost estimate will support more informed operational and strategic decisions.

Spedding & Sun (1999) illustrated how discrete-event simulation may be used to evaluate the ABC of a manufacturing system. A visual interactive simulation software WITNESS was used to model a semi-automated Printed Circuit Board (PCB) assembly line. The PCB assembly line case study demonstrated how ABC can be applied to a manufacturing system using simulation modeling techniques. The research also discussed further applications of ABC in the manufacturing environment and included a case study on the operational quality cost.

Rasmussen et al. (1999) presented an integrated simulation and activity-based management (ABM) approach for determining the best sequencing scheme for processing a part family through a manufacturing cell. The integration was illustrated on a loop or U-shaped manufacturing cell. Production requirements for the cell demanded that part batches be processed one type at a time. In addition to traditional measures, the simulation model produced detailed ABC estimates. Analysis of cost and performance parameters that indicated part sequence that provides the best overall choice. This sequence achieved a low per unit manufacturing cost, minimized average time in the system and in-cell inventory cost, and maximized unused production capacity.

Homburg (2004) used simulations and mixed-integer programming to analyze the extent of the sub-optimality incurred by ABC-heuristics. He analyzed the effects of establishing a cost driver corresponding to a higher cost level. A portfolio-based cost driver captured the demand heterogeneity triggered by the portfolio. This heterogeneity driver was then used to proportionalize all costs due to inflexible overhead resources. One of the main findings was that such a heterogeneity driver improves the quality of ABC-heuristics significantly.

In addition to this, some other tools like GRAI integrated methodology (GIM), Theory of constraints (TOC), process modeling, and mathematical programming are used.

Tatsiopoulos & Panayiotou (2000) integrated the ABC technique within the framework of GRAI Integrated Methodology (GIM) in order to assist business process reengineering justification and evaluation. The first step of integration was to have ABC adopt cost pools and lists of activities derived from GIM process modeling. Further on ABC was involved in two stages of the methodology: (a) ABC added to the ECOGRAI method of performance modeling by supporting the determination of the right performance indicators that are responsible for business process costs. (b) ABC was a sound approach to translate operational performance indicators not found in accounting ledgers into financial terms and the company's profit bottom line.

Kee & Schmidt (2000) represented ABC and the theory of constraints (TOC) alternative paradigms for evaluating the economic consequences of production-related decisions. However, their application can lead to contradictory product-mix decisions. To resolve this conflict, it is frequently suggested that the TOC is appropriate for the short run, while ABC is appropriate for the longer term. This study models the selection of a product-mix with the TOC and an ABC model integrating activity-based cost with the capacity of production-related activities. The study demonstrates that management's discretionary power over labor and overhead resources determines when the TOC and ABC lead to optimal product-mix decision. It also demonstrates that both the TOC and ABC may lead to a suboptimal product-mix across a wide range of economic conditions.

Tornberg et al. (2002) aimed to investigate the possibilities of ABC and the modeling of design, purchasing and manufacturing processes in providing useful cost information for product designers. The hypothesis was that ABC and process modeling might provide an effective tool for the evaluation of different design options. The study was conducted in a large Finnish manufacturing company. First, the most costly items of one product's sub-assembly were studied in order to identify the activities needed to produce the items and to calculate their activity-based costs. Second, the processes, in other words the activity chains, were modeled with graphic flowcharts from product design, purchasing, and manufacturing departments. Finally,

the applicability of activity-based cost information and process models to product designing practices was tested. The results of the study suggested that ABC and process modeling provide a good starting point in heading toward more cost-conscious design. This way the designers learn the relationships between the activities performed in the organization and their associated costs.

Shapiro (1999) examined connections between data-driven models for analyzing a firm's strategic plans, which use ABC and mathematical programming, and the resource-based view of the firm. After brief reviews of the three disciplines, extensions of ABC methods to mathematical programming models for strategic resource planning are discussed. Applications of these models to supply chain planning in a multi-national food manufacturer, a specialty chemicals company, and a wholesaling/retailing company are presented. The study concludes by using concepts from the resource-based view of the firm to interpret optimal solutions from mathematical programming models.

The briefly mentioned papers are shown in Table 3.1 with the used tools, problem type and the objective of studies.

3.2 Definitions and Main Concepts of the Activity Based Costing System

3.2.1 Definition of the Activity Based Costing System

Especially in the recent years, it is possible to find different definitions of ABC what has been the subject of many publications in accounting literature. As can be seen from the name, it is a system that focuses only on activities as the main cost subject and uses the costs of these activities in summing other cost subjects. This method named ABC because it takes the business' activities as the main cost identifier, has been defined differently depending on the fields it is used.

Table 3.1 Objectives, problem types and the used tools in literature

PAPER	TOOL	OBJECTIVE	PROBLEM TYPE
Cagwin & Bouwman (2002)	ABC	To measure the improvement in financial performance	Performance analyzing
Tsai & Kuo (2004)	ABC	To calculate accurate costs, including the operating costs for individual airplanes and flights	Operating costs and capacity in the airline industry
Ben-Arieh & Qian (2003)	ABC	To present a methodology to evaluate the cost of the design and development activity for machined parts	Cost estimation
Goebel et al. (1998)	ABC	To describe how ABC provides accounting information in a manner that enables marketers to make better decisions	Decision making
Sievänen et al. (2004)	ABC	To analyze the phenomenon of product profitability and to investigate the causes determining the differences in profitability between products	Cost management and product profitability
Lere (2000)	ABC	To describes how recognition that ABC a powerful tool for industrial marketers	Pricing
Lee & Kao (2001)	ABC and Simulation	To analyze the operational costs of a wholesale fish market	Cost management
Özbayrak et al. (2004)	ABC and Simulation	To estimate the manufacturing and product costs in an advanced manufacturing system	Cost estimation
Takakuwa (1997)	Simulation	To perform ABC for illustrating a procedure, analysis of the random-access type of the FMS	Cost analysis and cost accounting
Von Beck & Nowak (2000)	Simulation	To estimate the costs of products by combining ABC concepts with a discrete-event simulation model	Cost estimation
Spedding & Sun (1999)	Simulation	To evaluate the ABC of a manufacturing system	Cost management
Rasmussen et al. (1999)	Simulation	To integrate simulation with activity-based management (ABM) approach for determining the best sequencing scheme through a manufacturing cell	ABM and part scheduling
Homburg (2004)	Simulation and Mixed-Integer Programming	To analyze the effects of establishing a cost driver corresponding to a higher cost level	Performance analyzing
Tatsiopoulos & Panayiotou (2000)	GRAI Integrated Methodology (GIM)	To integrate ABC technique within the framework of GIM in order to assist business process reengineering (BPR) justification and evaluation	BPR justification and evaluation
Kee & Schmidt (2000)	Theory of constraints (TOC)	To model the selection of a product mix with the TOC and an ABC model integrating activity-based cost with the capacity of production-related activities	Product-mix decision
Tornberg et al. (2002)	ABC and process modeling	To investigate the possibilities of ABC and the modeling of design, purchasing and manufacturing processes in providing useful cost information for product designers	Cost accounting and product design
Shapiro (1999)	ABC and Mathematical Programming	To discuss connections among three disciplines concerned with strategic resource planning in the firm	Strategic resource planning

In general, ABC is defined as an accounting system that calculates the cost of activities in a business and reflects these costs to products and consumers (Lere, 2000, p.24). Method is based on the facts that activities are done with certain costs and consumers and products consume different amounts of activities. Therefore, first, the costs of the activities should be determined and later these costs should be assigned to each product or consumer depending on their activity consumption proportions (Kee & Schmidt, 2000, p.2-3).

In another definition, ABC is explained as a technique to understand costs. It is a method that focuses on activities as cost objectives and uses the costs of these activities as other cost objectives. As a result, the method redefines the business as a sum of activities and determines the resources consumed by these activities (Rasmussen et al., 1999, p.758).

ABC is developed as a strategic purposed product cost calculation technique. Cooper and Kaplan have stated that this is also a tool of business strategy. ABC is a database that can give information on a very wide scope. With this characteristic, the method can be summarized as following (Doğan, 1996, p.77); "It is a system that creates, uses and establishes a database on the activities and products of a business. It defines the activities done, monitors the costs of these activities and assigns these costs to consumers and products through various cost drivers. These cost drivers reflect the activity consumption of products."

Computer Aided Manufacturing-International (CAM-I), has made this definition by using Activity Accounting rather than ABC: "Activity Accounting is gathering financial and operational performance information about the main activities of the businesses". In another definition, Activity Accounting is explained as a technique that perceives a business from the activities and helps to understand the costs better. The system (prepared according to company unit, factory, and department or cost center) aims to eliminate the misleading sides of the organizational reporting (Güner, 2002, p.49).

Cooper who explains ABC method by the hierarchical classing of the activities defines it as follows (Çavuşoğulları, 2003, p.23): “ABC defines the main activities taking place in the production process of a business and classes them in one of the categories which can be listed as unit level, party level, product level and plant level activities. The costs in the first three categories of activities are assigned to products by using scales named costing factors that represent the issues of the behavior of the costs to be assigned. Costs related to plant level activities are seen as seasonal costs and are assigned by using certain distribution methods.” Cooper’s definition is a short summary of the system.”

In the light of the definitions given above, it can be said that traditional costing methods are methods that focus on the product in the costing process and determine cost drivers depending on the production qualifications as mentioned before. However in the ABC method, the focus is on activities in the costing process and, therefore, cost drivers are made up of the activities made. ABC has been developed to satisfy the need of the new production mediums. It is also used as an important management tool going beyond its principle use, product costing.

All of these definitions explain ABC from a different way. From the explanations, we see that ABC is a strategic accounting system that allows multi-functional use. ABC was introduced as a result of new production mediums and the modern production thought.

3.2.2 Basic Concepts of Activity Based Costing System

Some concepts of the ABC system are given below:

3.2.2.1 Activity Concept and Its Importance

ABC, as can be understood from the name, is based on business activities and the system is established on this concept. Activity concept has great importance to understand the method clearly.

Activity, as a concept, means the work done in general. However, when we look at it from the business view point, it has different meanings. According to this activity, is a part of the work done in an organizational unit or all of the work done by a person or by an organization. In other words, activity is the repeating actions done by groups in an organization to fulfill their functional duties and is done in every step of the value chain. Activity means work done or activity conducted as a concept (Shapiro, 1999).

However in the production medium, activities can be described as processes that consume the resources in order to produce a certain output. Activities are actions that transform resources or various inputs into outputs (Goebel et al., 1998).

Activities in a business vary. In general, these activities can be listed as below:

- Activities that generate value or do not generate value,
- Main activities,
- Supporting activities,
- Continuous or discontinuous activities,
- Primary and secondary activities,
- Necessary or arbitrary activities.

Although different concepts are being used by different authorities while these classifications are being made, the most important ones are value generating or non-generating and primary and secondary activities.

Value generating activity is any activity that contributes to consumer value, needs and organization. In another definition, value generating activities are explained as activities that do not reduce the quality of the good or service provided and that can not be redesigned. Activities that do not generate value are presented are those that can be redesigned without taking into consideration consumer satisfaction or company needs (Clarke et al., 1999).

Primary activities are activities done directly by the firm or units to achieve objectives. Secondary activities are those that support and facilitate the primary activities.

Activities being the work conducted by the businesses, have a really wide scope including actions to support both production and consumption processes. As a result activities (Lere, 2000);

- Are the work done,
- Assign the cost,
- Are focused on company strategy,
- Complement continuous growth,
- Are in accordance with the total quality management,
- Can be understood easily by the users,
- Link planning, control and decision support system together,
- Create a whole with financial and non-financial performance evaluations,
- Draw attention to mutual solidarity,
- Increase the accuracy of the product cost,
- Facilitate the management of the business during its activities.

3.2.2.2 Activity Center

Activity Center is a new concept of ABC method and it is closely related to cost center and responsibility center concepts that we know traditionally.

Cost center, is an organizational unit that gathers costs and activities relating to these costs. Responsibility center is the organizational unit in which business managers use their authorities and they are held responsible. In short, responsibility center concept has a wider scope than cost center concept. Each cost center is linked to a responsibility center. A responsibility center is made up of more than one cost centers. For instance, cutting shaping and welding centers in a safe box production can be united to form a jobshop responsibility center.

Activity centers, like cost or responsibility centers, can be arranged within the organizational structure. Activity center from the management point of view, can be defined as a part of the production process that has to separately report the cost of each activity it is in charge of. At this point, since there will be too much activity, it would not be practical to monitor each of them separately. Taking a bunch of these activities as separate activity centers would be a better approach. Especially in ABC implementations where there are various activities, determining product costs can be done by activity centers. Additionally, reporting activity costs by activity centers will help the management to manage the activities better (Güner, 2002).

In Figure 3.1 below, activities about quality in three departments of a business and a single activity center that indicates these activities can be seen.

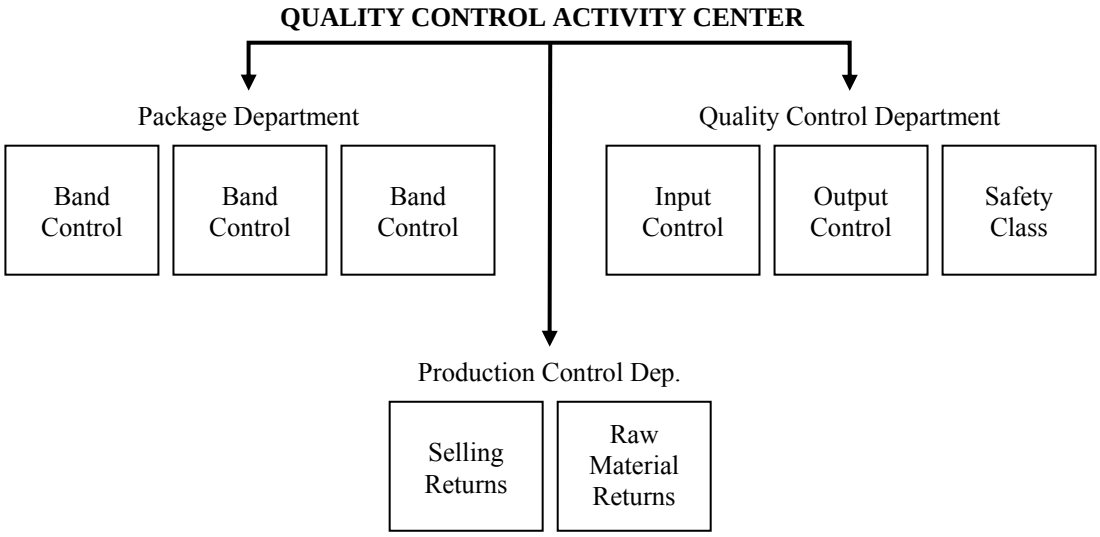

Figure 3.1 Accumulation of activities in a single activity center

Activity center as a result of being functional act as a responsibility center and can detail the activities like cost center. Activity centers contribute to organize the activities in a more meaningful way. In a business which has many activities, activities related to one and other are brought together to form activity centers. So, information on certain activities is gathered in these centers. Possible main activity centers of a producing business are given in Table 3.2.

In determining activity centers, companies prefer them to be suitable to the organization's structure as they go through different alternatives. Therefore, activity centers are organized in accordance with the business departments.

3.2.2.3 Activity Levels

ABC, while basing on activities conducted in the business, also accepts the activities which create costs. According to this, activity levels must also be taken into consideration for the right calculation of the costs. ABC has classified activities in four general levels in product costing. These levels are as follows:

Table 3.2 Some main activity centers to be used in producing businesses

MAIN ACTIVITY CENTERS	
Production	All activities concerning production process except direct workmanship
Supply	All activities conducted to supply the necessary materials for the activities
Production Management	All activities concerning programming, monitoring, quality control
Quality Control	All activities concerning product services, inputs and production processes
Tools and Equipment	All of the activities concerning the maintenance, repairing and renewal of the current tools and equipment
Maintenance	All of the activities concerning the maintenance, repairing and renewal of the current plant
Storage and Transportation	All activities concerning the storage and distribution of the products produced

Direct raw material and direct labor costs (main costs) which are considered as traditional production costs are in unit level costs. Indirect manufacturing costs are included in every group as the main element. In this classification, ABC separates the indirect activities concerning the general production from their costs. This separation is of great importance in costing and in the accuracy of the costs. Because costs in each level differ depending on various factors and different "cost factors" occur. ABC tries to create a relationship between indirect costs and products by choosing cost factors appropriate for each level (Gunasekaran, 1999).

3.2.2.3.1 Unit Level Activities. These are the activities conducted when each unit of product is produced. In other words, these activities occur as the result of the total value of the continuing production in a business and are all the activities conducted for the production of unit product. Expenses for unit-level activities consist of direct labor, materials, machine costs, energy, and so on (Takakuva, 1997, p.795).

These activities depend on the production level and change with the production volume. Costs resulting from the conduction of these activities also named as unit level costs.

3.2.2.3.2 Party (Group) Level Activities. In the case that products are produced as groups, these are the activities that are done for each group rather than for a unit of product. Assembling the equipment, delivering the goods to the consumers and material purchase are all group level activities. The cost of these kinds of activities depends on the number of groups produced. According to this party level costs are independent from the group volume meaning the amount of the units produced (Shapiro, 1999). Expenses for batch-level activities consist of setups, material movements, purchase orders, inspection, and so on (Takakuva, 1997, p.795). The cost resulting from a group level activity such as purchasing, is not going to be a function of the volume of these orders but a function of the fulfilled orders.

3.2.2.3.3 Product Level Activities. These are activities concerning certain products produced by a business and are conducted when there is a need to support the production of each product type. In these activities, examples of making a proposal to change the product, developing new testing programs and delivering the goods to the consumer to fulfill customer demands can be given. Sometimes the product level activities can be related to only one product (Özbayrak, et al., 2004). Product level activities consist of process engineering, product specifications, engineering change notices, product enhancement, and so on (Takakuva, 1997, p.795). The main element affecting these activities is the change in the variety of the products produced.

3.2.2.3.4 Plant Level Activities. These are the activities that complement the general production processes of a plant and create the continuity in production. Plant level activities consist of plant management, maintenance of the building and grounds, heating and lighting, and so on (Takakuva, 1997, p.795).

Plant level activities which generally consist of production supporting activities deal rather with administrative costs and therefore are independent of the production level. In the cases that ABC is fully used, plant level activities are considered to be an important problem. Since it is really difficult to determine the valid cost drivers, it is impossible to assign the costs directly to the products. The costs of these activities are considered as seasonal expenditures and are assigned to the product arbitrary.

There is a distinct separation between the levels mentioned above and the activities and their costs. This distinction is important to be able to determine the right cost of the product. Because the costs of every level changes depending on different factors and different cost drivers are being used. ABC tries to create an efficient relationship between activities and products by choosing appropriate cost drivers for each level. Activity levels and cost elements are shown in Figure 3.2.

The hierarchy shown in Figure 3.2 shows a structural way to the business management about the relationship between activities and the resources which consume the activities. Additionally, this structure provides the hierarchy that managers need to distinguish the cost of the resources consumed in unit and plant levels.

3.2.2.4 Cost Drivers

One of the important elements of the Activity Based Costing system is cost drivers (direct labor hours, machine hours, quantity of finished goods, number of orders …etc.) also known as activities drivers. They are used in distributing the costs concerning the activities to cost objects meaning products and consumers. For ABC

system, to give accurate results, the right choice of quantities, and qualities cost drivers is of great importance (Homburg, 2004).

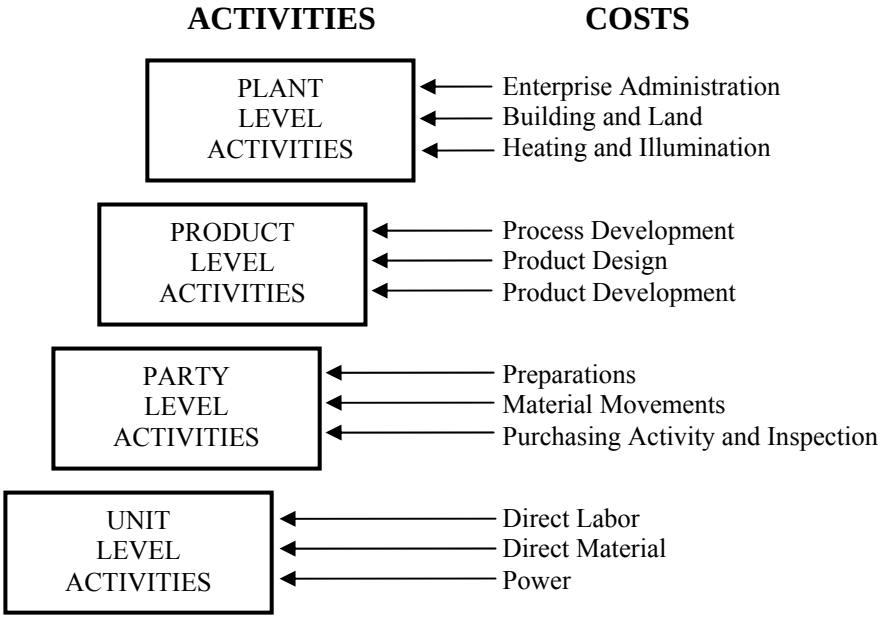

Figure 3.2 Activity and cost hierarchy

There are different definitions of cost drivers. According to one definition, it is any event resulting from the consumption of business resources and concerning an activity. According to another, on the activities demanded by products, it is the size of the quantity and intensity of this demand. In the light of these definitions, cost drivers can be explained as activity measurement tool (Sievanen, 2004, p.394-395).

In ABC method, cost drivers are used like cost drivers of the traditional system. However, cost drivers, are closely related with the activity levels mentioned before. A cost driver may be in unit, party or product level. Traditional systems use cost drivers such as direct labor hour or machine hour that have the unit level in distribution of indirect manufacturing costs that are gathered in production centers to products. On the other hand, ABC established a more realistic relationship based on cause and effect between products and consumers by using various cost drivers (Homburg, 2004).

Cost drivers which are of great importance in ABC system should be chosen carefully. All factors shall be observed and the most appropriate combination for the business's structure and product line in deciding the number of cost drivers and on which cost driver should be used. High number of cost drivers increases the details and help the managers in having more information in all areas. However, with high number of cost drivers, it is harder to keep track of activities and it increases the cost of the system.

3.3 Cost Distribution in Activity Based Costing

ABC is a system developed to assign indirect manufacturing costs. It has a distribution process that assigns costs first to activities and later on to products and consumers. However, for the cost distribution process to be understood better, it should be pointed out that it is different from the cost distribution process of the traditional systems.

3.3.1 The Differences of the Method from the Traditional Costing Systems

Traditional costing systems use a three-level distribution process to assign indirect production costs to the products. In the first level, indirect costs that are common for both production and service centers are assigned according to production and service center. In the second level, costs gathered in the service centers are assigned equally among production centers. In the last level, the cost of the production centers is assigned to products. Last distribution is done by using indirect manufacturing cost proportion (Çavuşoğulları, 2003). There can be one proportion for the whole plan or there can be different proportions for different production departments. In determining these proportions, generally, the direct labor hour or cost of production is taken into consideration. However, elements such as machine hour, production amount or direct raw material costs are also used.

This process which is summarized briefly can be considered as a two-level process. Fist and second distribution levels are done to assign indirect costs to

production (cost) centers where the production is conducted. Therefore, these two-levels can be seen as one. As a result, traditional cost distribution is transformed to two-level distribution process shown in Figure 3.3.

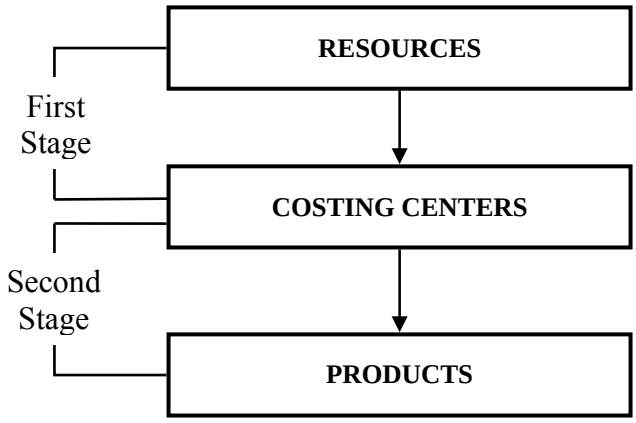

Figure 3.3 Two-level distribution in traditional system

Since traditional costing systems use cost drivers that depend on the production amount, indirect manufacturing costs also depend on production amount. In the new production mediums that use automation, indirect manufacturing costs are independent from production amount. Indirect manufacturing costs taking place in these mediums include various activities such as quality control, programming, products design and monitoring the production process. The indirect costs occurring in these cases do not depend on the production amount. As a result, traditional costing systems give lack of information about the cost of each product consumed (Homburg, 2004).

ABC, first, determines the consumption of business resources by activities and then creates a relationship between the cost of these activities and products and consumers. As a result costs are assigned better without depending on the production amount. According to this, two-level distribution process occurs as shown in Figure 3.4 (Çavuşoğullari, 2003, p.36-37).

While ABC method uses the two-level distribution method shown in Figure 3.4, it is based on four activity levels in the production processes and chooses cost drivers

accordingly. For instance, ABC, to assign party level activity costs to products and consumers uses cost drivers that carry the characteristics of the products group such as sample number or production order number.

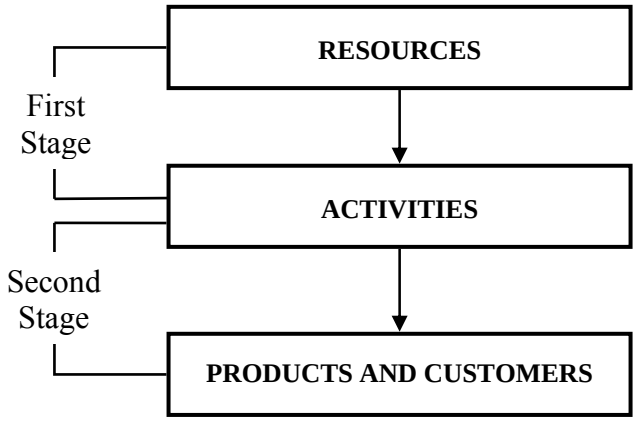

Figure 3.4 Activity based two-level cost distribution process

ABC differentiates the products, which is produced as big or small parties. Since the order number shows the demand towards these activities, the costs of the activities concerning the preparation are assigned according to the order number (Clarke et al., 1999). Since the cost of the activities concerning preparation are assigned in part level, products produced in low amount will receive higher preparation cost while products of large amount will have less preparation cost. However, traditional cost distribution, assigns party level costs by using unit level distribution parameters (Gupta & Galloway, 2003).

In the light of this information, if we do an evaluation from two-level distribution process' viewpoint, ABC differs from traditional systems in two ways:

a) Production pools are not defined as production cost centers but activities,
b) The cost drivers used to assign the activity cost are structurally different from the ones used in traditional systems.

These differences lead to a better organization of two-level process. Since ABC clearly determines costs of different activities and assigns the activity costs to outputs using appropriate parameters, it provides more accurate information in

comparison to the traditional system. What provides accuracy at this point is the parameter or in other words cost factor. These are considered as appropriate parameters because production activities represent the consumption style.

Some differences between traditional cost methods and ABC are given in Table 3.3 (Güner, 2002, p.65).

Table 3.3 Comparison of traditional cost accounting and activity based costing methods

Cost Distribution Parameter	**Traditional Cost Accounting**	**Activity Based Costing**
Factors affecting the resources used	Only the production volume	Various factors such as moving number or production orders number
Cost Drivers	One	Many. One for each factor that affect the resource consumption
Number of Cost Drivers	One	Many. One for each cost pool
Costing of products	Using production volume as cost driver	Using each cost driver fort he relevant cost pool

As can be seen in Table 3.3, the only factor that affects the resources used is production amount according to traditional methods. However, in ABC, resource usage has many reasons and production amount is only one of them. Again in traditional costing while there is only one cost pool for indirect manufacturing costs, in ABC, there are many cost pools.

In short, while traditional costing methods calculate product costs with only one cost driver, ABC method uses different cost drivers for different cost pools in determining product costs.

3.3.2 Cost Distribution Process in Activity Based Costing System

ABC is a system that assigns costs to cost objects by first tracing costs to activities and then tracing costs to cost objects. Cost object is a technical term in cost management and is any item such as products, departments, projects, activities, and

so on, for which costs are measured and assigned (Lee & Kao, 2001, p.71-72). Figure 3.5 shows the detailed cost assignment view of ABC. It assumes that cost objects create the need for activities, and activities create the need for resources. Accordingly, the technique uses a two-stage procedure to assign resource costs to cost objects (Tsai & Kuo, 2004, p.271).

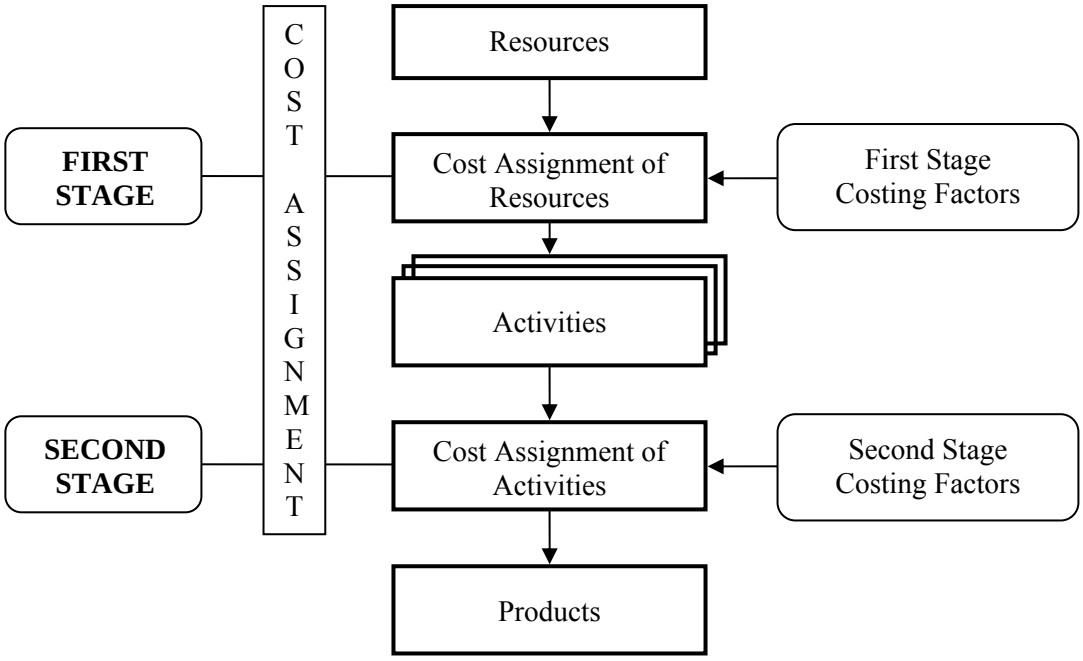

Figure 3.5 Activity based two-stage procedure

Two-stage procedure, first defined by Cooper, is the main structure of ABC. According to Cooper, this procedure is also the foundation of many modern cost accounting systems. This procedure is done in two levels because it is impossible to assign the indirect production costs directly to the products.

Cooper explains using the two-stage procedure of ABC method as (Kee & Schmidt, 2000, p.15), "Two-stage procedure starts with taking into consideration the resources needed for production."

In the first stage, resource costs are assigned to various activities using resource drivers. Resource drivers are the factors selected to approximate resources consumed by various activities. Each type of resource traced to an activity becomes a cost

element of an activity cost pool. An activity cost pool is thus the total cost associated with an activity. An activity center comprises related activities, usually clustered by function or process (Tsai & Kuo, 2004, p.271-272).

In the second stage, each activity cost pool is assigned to cost objects using an adequate activity driver that measures activity consumption by cost objects. The various kinds of activity costs are traced to cost objects by using the different kinds of activity drivers. For example, machine hours is used as the activity driver for the activity machining; setup hours or the number of set-up for machine set-up; and the number of drawings for product design. If cost objects are products, then the total cost of a specific product can be calculated by adding the costs of the various activities assigned to that product. The product unit cost is achieved by dividing the total cost by the product quantity (Tsai & Kuo, 2004, p.271-272).

In the light of this definition, two-stage procedure and therefore the conceptual structure of the ABC system is shown in Figure 3.6 (Doğan, 1996, p.83).

As can be seen in Figure 3.5 there are five operation levels along with the two-stage distribution process. These operations conducted in the first and second levels of the distribution procedure are given below.

3.3.2.1 Operations Concerning The First Level

In this level, determining resources, determining resource drivers and monitoring of costs with activity centers and cost pools are the operations that are conducted.

3.3.2.1.1 Determining the Resources. Resources are economic elements needed to conduct activities and they establish the main source of costs. These include all direct and indirect production resources. Resources, as can be seen in the example given in Figure 3.5, represent the costs of indirect resources that posses the characteristic of supporting the production and that mostly take place in production costs. Because there is no need for resources such as raw materials and direct labor to

go through the two-stage procedure. Normally “Resources” include all cost elements, but in two-stage procedure they only include indirect costs necessary for production.

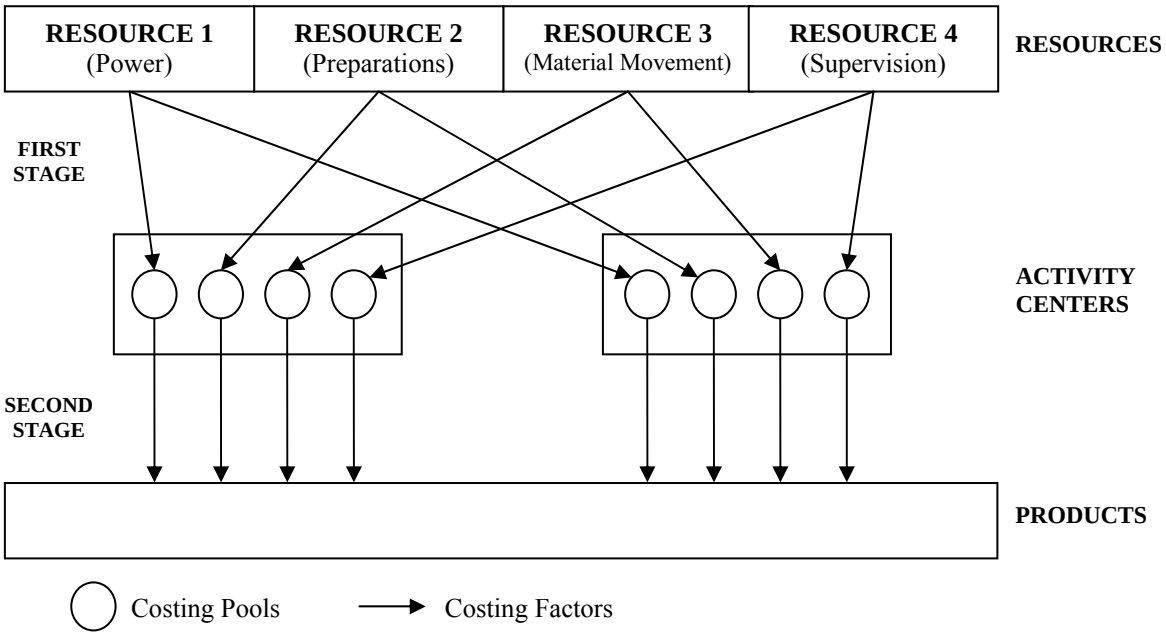

Figure 3.6 Conceptual structure of activity based costing system

ABC systems that provide separation of resources can create problems in evaluation of the details while rendering the activities more detailed. Bringing together or separating the relevant ledger account, will cause the indication or loss of the differences that can be seen in the production process. This will make it easier or harder to comment on the costs of some activities. Therefore, determining resource categories accurately is the first important step to take to get right answers from the system (Lere, 2000).

3.3.2.1.2 Determining Resource Drivers. In ABC method, the second step is determining resource drivers. Resource drivers are used to create a link between resources and resource costs to determine the activity costs. In short, resource drivers are elements used in distributing resource costs to activities (Lee & Kao, 2001).

Resource drivers can be defined as parameters that show the amount of resource consumed by an activity. Therefore, all parameters that create a linkage between cost

resources and activities can be used as resource drivers, such as meter square, kilowatt, labor hour, machine time and number of light bulbs. In Table 3.4 there are some examples of resource drivers that can be used with some resource costs consumed by activities (Baird et al., 2004, p.389).

Table 3.4 Some resource drivers that can be used in distributing resource costs to the activities

RESOURCE	RESOURCE DRIVERS
Salaries	The time percentage spent by employee on each activity
Rent	Factory area used by each activity
Equipment Depreciation	Machine time used for each activity
Energy	Kilowatt per hour consumed by each activity

There is a need for a resource driver in order to assign the cost used to activities in conducting the activities. However, for an accurate product cost evaluation a right relationship has to be set between resources and activities. Because the structure and size of the error done in determining the costs can be caused by the distribution parameters used in the first level. In this case, determining resource drivers by taking into consideration the following will be a better approach (Doğan, 1996).

- After studying how resources are assigned to activities, cost monitoring should be done relying on the most appropriate driver.
- If resources are being assigned to many activities, costs can be directly assigned to product cost. For example, some of the plant-level activity costs can not be linked to an activity. In this case, costs can be assigned directly to products and consumers.
- In the case that evaluation of resource usage is not practical or is too costly, resource costs can be directly assigned to product cost.
- If the resource cost value is too low to be considered, also that can be directly assigned to product cost.

3.3.2.1.3 Monitoring Costs with Activity Centers and Cost Pools. ABC should organize the activities in a meaningful way like in organizational charts of businesses. The most common approach used for this purpose is to group activities by activity centers. Activity centers formed by bringing together related activities (in a certain department) represent an activities cluster.

Activity centers take place indirectly in distributing costs to the products. Initially, cost pools are being defined and cost factors are being determined and later on cost flow is being done from resources to cost pools and to products. Since establishment of cost pools are made possible by distributing each resource between activity centers, activity centers have an important role in ABC system. In other words, in every activity center, there will be only one cost pool for each resource. Activity centers have an important role also in evaluation of cost information by the ones who use the information gathered from ABC (Doğan, 1996).

In Figure 3.1 all quality control activities of the business are considered as one activity center and this center is named as Quality Control Activity Center. Packaging, warranty and production control activity groups in this activity center can be defined as cost pools.

Since there will be a resource consumption for each activity located in the Quality Control Activity Center, separate activity groups (cost pools) will be needed in distributing resource costs to activities.

Resource drivers need to be used to monitor resource costs with activity center and cost pools. Resource drivers plan the cost of the cost pools and determine the resource cost amount set for each pool. In Figure 3.7, the flow of Quality Control Department's of Quality Control Activity Center salaries to department activities in a production business (Çavuşoğulları, 2003, p.78).

In this example, resource is the salaries of Quality Control Department. Activities are input control, output control and safety class. The time percentage of personnel

for each activity of the Quality Control Department has been set as resource driver. However, many resource drivers can be used in distributing resource cost to cost pools. In the example time percentage of the worker has been chosen as a resource driver but also the number of personnel doing each activity could also have been chosen.

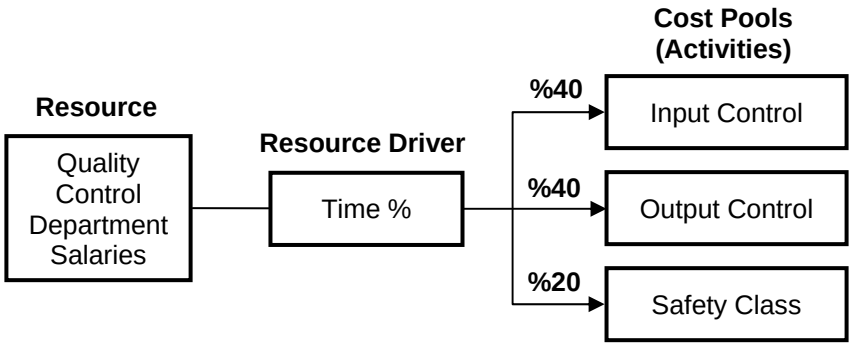

Figure 3.7 Monitoring resource costs with activity center and cost pools

If we consider salaries as the resource of warranty department only, it will be very easy to calculate the cost of department activities. According to this, sum of the quality control department's salaries is 1.000 YTL. Cost of each activity will be given as below when resource amount (salaries) are multiplied with resource driver (time percentage).

These costs are related with activities of Quality Control Department established in Quality Control Activity Center and therefore with the cost pool. However, in practice, it is very rare to have only one resource and resource driver. It is highly possible that Quality Control Department of a big organization will use many resources and resource drivers. In this case total activity cost will be determined by distributing each resource cost to the relevant department activities by using an appropriate resource driver.

In the first level activity costs are determined as explained above, then costs gathered in cost pools are assigned to product and consumer costs using appropriate cost drivers.

3.3.2.2 Operations Concerning The Second Level

In the second level, choosing the necessary cost drivers for distribution of activity costs and distributing activity costs to products and consumers by using these cost drivers will be done.

3.3.2.2.1 Determining Cost Drivers. The first operation to be done in the second level is to determine appropriate cost drivers to provide the distribution of the activity costs gathered in activity centers and cost pools to products and consumers. In this case cost drivers are also called activity drivers.

Cost drivers are one of the most important elements of this method. Because successful application of ABC method depends on choosing and using cost drivers. At this point this system differs from the traditional methods (Shapiro, 1999).

Cost drivers should be chosen carefully in order to determine product and consumer costs accurately. While choosing a cost driver for an activity center, it should be made sure that cost driver evaluates the activities actively consumed by products and consumers. Unless a link between cost driver and active activity consumption, the situation of wrong costing will be faced (Ben-Arieh & Qian, 2003).

In this way in determining cost drivers, the following shall be taken into consideration.

- Creating a linkage between activity costs and products and consumers,
- Ease of gathering the data linked with cost driver ,
- Choosing cost drivers that have minimum evaluation cost,
- The evaluation scale of the cost driver in products' and consumers' active activity consumption,
- Reducing the number of rarely used cost drivers to minimum,

- Choosing cost drivers that encourage the development of performance,
- Paying attention to not choosing cost drivers that require new evaluations.

By taking into consideration the elements mentioned above; cost drivers to be used for ABC can be divided into two groups as duration and transaction drivers. Transaction drivers assume the same amount of a resource is used every time an activity is performed. Typical transaction drivers include number of setups, number of receipts and orders. Duration drivers are slightly more expensive than transaction drivers to measure and record, but deliver more accurate results. Duration drivers are used when significant variation exists between the amounts of an activity required for different cost objects. For example, some setups take 10-15 minutes, while others take 6 hours. Use of the number of setups (a transaction driver) would distort the costs, as a 15 minute setup would cost the same as a 6 hour setup (Beck & Nowak, 2000, p.2049).

An effective data gathering method should be developed in order to render ABC usable. Businesses with access to high technology have a different advantage in gathering data. Because they can keep track of time lengths of the activities and how many times they have been done by creating large information net related to each step of the production process with the help of the computers that control their systems.

In determining cost drivers, it is important in what levels (unit level, party level, product level) the consumers and products consume the activities. Since, the cost drivers will vary according to the varying activity levels.

3.3.2.2.2 Distributions of Costs to Consumers and Products. Outputs of the accounting system differ according to activity areas of businesses. These outputs, also called accounting subjects, can be products, services, consumers, projects or work units.

The last operation of the distribution system used in ABC and therefore the last step of the second step is distribution of costs to consumers and products. Activity costs are assigned to consumers and products via cost drivers.

In the example shown in Figure 3.8 distribution of costs of a cost pool of Warranty Department of Quality Control Activity Center to products is given (Çavuşoğullari, 2003, p.79).

In the example, control activity of Warranty Department was taken as a vase and control number has been determined as the cost driver. If we assume that there is only one resource cost (department salaries) for control activities, cost of 400.000TL will be assigned to the products as given below.

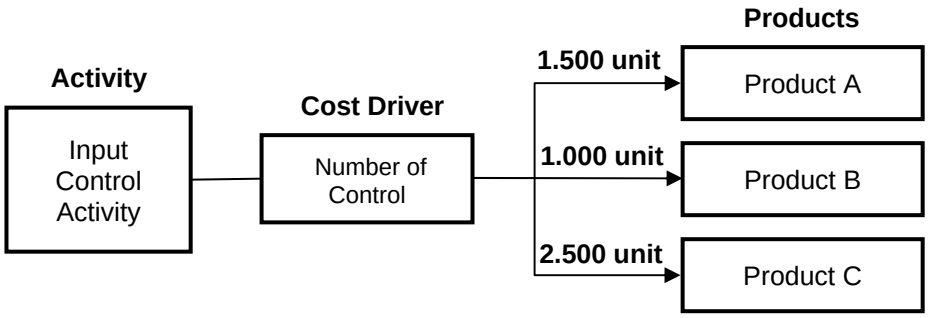

Figure 3.8 Distributions of costs to the products

For this example distribution process was done by using only one resource cost and one activity. Even in the simplest ABC application there are 5 to 10 resources and 25 or more activities and a couple of products. Additionally since there will be many cost drivers for calculation system will become more complicated. Therefore, in ABC applications it is wise to use computers. With the pack programs to be prepared, the difficulty and complexity of using this method will be eliminated.

3.3.3 The Need for A New Accounting Method

In ABC method many cost drivers are being used and determining these can be very costly for the business. The benefit that will be provided by using distribution elements can be inadequate in affording the cost of gathering information on these keys. In other words, the cost of using a new costing method in a business can be too high that it can annul the benefits of the system. Additionally making a decision on when a new method can be necessary is also of great importance for appropriate costing (Doğan, 1996).

There various factors in determining whether the benefit of ABC method will exceed its costs or not. However the three factors given below can be initially taken into consideration in evaluating the pros and cons of a new method.

- The structure of the information system that the company posses,
- Costs of possible errors,
- Product variety of the business.

Optimum costing system concept can be used to understand the effect and importance of these three factors in determining whether using a new costing method would be appropriate or not. Optimum costing system is an approach that minimizes measurement and error costs. Measurement costs, are costs concerning the measurements made to gather the information that the system requires. Error costs are the costs that wrong information will cost when wrong business decisions are made based on wrong costing information. In optimum costing system there is a negative relationship between these two costs.

While simple costing systems determine low product costs that are hardly right with less measurement costs, they will have rather high error costs. In this case to be able to make efficient and effective decisions, it is necessary to have complex and detailed costing methods. However also this has a cost. The total

cost of a new costing system will include also the following (Gupta & Gunasekaran, 2005):

- Providing management's support for a new system,
- Establishing a team to design the system,
- Designing and realizing the new system,
- Attaching the new system to other information systems of the business,
- Forming a team to run the new system.

Along with the error and measurement costs, some costs that can appear in the process of initiating a new system can create an obstacle for the eligibility of the system. In this point optimizing these costs is of great importance. If the costs of introducing ABC can be afforded with benefits provided in the long-term, then this method will be a must for businesses.

3.4 The Characteristics of The Businesses That Will Use ABC System

Costing systems are developed to provide the cost information that production businesses need. There is not one costing system that is appropriate for every business. Because businesses need different cost information because of their production processes, product structure, technology they use and information the management requires. Therefore the question whether ABC will contribute to the business or not should be evaluated thoroughly.

ABC is a system that is used both for industrial businesses and service businesses. The first ABC applications were seen in industrial businesses and also in service businesses. There are some examples of using ABC for only one part of the businesses. The differences of production types of industrial businesses do not create an obstacle. Since, ABC is a wide-scoped costing system. Businesses that use order or phase costing system can use ABC as a part of their own systems. Since ABC is not directly related to the production type or cost amount used, it can be used with all costing systems.

Businesses whose indirect manufacturing costs have a large proportion in total production costs should consider using ABC. If personnel and managers who work in production area do not trust in their current costing accounting system, they too should try ABC as a costing system approach. Firms having many products and cost factors should think of using ABC. Businesses that use computer technology at least in production and/or management information system can use ABC. Additionally ABC is also advantageous for the firms who have some or all of the characteristics mentioned below (Cagwin & Bouwman, 2002):

- High indirect manufacturing costs,
- The main proportion in indirect manufacturing costs is not of costs that are related with the production amount,
- Automation has gained importance,
- The variety in production activities,
- Wide product range.
- Lack of trust to the current costing system,
- High preparation costs,
- Differences that have occurred in time are not reflected to the accounting system,
- No use of high computer technology.

The most important characteristics of the businesses that can use ABC are complexity and diversity. Complexity increases the indirect manufacturing cost and the possibility of wrong costing. At this point ABC provides right and realistic information.

Diversity in products or volumes increases the value of ABC. If there are products with different designs in the product line, these require different activities and their costs also differ. ABC does distribution taking into account the effect of diversity on costs. If products differ in production amounts, traditional system gives higher costs to products of high volumes and fewer costs

to the products with lower volumes. If differences in volumes are important the error possibility in costing will increase. In these cases using ABC is necessary.

3.5 Advantages of Activity Based Costing System

Having comparative advantage and modern production thought provides businesses with continuous improvement. Main objectives of continuous improvement are eliminating waste, decreasing the time length of total production, increasing quality standards and worker efficiency and lowering costs. To achieve these managers should have the necessary information on product costs. Since right cost information will reduce the number of wrong decisions (Baird et al., 2004).

Traditional costing methods can provide very limited information on continuous improvement in new production mediums. And this costing information is inadequate for encouraging managers to implement new strategies to improve production. This situation results from the fact that traditional costing methods can not assign the increasing indirect manufacturing costs accurately in new production mediums and therefore can nor provide right product cost information (Rouse & Putterill, 2000).

ABC has been developed to fill this information gap and can provide the necessary information in continuous improvement of production activities. This method, assigns costs by using activities consumed in the step of distributing indirect costs to products and consumers. Activities of products and consumers ensure right and realistic cost information by using the assumption activities too consume resources. According to this, advantages of ABC system are given below (Doğan, 1996):

- It provides better calculation of product cost by distributing indirect costs that occur in new production mediums and that are no related to production amount more accurately.

- With the cost information it provides, helps realistic calculation of product profits and help in determining product mix.
- Helps management to make better decisions in the global competitive arena
- Helps businesses in focusing on activities that provide added value.
- Facilitates management decisions such as pricing and stopping production of certain products in businesses that produce more than one product.
- Helps developing new performance measurements for the aim of continuous improvement.
- Provides an effective cost management by analyzing the activities of the business and the costs of these activities.
- Supports cost lowering efforts by showing each item separately in indirect costs.
- Gives flexibility to the system in a way that it can adapt to new production mediums.

ABC has another benefit that can not be seen directly which is all workers, technical personnel, managers and accountants work together in establishing and implementing the system. Information provided by ABC creates a common language that everyone understands within the business. As a result, cost information of the business will become understandable for all personnel. Additionally having employees contribution will be important in developing the system (Tatsiopoulos & Panayiotou, 2000).

3.6 Criticism Towards ABC System

There are some criticisms made towards this system. These are given below:

The most common one is that it is costly to establish and implement this system. Designing and implementing a new costing method that has a different structure and that uses different data is an additional cost. Therefore the

advantages and benefits to be gained from a new costing method should be analyzed carefully.

A second criticism is that the system is very complex and it is hard to understand it. Because in this system there are many activities, costs of these activities and cost drivers that are used in distribution of these activities to products and consumers. In such an implementation there will be an increase in the number of analysis used in distributing the analysis. Since it is hard to comprehend, simple and easily understandable other costing methods are more proffered (Güner, 2002).

ABC is a traditional costing method with more cost drivers. In this method indirect production costs are assigned to products and costs via carious cost drivers. Monitoring direct costs are the same with the applications used in traditional costing methods. In this case, rather than developing a new costing method, improvement of the available method can be a solution. Using machine measurements along with direct labor in distributing indirect labor to products and consumers will be sufficient in satisfying the needs (Spedding & Sun, 1999).

Another criticism is that, despite ABC gives more accurate costing information, product prices are set in the market therefore there is not a need for such information. This view can be acceptable for some sectors. However it is a common fact that every business needs accurate costing.

Innes and Mitchel state that ABC system shows how products consume business resources in the past term but it does not indicate increasing costs (such as growth) or inevitable costs (such as stopping the production of a product) in the future (Clarke et al., 1999).

Sharp and Christensen also point out the same criticism as; “Activity Based Costing gives the right cost of a cost driver. Therefore also ABC carries the same deficiencies as all other costing approaches.” This deficiency is not being able to

show inevitable costs. Because it is stated that not all the resources that a cost driver uses are inevitable and therefore this leads us to wrong decisions. According to Sharp and Christensen, ABC should be analyzed with "inevitable cost" concept for the managerial decisions (Tsai & Kuo, 2004).

Here it is said that system uses active numbers of the past term and doesn't provide information on certain decision oriented costs. Using historical data will show the situation of the real activities and therefore it is beneficial. However it is possible to use also projected numbers. The criticism made on inevitable cost is only possible when there is resource consumption even if there is not a cost driver available. As a solution rearranging ABC so that it gives direct activity costs will be enough.

Woods point out that ABC is discussed with fixed and variable costs however it needs to be done an additional study on variable costs needed when making economic decisions. Additionally, he discusses that ABC shows some fixed costs as variable costs which will result with wrong decision making. However Wood also says that it is possible to solve these. He proposes to develop different costs for different objectives and organizational forms (Rouse & Putterill, 2000, p.368).

Despite all the criticism above, it can be seen that ABC is a very good costing system and it is becoming more widespread. It is possible to increase the advantages of ABC by conducting more detailed and careful studies. Success in implementation depends on the following three factors (Güner, 2002).

a) Knowing the structure and differences of ABC and creating a system to satisfy the needs of a business,
b) Knowing that ABC is not a perfect system that can provide all the information needed,
c) Knowing that every ABC system has some limits and if not designed and monitored carefully will not provide benefits to the business.

CHAPTER FOUR
AN APPLICATION IN A COMPANY IN AEROSPACE INDUSTRY

4.1 General Information on the Company

Turkey's first aircraft and engine factory has been established in Kayseri with the name TOMTAŞ on October 6, 1926, according to the agreement reached between Turkish Aircraft Society and German Junkers Aircraft Factory. The factory's activities have been terminated and the factory has been closed in 1928 because of the disagreements between TOMTAŞ and the government of the time.

In 1930, company's account has been stopped and the facility has been transferred to the National Defense Ministry. After 1933, according to the agreements reached with USA, Germany, Poland and England various types of aircrafts have been produced. From the year 1950, the factory's name has been changed into Air Supply Center in which the maintenance and repair of the propeller aircrafts of the Air Force Command were being conducted. Additionally overhaul and repair of motor vehicles, heavy duty machinery and ground support equipment of various types and repair and production of different kinds have been conducted.

Within the framework of REMO-II (Reorganization and Modernization) Project realized with USA, production capacity has been increased to a large extent through acquisition of counters and equipments utilized in overhaul and maintenance of motor vehicles, ground support equipment and weapons and in various production activities. In 1975, the factory's name has been changed into the 2nd Air Supply and Maintenance Center Command (ASMC).

4.1.1 Activity Field, Duties and Responsibilities of the Factory

The 2nd ASMC is one of the three Supply and Maintenance Centers of Air Logistics Command. The factory conducts its activities within the boundaries of Kayseri province of Turkey. The factory has premises in two different locations, one

of which is, being structured in the Centrum and having the duty of production activities and maintenance, repair and overhaul activities of various types of weapons and ground support equipment, Command Center. The other being located in the village of Erkilet is Aircraft FASBAT facilities where the maintenance, repair, overhaul, paint and calibration activities of aircraft, aircraft engine and aircraft equipments are done.

In the organizational chart shown in Figure 4.1, general condition and its own organizational structure of the 2nd ASMC, which is within the Air Force Logistics System is shown.

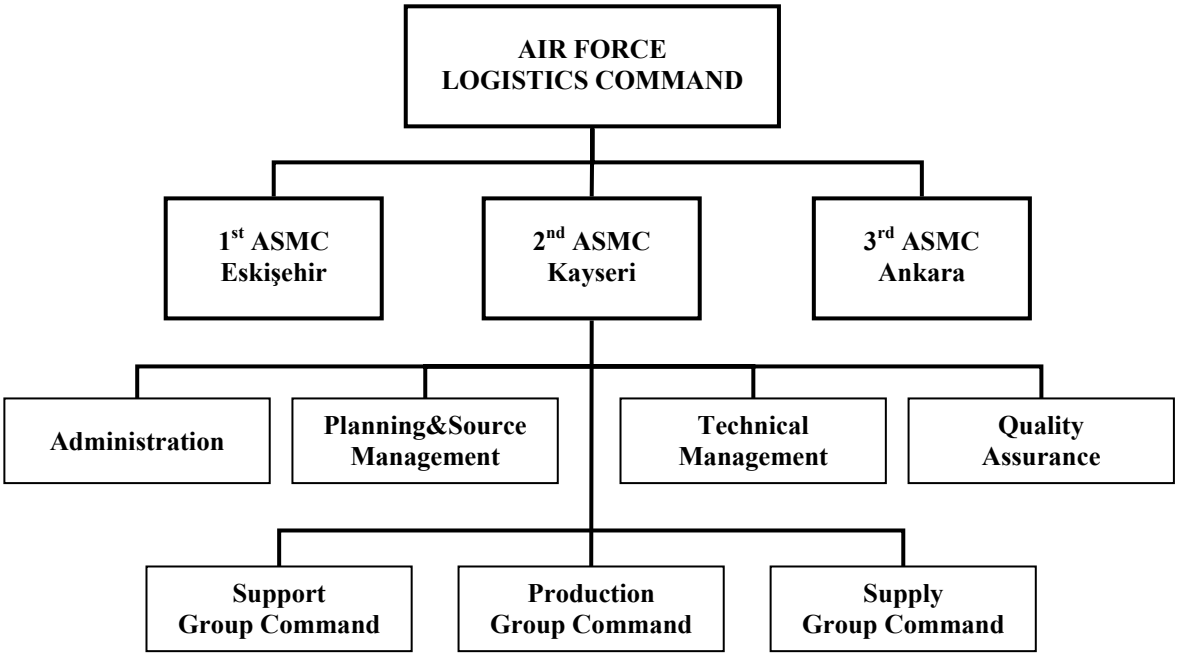

Figure 4.1 Air Force logistics system and the 2nd ASMC organizational chart

The 2nd ASMC is an institution providing services of international standards, principally satisfying the needs of Air Force Command and having the NATO AQAP-2110 and TS-EN-ISO 9001 (2000) quality assurance certificates and also having the authority to do the maintenance of the JAR-145 civil aviation Aircrafts. And also calibration laboratory is certificated by US Air Force Command AFMETCAL organization.

The factory has various duties and responsibilities on supporting the Air Force Command from the Logistics point of view. These are generally given below;

- **Depot Level Maintenance** for aircraft, engines, avionics and accessories, and ground support equipment.
- **Manufacturing** of spare parts, systems and units of aerospace requirements, support equipment.
- **Technical Management Responsibility** of selected weapon systems, aerospace equipment, ground support equipment.
- **Material Supply Functions** for more than 250.000 items.

As of 2006 1.630 employees, 300 of them being managers, 130 of them being engineers and 1.200 of them being workers, are working in the factory.

4.1.2 Production Method and Product Range

The 2nd ASMC is conducting its activities according to a production model based on orders. In the manufacturing department, discrete type mass production and assembly type production are being applied depending on the product structure and the amounts needed. In Aircraft FASBAT and Ground System departments, jobshop and discrete type productions are being used. In the production catalogue of the factory there are over 14.500 and in the repair catalogue there are over 6.400 pieces. Accordingly the product range of the factory is given below:

- **Depot Level Maintenance** (Depot level maintenance, repair and modification of transport, training and specific mission aircrafts),
- **Aircraft Painting and Corrosion Control** (Aircraft painting jobshop, which utilizes polyurethane, water-based, and baking oven painting techniques, maintains mechanical and chemical paint and corrosion removal and repainting activities.),
- **Aircraft Accessories Overhaul**
  - Tests and inspections of electronic, communication and navigation systems,

instruments and auxiliary elements

- Maintenance and repair of all propeller and jet aircraft non-inertial type gyroscope
- Maintenance, repair, overhaul, balancing and testing of all kinds of propollers
- Maintenance, repair, overhaul and test of all electricityal systems and units of propeller aircraft and some units of jet aircraft
- Maintenance, repair, overhaul and test of all hydraulic, pneumatic and mechanical systems of propeller aircraft and some units of jet
- Maintenance, repair, overhaul and test of all kinds of aircraft oil and fuel systems

- **Radome Repair & Test** (Radom test laboratory performs electromagnetic permeability test of aircraft nose radomes.),
- **NDI Capabilities** (Fluorescent Penetrant Inspection, Magnetic Particle Inspection, Eddy Current Testing, Ultrasonic Inspection, Radiographic (X-Ray) Inspection),
- **Aircraft Engine Overhaul** (Engine overhaul jobshop performs depot level maintenance and repair of piston engines.),
- **Calibration Activities** (Calibration of electronic and mechanic testing equipments),
- **Ground Systems Overhaul & Repair** (Weapon Systems, Ground Support Equipment, Power Supply Systems, Vehicle & Heavy Duty Machinery),
- **Manufacturing Capabilities**
  - Aircraft Spare Parts (O-rings, Structural / Sheet metal / Mechanical Parts)
  - Systems & Units for Aerospace Requirements,
  - Ground Support Equipment (MHU-12 Bomb Handling Trailer, Airfield Lighting Weaponatures, Cargo Loading Pallets, Rigid Radoms & Towers For Ground Radars),
  - Parachutes (Personnel, Pilot, Drag, Cargo and Sorts Chutes),
  - Helmets,
  - Ballistic Vests.

4.1.3 Factory Management and Development System (FMDS)

Factory Management and Development System (FMDS) is a Project initiated in the 1980s to establish a management system based on know-how and automation to the Air Supply and Maintenance Center Commands by the Air Force Command. The Project has been started by USA, however in the ongoing process it has been completed by University of Ege. This system is the commonly used ERP system adapted to Air Supply and Maintenance Center Commands. System is composed of eight modules in total.

Table 4.1 Factory management and development system modules

FMDS MODULES	
Work Plans	Material Control
Workload	Cost and Budgeting
Programming	Development and Analysis
Work Monitoring	General Applications

The modules mentioned in Table 4.1 are working in coordination with each other and modules such as “Cost and Budgeting” and “Development and Analysis” are in great integration with the other modules because of the nature of the information they provide. There are defined users for each module. The user entering data to the fields related with the module under his/her responsibility have only the authority to view other screens. He/she cannot perform any operation related to modules other than the ones under of his/her responsibility.

Costing system consists of the integration of sub modules. In these modules, information on expenses on seven items creating costs, man/hour expenses, material histories, factory inventory and work done in jobshops are being gathered in data pools. This raw information is being transformed into the structure used in cost calculations by the batch programs utilized. Cost module calculates the operating unit costs through the use of this processed information.

In the Cost and Budgeting module, operating unit costs are being determined with the periodically conducted calculations. Additionally every year, 3-year budgets are being prepared by using the cost information of the past year and a comparison between the planned and the actual costs is being done.

4.2 Current Cost Accounting System

When we look at the cost structure of the company, the fact that labor costs make up a significant part of the production costs can be seen. However when the cost drivers are considered, direct raw material cost and direct labor cost are calculated according to labor.

Direct raw material cost is the cost of the raw material used directly in the product and is being calculated directly for each product. Direct labor cost is a criterion used in assignment of the production and management costs except the direct raw material of products.

With the explanations below, the general operation function of current cost calculation and budget prediction system has been expressed. By taking into consideration these explanations, when all the aforementioned calculations are analyzed in detail, we see that there are seven main cost factors and there are sub cost items belonging to these affecting operating unit costs.

4.2.1 The Philosophy of Current Cost Accounting System

When calculating costs the smallest calculation unit to be considered is jobshop. Each organization unit in the factory is compromised of its sub units and these sub-units are called jobshops. In calculating Operating Unit Costs of all organization units, seven cost factors and values of these factors are being used. However for every jobshop, these seven cost items have not been formed.

Direct labor and direct and indirect material costs can only be seen in the jobshops

where production takes place. Indirect labor, depreciation, general and factory management costs can be seen in the entire unit throughout the factory. All the expenses of the jobshops in which direct labor is not being used should be assigned to the jobshops using direct labor through operation steps of cost allocation process, because cost calculations are being made only for the jobshops using direct labor. Operating unit costs of these items are being calculated by dividing each operating cost item of a jobshop by the total Logistics man hour of the factory. Direct material cost is being considered as a separate item in calculation.

Man hour is the most critical cost driver used in cost accounting. There are two types of direct man hour used in the factory. While Logistics man hour contains man hour values used in activities of Logistics system by the factory, "factory support" expresses the man hour values utilized in the factory jobs. In determining the wages of the personnel and man hour usage ratios, total man hour values are taken into consideration. However in calculating operating unit cost, hourly cost value can be seen and in the denominator Logistics man hour use values are present.

Since the factory is both a unit of the military and an institution operating in defense industry sector, it contains various types and classes of personnel (officer, noncommissioned officer, clerk, worker etc.). This (the fact that the factory has two different structures) brings some changes in classifying the personnel expenses and cost calculations. In the jobshops in which production is done labor costs are shown in direct and indirect labor accounts. Personnel costs of units providing support to production activities on quality, planning, engineering and units giving supply services are in the factory item and personnel costs of factory management and other managerial units are in the general administration item. The parts determined by supporting production, of the costs of the units providing security and supply services are being a part of the cost calculations.

There are material plans of each product to be produced or repaired. During production all the materials in these plans and during the repair process the materials needed are being used. All the material usage is being recorded according to the FMDS

modules, job orders and jobshops. Material costs in jobshop terms are calculated by utilizing the cost module.

Indirect material costs are determined in organization terms. This cost item can be seen only in the jobshops doing production. This cost being taken as periodic total value is being allocated according to the personnel number working in the jobshops.

Depreciation costs can be analyzed under two groups, namely; machine/equipment and building/facility. These depreciation costs of the producing jobshops are being assigned to the cost accounts by jobshop code; the depreciation cost of the jobshops supporting production is being gathered in general administration and factory management costs and being reflected to the producing jobshops through the use of cost drivers.

Factory continuation costs are all the costs except the labor, depreciation and material costs of the factory. These costs are being hold in the factory management costs account.

4.2.1.1 Calculation of Production Cost

In this section, using the Cost and Budgeting module of the FMDS, information will be given on the calculation of production cost and budgeting.

4.2.1.1.1 Cost Parameters. Cost parameter can be analyzed in two groups; main account types and sub account numbers.

a) Account Types: Are main account items mentioned in the account plan. They are held monthly on organization unit level. Accordingly account types;

- Direct Labor Expense (A),
- Indirect Labor Expense (B),

- Direct Material Expense (C),
- Indirect Material Expense (D),
- Depreciation (E),
- General Administration Expense (F),
- Factory Management Expense (G).

b) Account Numbers: Are sub account numbers that take place under the main account type. These are;

- Basic Labor Salary (1),
- Officer, Noncommissioned Officer, and Clerk Salary (2),
- Overtime, Vacation Salary and Premium (3),
- Social Support (4)
- Officer, Noncommissioned Officer, and Clerk Social Support (5),
- Travel Allowance (6),
- Damages and Prize (7),
- Machine/equipment Depreciation (8),
- Building/facility Depreciation (9)

4.2.1.1.2 Calculation of Costs. Is the operation of calculating the ratio of each jobshop from factory costs (These costs are calculated by using information on finance-accounting department, factory inventory, work monitoring module and materials history.). The assignments of costs are done according to the ratio of man hour spent or number of personnel working in the jobshops. Calculating the costs has four levels.

a) Calculating Labor Costs: Labor costs are gathered as a whole for the entire factory and are calculated according to the payroll information prepared in personnel terms. Costs taken in factory terms are entered into direct or indirect labor costs account depending on the direct/indirect worker ratios. The fact that personnel are direct or indirect can be understood by checking the duty code.

b) Calculating Material Costs: Direct material costs are calculated by using material usage history (with material usage amount and material's price on that day) formed during the material control level. In indirect material costs however, the total price of all the materials, which leave the warehouse in a certain period, is calculated. The jobshops using the warehouse are detected and costs are allocated to these jobshops according to direct man hour ratio.

c) Calculating Depreciation Costs: Depreciation costs are divided into two groups being as machine and building depreciation. Building depreciation is calculated by taking into consideration the value and the physical life of the building. Later this value is added to the depreciation account of the jobshops according to the total area ratio that each jobshop uses. Machine depreciation is calculated according to the value and physical life of the machine and is added to the depreciation cost of the jobshop that has the machine.

d) Calculating Other Costs: Contains all costs other than labor, depreciation and material costs of the factory.

4.2.1.1.3 Calculation of Operating Unit Cost. Operating unit cost is the cost of man hour work of a jobshop. Operating unit cost is calculated only for units that use direct labor and their upper organizations. There can be no other unit under a unit that utilizes direct labor. The costs of the units not using direct labor are transferred into units using direct labor within the organization. If direct labor is used in none of the units of a sub organization, in this case costs will be transferred to an upper management.

For monthly cost and man hour fluctuations to not affect unit costs, costs and man hours belonging to a past year is utilized in calculations. Calculation of operating unit costs is done in two steps:

a) Distribution of costs to jobshops: Starting from the units in the lowest level, costs of the units that do not utilize direct labor are transferred to the upper level. The process of transferring continues until finding a unit that uses direct labor.

Consequently if any one of the sub units does not use direct labor, the costs of this unit are carried up to the organization unit level.

Since operating unit costs should be calculated only for jobshops using direct labor, intermediate level units' costs should also be allocated to the units that utilize direct labor. Assignment of costs of high units to sub units is done starting from Production Group Command to the lowest units using direct labor according to the direct labor ratio each jobshop uses. Upon completion of this operation, all costs of the factory are transferred to the producing jobshops according to the ratio of their production.

b) Calculation of operating unit cost: Operating unit cost of the jobshop is calculated through dividing the total factory costs distributed to the jobshops using Logistics man hour spent in the jobshop. This cost calculation is done for each of the seven main accounts in the account plan of all jobshops.

4.2.1.1.4 Calculation of Production Costs. Production costs can be calculated in terms of job order, production number and family. To calculate the cost of a job order, the man hour that the job order uses in each jobshop is multiplied with the unit cost of the related jobshop and the price of the materials used by the job order is added to this arithmetical operation. Cost calculating in terms of production number is the operation of calculating the average costs of all job orders under a certain production number. In calculation in terms of family, direct man hour that job orders which comply with family definition use in the jobshops is multiplied with amount produced from that family and jobshop operating unit cost and total material costs relating to the operation is added to this value.

4.2.2 Problems of the Current Cost Accounting

The factory being a governmental institution is also producing military products being affiliated to a military unit. Because less dependency on other countries and continuous activity of operations and therefore weapon systems are desired, "no matter what" point of view can be seen as an acceptable cause in the national security field.

This fact is postponing the need for a healthier cost calculating and therefore the necessary adjustment cannot be made. To be able to make the necessary adjustments, Air Force Logistics Command has to give consent and software should be changed in FMDS. The same changes should be done also in the factories in other cities (Ankara, and Eskişehir) and common cost calculation criterion should be set in order to provide uniformity.

When the current cost calculation module and accounting system is analyzed, costs are seen to be high. It has been seen that there are some elements causing this situation. These elements and their effects on cost accounts are as follows;

- **Logistics Man Hour:** The man hour expenses of the factory are classified depending on the type of jobs conducted. According to this, man hour spent for Logistics system needs in a certain period is called "Logistics" and man hour spent for factory Works in a certain period is called "factory support". In the cost calculations done periodically and annually, all the expenses of the factory are being calculated only by dividing Logistics man hour value. In this case man hours spent for factory support are being ruled out of the calculation. This causes the operating unit costs to be higher than expected.
- **Garrison Command:** The 2nd ASMC also has the duty of being Kayseri Province Garrison Command. Expenses done in this context are also reflected to the expense items of the factory and therefore operating unit costs come out to be high.
- **Personnel Salaries:** Since the factory is a governmental institution and since aviation sector is dependent on experienced work force, the worker has a high average service period. This causes the fees and allowances to be high also. This also reflects to the operating unit costs.
- **Depreciation:** In the analysis conducted, it has been seen that the information on building and facility depreciation of the factory has not been updated for a long time. Therefore depreciation expenses cannot be calculated properly.
- **Cost and Budgeting Module:** It has been seen that batch programs have problems in processing raw information taken from the data pools. As a result

of this, the fact that some cost values of the jobshops using direct labor that should have been formed, have not been formed has been detected. These problems in cost accounts cause the production costs and budgets to be calculated incorrectly.

- **Jobshop Codes:** There some situations in which some personnel are not actually working in the jobshop where they are registered in. Therefore there are some dissonances between the number of personnel registered in a jobshop and the number of personnel working in that jobshop. Current cost calculations are done according to the registered personnel information. This causes deviations in operating unit costs of the jobshops and errors in the analysis and evaluations to be made.
- **Direct Labor Expenses:** Some account numbers belonging to direct labor costs (compensation, premium, temporary duty, social support, and overtime) are reflected to direct labor costs but instead, they should have been shown as an indirect cost component. As a result direct labor costs have increased and indirect labor costs have fallen.
- **Single Shift:** It is possible to utilize three-shift system in factory in terms of facility and equipment. However because the factory is a not-for profit organization and because of a decision of National Defense Ministry the factory is working with a single shift. This too, is one of the main reasons why the costs come out to be this high.
- **Direct/Indirect Worker:** Because of the confusion in the definitions of direct and indirect workers provided by Air Force Command and National Defense Ministry, direct and indirect labor costs cannot be properly reflected. However here, error margin is very narrow.
- **Entering Data to the System:** One of the main factors that make each module in the FMDS system provide correct results is entering the data to the system correctly. This situation applies also for the cost and budget module. These values are reflecting to the operating costs both directly and indirectly.

4.3 Application of Activity Based Costing System

As a result of the analysis and evaluations done, the applicability of the new costing system to the 2nd ASMC was researched and the limit of the application has been detected. The factors given below have been used in deciding on using ABC method.

Product Range: The 2nd ASMC's production department consists of Production unit in which numerous products and spare parts are being produced and Aircraft FASBAT and Ground Systems units in which maintenance, repair and overhaul activities are being conducted. Every year an average of 2500 types of products are being produced. While some jobshops support a machine abundant production, some other jobshops utilize labor abundant production approach. In other units job-shop type production approach is being used. According to this, the jobshops in the production unit is the most suitable application field of the new cost method both from the production range point of view and from the production processes point of view.

Production Technology: When the structure of the production environment is analyzed it can be seen that computer controlled CNC machines are being used along with classical machines. Especially in military field and in aviation sector there is a great need of sensitive and high quality products. In workforce based jobshop, experienced and specialist technical personnel works. As a result, the production environment of Air Supply Maintanance Centers is thought to be suitable for Activity Based Costing System because of the technology used and the different production processes for each product and various resources that are used.

Cost Structure: In spite of the fact that the production environment of the 2nd ASMC is machinery abundant, whether the costing structure changes accordingly and the elements predominant in the production costs were analyzed. It has been seen that indirect costs have a large proportion and the direct labor costs are losing their importance. Indirect production costs are 3-4 times bigger than direct labor costs and the effect of the fact that the production is technology abundant on this proportion is not clear. Although technology has a role in the increase of indirect costs, when the

special structure of the company is considered, we see that there are other factors, mentioned before, are affecting this increase. Also the increasing importance of the indirect manufacturing costs within the cost structure is solidifying the idea to try ABC system as a solution.

Lack of Confidence to the Current System: In the 2nd ASMC at the end of each production period, Operating Unit Costs are being calculated by using records belonging to the last one year. Comparisons are being made between the cost values obtained as a result of the calculations and same period of the past years and averages belonging to those years. Values deviating largely from the averages are being analyzed and the reasons of the deviation are being researched. According to the studies made, it has been seen that these deviations are caused from incorrect cost calculations, in other words "Cost and Budgeting module and the current cost accounting system does not give accurate results.

4.3.1 The Context and Limits of the Application

Since it is not possible or suitable to apply the new system in all the production units of the factory, the application should be limited. Additionally keeping the context limited in an application that can be considered as a trial will be more suitable to be able to do proper analysis and evaluations. Other initial applications of ABC done in other countries have also been limited to certain parts of companies and later on the application which is used used for the entire company. This is the approach widely accepted by the researchers.

Limiting the application in the terms of context also means narrowing the cost elements. From this point of view, assuming that the current cost accounting system does not have a major problem in main costs (direct labor and direct materials), it has been decided that these cost information shall be used directly. This way indirect production costs that make up the actual reason of the problem can be focused on and the difference of ABC with respect to the current system will be seen more clearly. Therefore, the context of the application has been narrowed in terms of cost elements

and indirect production costs have been focused on. However in the researches conducted, it has been seen that some indirect expenses such as compensation, premium, and social support have also been included in direct labor expenses. In application of the new costing method, this mistake has been corrected.

Limiting the application by activity area is done by deciding on one unit from the production lines or from the production centers. As mentioned above production jobshops are the most suitable ones for the ABC system. In these jobshops while there are different types of machines for production, each machine is being used in different amounts for each product. Additionally for each product, different activities are being consumed and different flows of activities are being seen. In this case allocating indirect costs to products is of great importance. Therefore production jobshops have been chosen as the field of application. So that implementation is limited by products.

In manufacturing department, each product being produced has a standard production time depending on the production process. These times do not change unless changes are made in the production process or technology. In other two departments (Aircraft FASBAT and Ground Systems) maintenance, repair and overhaul activities are being conducted. These activities too, have standard duration. However some it has been seen that variations may occur because of some problems.

The most important limit of the application is that the factory is a military company and therefore the results of the current application cannot be reflected to operations accurately. Therefore rather than focusing on quantitative results we have handled evaluations of these results and application steps. Additionally, all calculations have been made by eliminating the problems mentioned above.

4.3.2 Application Periods

ABC needs more and more detailed information when compared to the traditional systems in terms of structure and context. For the application to be realized correctly, the study period has been divided into two periods: “preparation and application”.

These periods are handled in detail below.

a) Preparation period: It is the establishment step of the system. It is the most critical and important process of the study since the system is being designed in this period. Operation steps of ABC including providing information to managers constitute the main philosophy of the system. Determining the limits of the application and cost calculation has been resulted in this period.

While structuring ABC, it has to be decided whether this is going to be done as a part of the current cost accounting system or as a totally separate system. Since the application done in the 2nd ASMC is a trial, it has been established as a separately working system than the current one as can be seen in many examples in the world. The information and documents about the system designed to work separately are issued separately of the official documents and records of the factory.

Secondly, it has been decided on the complexity of the new system. As the level of susceptibility of the information to be gathered increases, the establishment cost of the system will also rise. Therefore rather than establishing a complex system at first, it is better to create a simple system. However this simplicity level makes it possible to do a general evaluation of the system in terms of the results provided.

It has to be decided whether the cost information the system is to use are going to be past information or information related to the future costs. It is a fact that in our country actual costs are being used. Additionally to be able to do a comparison with the current cost accounting system of the factory, it will be more suitable to use past actual numbers.

b) Application period: This is the period in which the necessary information is gathered in the period after the structural establishment, costs are calculated and results are analyzed. In other words, the system designed in the preparation period is being applied.

4.4 Determination of Activities

The first step in ABC is “determination of the activities”. In this step the complexity and susceptibility of the system to be established is of great importance. In the explanations done before the fact that the application in the 2nd ASMC is not to be too complex but a simple one has been mentioned. This caused the number of activities to be kept limited.

The factory’s organizational structure and the workflow charts on the production process should be analyzed. Organizational chart provides important information especially on seeing task distribution in the factory and determining activity centers. Workflow charts on the other hand, helps in determining the production process and the activities of this process more accurately.

In the factory’s organization, departments and sub units of these departments are grouped according to their main duty areas. This facilitates determining activities and therefore creating activity centers.

4.4.1 Organizational Structure of the Factory

ASMC, being both a factory that does production (production, overhaul, and maintenance, repair) and a unit providing military service has a different organizational structure than industry companies. In this structure there are various units that have nothing to do with production. But according to the confidentiality principle of military units, the details of ASMC’s main sub units have not been given. In Figure 4.1 the factory’s general organization structure is shown.

Supply Group Command: Does the warehousing and distribution operations of all types of materials. Runs the unit equipment and support activities. Within the context of Contract Management activities, does market price research, options and supply and contacting services from government and private sectors for the authorized good and service. Does the warehousing, protection and maintenance of the ammunition it is in

charge of. Doing operations like counting, controling, document recording, record deleting and material analyzing.

Support Group Command: Provides security and protection services. Additionally, does the maintenance and repair of infrastructure, buildings and facilities and closed and green areas.

Production Group Command: Does the manufacturing activities of which is authorized and conducts the maintenance, repair, overhaul, painting etc activities of weapon systems. Additionally, it is in charge of engineering services, preparing works standards, transferring the annual and periodic production plans into monthly and less application plans, ordering materials and controlling the production.

Quality Assurance Presidency: It establishes, runs and develops systems to provide quality assurance of all the goods and services provided and supplied. Provides personnel support in order to participate system assurance and unit proficiency evaluations. It conducts unit and personnel qualifying activities and provides all types of laboratory services.

Technical Management Presidency: Gives engineering service to light, medium and special mission transporting aircrafts, training aircrafts, helicopter systems and ground systems. Additionally provides support also in configuration, project management and technical training. It does analysis and technical support in technical transmission, translation, preparing technical specifications.

Planning and Resource Management Presidency: Provides workload, material and financial resources planning service. It conducts the operation of system analysis and development, report and staff analysis and supports cost accounting and analysis services.

Administrative Management Presidency: Runs administrative activities such as civil and military personnel operations, all types of documents services and health and veterinary services.

The organizational units explained above are the ones supporting production directly or indirectly with the activities they conduct. Production Group Command is the general element of the factory and is the unit being in the center of the ABC application, therefore will be analyzed further.

4.4.2 Organizational Structure of Production Group Command

Production Group Command is divided into three sections (in Figure 4.2) according to the production activities. These are;

- Aircraft FASBAT Department which is in charge of maintenance, repair, overhaul and renovation of aircrafts, aircraft engines and accessories and calibration services,
- Manufacturing Department which provides all engineering services for production and produces the materials that it is assigned to,
- Ground Systems Department that conducts the operations of maintenance, repair, overhaul and renovation of ground support equipment, ground and air weapons, vehicles, heavy duty machinery and their accessories.

Since Aircraft FASBAT and Ground System Departments are not in the context of the application, they are not mentioned here. As cited before, application is limited to the products produced in jobshops of Manufacturing Department.

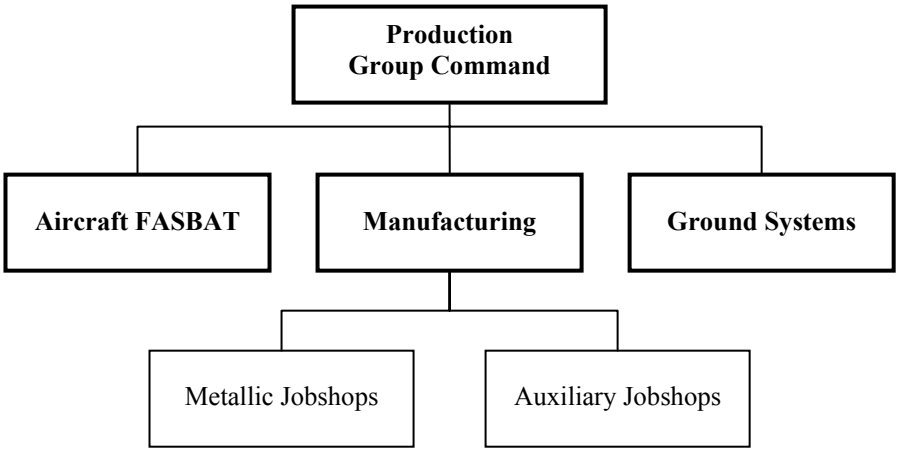

Figure 4.2 Organizational structure of production group command

Manufacturing Department is composed of two main jobshop groups called “metal jobshops” and “auxiliary jobshops”. Metal jobshops are jobshop groups that are linked manufacturing directly, which are lathe, milling machine, grinding, etc. Auxiliary jobshops on the other hand are the ones made up of supporting jobshops such as wood,

rubber, painting, and so on.

4.4.3 Activity Centers and Activities

The activities determined by using the organizational structure of ASMC and the duties and responsibilities of the units in this organization are given in the table below. Additionally to be able to keep track of the effects of the expenses in the factory on costs, centers of these activities have also been determined. Accordingly, main activity centers and activities for the ABC System are in Table 4.2.

The activities and activity center mentioned above have been determined by taking into consideration both main organizational structure and the duties and responsibilities of the main and sub units. Some activities have been unified while some others have been separated. As a result, through thinking cost drivers to be used the most realistic ABC structures to reflect the correct results have been created.

While the increased detail in the system increases the susceptibility in calculation, the process of calculation is being affected adversely. However using an extremely simplified cost calculation structure could be insufficient in meeting the needs. Therefore in this study we have tried to create a structure that has a certain level of details and facilitates the calculation.

4.5 Finding Activity Costs

4.5.1 Grouping Activity Costs

After determining the activities as mentioned above we have tried to calculate total costs of these activities. When the cost records of the company and cost account types (direct labor, direct material and indirect manufacturing expenses) in the literature are combined, the functions affecting cost creation are determined as follows; “Personnel Expenses”, “Material Expenses” and “Other Expenses”.

Table 4.2 Activity centers and activities

ACTIVITY CENTERS	ACTIVITIES
Administration	
IT	
Supply	Purchasing and Inspection, Warehousing and Distribution
Engineering	Research and Development, Work Standart Preparation, Manufacturing Engineering
Planning, Programming and Control	Workload Planning, Production Programming and Control, Material Planning and Control, System Analysis
Quality Control	Manufacturing Quality Planning and Management, Metallic Jobshops Quality Control, Auxiliary Jobshops Quality Control
Transportation	
Metallic Jobshops	Lathe, Milling Machine, Grinding, Smoothing I, Smoothing II, Bomb, Casting, Forging, Heat Treatment, Welding
Auxiliary Jobshops	Rubber, Composite, Wood, Painting, Printing, Plating (Coating), Textile, Inspection Without Damage

4.5.1.1 Personnel Expenses

When the personnel profile in the factory is analyzed we see that there are three main personnel expenses, namely; managers' expenses, direct labor expenses and indirect labor expenses.

Managers' expenses are the salaries related to the management staff of the activity centers and include officer, noncommissioned officer and clerk salaries. In this group, there are also the salaries of personnel such as chief, foreman etc. in the activity centers.

Direct labor expenses, is the expense item that consists of the salaries of the direct personnel working in the jobshop. In direct labor expense there is only basic personnel salaries. Other appendage salaries that can be seen in the payroll are being considered

as indirect labor expenses.

Indirect labor expenses are all the wages elements of the direct personnel working in production jobshops other than direct labor. Indirect labor expenses include indirect personnel salaries and all appendage salaries of the direct personnel. In this group the following cost elements can be seen;

- All salaries of the indirect personnel
- All appendage salaries of the direct personnel
  - Social support
  - Food fees
  - SSK employer share
  - Birth, marriage, and death supports
  - Vacation and Night
  - Premiums and Compensations
  - Other wage appendage salaries

4.5.1.2 Material Expenses

Material expenses consist of two groups. Direct material expenses are the expense item of the materials that are used directly in the production or repair of the product, or in other words that affect the product structure directly. Indirect material expenses are expenses of the materials that take place in the structure of the product indirectly.

4.5.1.3 Other Expenses

These expenses are made up of all the expenses except labor and material. It consists of items such as training, lighting, energy, depreciation, cleaning, and maintenance-repair. These expenses are also the indirect expenses of the activities. Because it is impossible to keep record of these activities for them to monitor directly or there needs to be very costly systems installed. Therefore these expenses should be distributed.

4.5.2 Figuring out Activity Expenses

There is a need to form groups as indicated above when there are costs that can be directly or indirectly assigned to the activities. Since while some of these activities are related only with manufacturing department, the others serve to the factory in general. Therefore the costs of these activities have been calculated in factory level and later on the proportion of manufacturing department has been calculated by using the cost drivers. Therefore these costs have not been used directly.

Operations of assigning the cost items grouped as personnel expenses, material expenses and other expenses to the activities (directly and indirectly) are explained step by step in this section.

4.5.2.1 Personnel Costs

These costs are monitored by using payrolls and jobshop codes. The departments in the factory and their sub units have codes defined in FDMS. These codes are also the jobshop codes of the personnel working in these units. The units that the personnel work in according to the jobshop code and periods spent in these units and salary information according to the factory numbers have been obtained. By unifying both pools, direct and indirect labor costs have been calculated according to the jobshop code.

After calculating all labor costs of the entire main and sub units in the factory according to the jobshop code, these costs should be assigned to activity centers and activities. When determining activity centers and activities, the main and sub units of which costs will be assigned to the activities and activity centers were also determined (More than one unit can support an activity center or activity.). These way assigning costs to activity centers and activities especially for labor costs have been facilitated.

Salary expenses of manager level personnel (officer, noncommissioned officer and clerk), all employees working in administration in all units of the factory organization, personnel in the jobshop such as chief, foreman, etc. and personnel expenses of all

supporting units are gathered in the administration costs pool. Personnel expenses in this pool are being calculated for the entire factory. After determining the proportion of manufacturing department in production activities, administration costs of manufacturing department has been determined by taking into consideration this proportion. The manufacturing department proportion of IT and supply operations have also been calculated in the same way. Accordingly, personnel salaries and salaries of the activities are given below in Table 4.3.

The values seen in the table have the information of the last period (October-November-December) of the year 2005. Since all wage expenses of each worker has been used after being analyzed one by one, it has taken a lot of time putting these information together.

a) Costs of Administration and IT Activities: In administration activities the expenses of both indirect labor and manager level personnel can be seen. These salaries are calculated primarily for the factory in general and later on the proportion of the manufacturing department that has been calculated with the ratios determined.

Our cost driver here is support ratio of the expenses taking place in the "Administration" activity for their units' manufacturing department. These ratios are the same both for labor expenses and administrative expenses. The resource drivers and their values are given in Table 4.4.

As can be seen in the table above, four different cost drivers are being used to determine the personnel expenses of "Administration" activity. These ratios are the support ratios of related units for manufacturing department. From these ratios, the proportion of both general administration expenses and indirect labor expenses to the manufacturing department has been calculated.

Personnel expenses belonging to IT activity have been calculated using the Production Support Ratio given below and the total expense of this activity. In Table 4.3 we see expenses of both activities (figured out after these calculations).

Table 4.3 Personnel expenses of activity centers

ACTIVITY CENTERS AND ACTIVITIES	DIRECT LABOR	INDIRECT LABOR	GENERAL ADMINISTRATION
ADMINISTRATION		**483.192,990**	**291.509,843**
IT		**41.070,555**	
Purchasing and Inspection		9.327,365	
Warehousing and Distribution		92.453,309	
TOTAL OF SUPPLY		**101.780,674**	
Research and Development		271.523,492	
Work Standart Preparation		99.851,340	
Manufacturing Engineering		188.168,173	
TOTAL OF ENGINEERING		**559.543,005**	
Workload Planning		73.233,957	
Production Programmig and Control		116.594,264	
Material Planning and Control	26.904,780	132.048,132	
System Analysis		101.459,473	
TOTAL OF PLANNING, PROGRAMMING AND CONTROL	**26.904,780**	**423.335,826**	
Manufacturing Quality Plan. And Man.		113.851,401	
Metallic Jobshops Quality Control	19.310,430	28.673,850	
Auxiliary Jobshops Quality Control	13.625,957	20.403,779	
TOTAL OF QUALITY CONTROL	**32.936,387**	**162.929,030**	
TRANSPORTATION	**23.061,240**	**34.317,925**	
METALLIC JOBSHOPS	**948.289,006**	**1.529.367,470**	
AUXILIARY JOBSHOPS	**483.352,868**	**810.043,279**	
TOTAL	**1.514.544,281**	**4.145.580,753**	**291.509,843**

b) Costs of the Supply Activities: These activities are done by Price Determining, Purchasing and Inspection Commission and Supply Group Command. These activities are being used by other units as well as production. Since our application is limited only to manufacturing department, we need to calculate the proportion of jobshops from these activities. So we primarily tried to obtain their total costs from the current cost accounting system.

Supply Group Command along with the factory is a unit that provides Logistics

support also to the other units of Air Force Command. While finding the proportion of the factory from this Logistics service, the factory's proportion in delivery and warehousing activities in the last period of the year 2005 has been used. As a result the service ratio provided by Supply Group Command has been determined.

Table 4.4 Resource drivers of administration activity

UNIT NAME	RESOURCE DRIVER	DRIVER VALUE
Administration Pre.	Management Ratio	% 31,27
Planning and Resource Pre.	Production Support Ratio	% 40,93
Technical Management Pre.	Production Support Ratio	% 40,93
Quality Assurance Pre.	Production Support Ratio	% 40,93
Supply Group Com.	Supply Ratio	% 18,83
Support Group Com.	Support Ratio	% 7,59

There are 57 personnel working in "Warehousing and Distribution" activities. This means that 85% of the service is provided by Supply Group Command. The rest is general service amount, which has been evaluated under "Administration" activity. Purchasing and Inspection Costs are personnel expenses of units providing support to the supply activities not belonging to Supply Group Command. The information on Supply Activity has been summarized in Table 4.5.

Since all of the supply costs do not belong to the products produced in jobshops, we had to calculate the part of the manufacturing department of these costs. At this point we had to choose a cost driver. A lot of activity measures (cost drivers) for purchasing and inspection such as number of technical specifications, number of administrative specifications, number of orders, number of inspections and inspection period have been determined. However taking into consideration current records, it has been seen that using number of order would be much more suitable. As a result equal cost has been assigned for each purchasing. There are some cost drivers such as number of delivered parts, raw material stock value, and number of delivery documents used in warehousing and distribution. It has been seen that warehouse shipping number is suitable. The first allocation done according to these has been shown in Table 4.5.

Number of order and warehouse shipping number used here is an example of first level cost drivers.

Table 4.5 Supply cost of manufacturing department

Purchasing and Inspection Expense	27.733,366
Total Purchasing Number	446
Manufacturing Department Purchasing Order	150
Manufacturing Department Total Purchasing and Inspection Cost	**9.327,365**
Warehousing and Distribution Expense	237.059,767
Total Warehouse Shipping Number	7.094
Shipping Number of the Manufacturing Department	2.732
Manufacturing Department Total Warehousing and Distribution Cost	**92.453,309**
Manufacturing Department Total Supply Cost	**101.780,674**

From these expenses, which are common for the entire factory, the parts of the manufacturing department have been assigned to the activities.

4.5.2.2 Material Costs

Direct material costs can be calculated directly. Materials that are used directly in the manufacturing of a product can be seen in the material plans. In repairing activities, materials to be used depend on the problem type. Material requirements belonging to these are being recorded to job order in types and units.

Material expenses are calculated both for the related product and for the general sum using the unit numbers and unit prices of the materials mentioned in the completed products'. Since this cost group is calculated directly and since it is outside the context of operating unit cost, it is not taken into consideration in this thesis.

Indirect materials which are used during the manufacturing processes on the other

hand are the materials that do not enter the structure of the repaired or manufactured products directly. The indirect materials used vary depending on the characteristics of the production activity. The indirect material information pulled from warehouses by the jobshops in which cost calculations are being carried on, are taken into the system in terms of jobshops. According to this, indirect material expenses in jobshop terms are given in Table 4.6.

Table 4.6 Indirect material expenses of manufacturing department

Jobshops	Indirect Material Expenses	Jobshops	Indirect Material Expenses
Lathe	45.408,70	Rubber	798,66
Milling Machine	55,08	Composite	981,58
Grinding	28,22	Wood	4.874,92
Smoothing I	40,12	Painting	0,34
Smoothing II	17,68	Printing	2.040,00
Bomb	---	Plating (Coating)	8.049,16
Casting	117,30	Textile	553,18
Forging	3,74	Ins. Without Damage	---
Heat Treatment	---		
Welding	5,10		
TOTAL	**45.675,94**	**TOTAL**	**17.297,84**

As can be seen in the table indirect material expenses of the manufacturing department in the last period of the year 2005 is 62.973,780 YTL.

4.5.2.3 Other Costs

Some of the cost items considered as other costs can be assigned directly to the activity centers and activities while some others need cost drivers.

Depreciation expenses are divided into two groups being; machine/equipment and building/facilities. Since the jobshops that the machines and equipments in the manufacturing department belong to are known, their depreciation value can be calculated directly. However the same situation does not apply for building/facilities

depreciation. These expenses will be assigned to activity centers and activities through meter square cost driver. Because the buildings in the factory are over 20 years of age, according to the procedure, they do not have depreciation values. In certain periods buildings are going through maintenance and repair. These expenses are held under the name “Structure-Building” and, they are assigned to activities.

Also advertisement expenses that belong to purchasing activities implemented according to supply activities are one of the cost items that are determined directly. This expense is added to “Purchasing and Inspection” activity directly under other cost item.

The expense done for the students of colleges is gathered in the same pool and is assigned equally to jobshops of the manufacturing department.

Costs that cannot be assigned to activity centers and activities are directly assigned using cost drivers. In choosing these drivers, the characteristics of the costs are taken into consideration. Using the annual values of indirect costs taken from the system, shares of the periods have been determined. Different cost drivers have been used to assign them to the activities. In Table 4.7 indirect cost items and cost drivers used to assign them to the activities have been shown.

In allocating these costs, it is possible to use much more meaningful cost drivers. However when the expectations, system’s simplicity and the situation of the information in hand are considered, these seemed to be enough.

While three different factors are being used as cost driver here, there are eleven different indirect cost items. When cost items are grouped according to the cost drivers, the situation below can be seen.

- **Personnel Number:** Allowance, Communication, Office Stationery, Transportation, Clothing, Health, Other
- **Machine hour:** Maintenance-Repair, Electricity

- **Meter square:** Structure-Building, Cleaning, Water and Heating

Table 4.7 Indirect cost expenses and resource drivers

Indirect Cost Expense	Resource Drivers
Travel Allowance	Number of Employees
Building-Facility	Square Meter
Maintenance-Repair	Machine Hour
Communication	Number of Employees
Electricity	Machine Hour
Cleaning, Water and Heating	Square Meter
Office Stationery	Number of Employees
Transportation	Number of Employees
Clothing	Number of Employees
Health	Number of Employees
Other	Number of Employees

Distribution of depreciation, advertisement, students and other indirect expenses according to activities is shown in Table 4.8.

Expenses having the same cost drivers have been united and new cost pools have been formed. Total expenses in these pools have been assigned to activities and activity centers by using preset cost drivers. For example, the calculation for "Structure-Building", "Cleaning, Water and Heating" expenses, which use meter square (m^2) cost driver, is done as follows.

1. Total of "Structure-Building" and "Cleaning, Water and Heating" expenses (54.559,282 YTL)
2. Total m^2 in which the activities are being carried out (43.798,989 m^2).
3. Unit cost for m^2 (1.246 YTL/m^2)

Table 4.10 Allocation of other costs

	Depreciation	Advertisement	Student	Personnel Number	Machine Hour	M^2	TOTAL
ADMINISTRATION				**52.884,644**		**11.029,692**	**63.914,336**
IT				**1.480,749**		**107,491**	**1.588,240**
Purchasing and Inspection		3.769,591		405,579		192,375	597,954
Warehousing and Distribution				3.861,706		5.833,480	9.695,186
TOTAL OF SUPPLY				**4.267,285**		**6.025,856**	**10.293,140**
Research and Development				9.245,389		222,938	9.468,327
Work Standart Preparation				3.747,392		108,284	3.855,677
Manufacturing Engineering				5.829,277		955,451	6.784,727
TOTAL OF ENGINEERING				**18.822,058**		**1.286,673**	**20.108,731**
Workload Planning				2.411,840		82,806	2.494,646
Production Programmig and Control				4.163,769		63,697	4.227,466
Material Planning and Control				6.245,654		44,588	6.290,241
System Analysis				3.290,554		74,563	3.365,118
TOTAL OF PLAN., PROGRAM. AND CONT.				**16.111,818**		**265,653**	**16.377,471**
Manufacturing Quality Plan. and Man.				3.361,167		547,027	3.908,194
Metallic Jobshops Quality Control				1.665,508		273,896	1.939,403
Auxiliary Jobshops Quality Control				1.249,131		273,896	1.523,027
TOTAL OF QUALITY CONTROL				**6.275,805**		**1.094,819**	**7.370,624**
TRANSPORTATION				**3.331,015**		**318,484**	**3.649,499**
METALLIC JOBSHOPS	**324.191,643**		**15.126,389**	**92.852,053**	**96.986,685**	**21.774,080**	**211.612,818**
AUXILIARY JOBSHOPS	**68.059,561**		**12.101,111**	**50.797,984**	**105.218,473**	**12.656,534**	**168.672,992**
TOTAL	**392.251,205**	**3.769,591**	**27.227,500**	**246.823,412**	**202.205,158**	**54.559,282**	**503.587,852**

As a result of these calculations, expense amount per activity can be calculated by multiplying unit cost values of “Structure-Building” and “Cleaning, Water and Heating” expenses and meter square of the area in which the activities are being carried out.

4.5.2.4 Assigning of Administration and IT Costs

As in traditional costing systems, here too, administration and IT costs have to be assigned to activities and activity centers. For this allocation, personnel number has been used as a driver. According to this, calculations will be as shown in Table 4.9.

Table 4.9 Total cost of the administration activitiy

TOTAL COST OF THE ADMINISTRATION ACTIVITY	
Direct Activity Costs	774.702,833 YTL
Indirect Activity Costs	63.914,336 YTL
TOTAL ACTIVITY COST	**838.617,169 YTL**
Total Personnel Number	515 People
Cost Distribution Ratio	**1.628,383 YTL/Person**

In the first step, administration expense has been assigned to IT and other activities. Total expense of the IT activity consists of direct activity, indirect activity, and administration costs. In the second step this total expense belonging to IT in Table 4.10 has been assigned to other activities.

In Table 4.11 situation of the activity centers and activities at the end of two allocations have been shown.

4.5.2.5 Determining the Total Costs of the Activities

Calculations and allocations done up until this points aim to find the total costs of activities. Total cost of an activity consists of personnel expenses, material (indirect) expenses and other expenses. Within the framework of the calculations done before,

total costs of the activities are shown in Table 4.12. Since cost calculation activities are done only for manufacturing department, sub units belonging to metal and auxiliary jobshops have been taken into consideration.

Table 4.10 Total cost of the IT activity

TOTAL COST OF THE IT ACTIVITY	
Direct Activity Costs	41.070,555 YTL
Indirect Activity Costs	1.588,240 YTL
Administration Costs	*14.655,446 YTL*
TOTAL ACTIVITY COST	**57.314,241 YTL**
Total Personnel Number	506 people
Cost Distribution Ratio	**113,269 YTL/person**

4.6 Calculating Product Costs

The next step in determining activity costs is that of calculating product costs. Generally, in this step, first the activity levels have been determined and then cost values of these levels have been calculated. With the help of these values, the production costs of the products have been determined.

4.6.1 Determining Activity Levels

To be able to calculate the costs correctly, activity levels too should be taken into consideration. Determining activity levels helps us to understand the factors that create changes in these activities. In product costing ABC is grouped in four levels. These are unit, party, product and facility level activities.

The levels of activities in the factory according to the activity level definitions of ABC are given in Table 4.13.

Metallic and Auxiliary Jobshops are areas in which the production takes place. Since all production activities done here are directly related to the produced good itself, activity level has been determined as “unit”.

Table 4.11 Administration and IT costs

Activity Centers and Activities	Number of Man	Administration Expenses	IT Expenses	TOTAL
Purchasing and Inspection	3	4.885,149	339,807	5.224,956
Warehousing and Distribution	27	43.966,341	3.058,263	47.024,604
TOTAL OF SUPPLY	**30**	**48.851,490**	**3.398,070**	**52.249,560**
Research and Development	23	37.452,81	2.605,187	40.057,996
Work Standart Preparation	9	14.655,45	1.019,421	15.674,868
Manufacturing Engineering	14	22.797,36	1.585,766	24.383,128
TOTAL OF ENGINEERING	**46**	**74.905,618**	**5.210,374**	**80.115,992**
Workload Planning	6	9.770,298	679,614	10.449,912
Production Programmig and Control	10	16.283,830	1.132,690	17.416,520
Material Planning and Control	15	24.425,750	1.699,035	26.124,780
System Analysis	20	32.567,665	2.265,380	34.833,040
TOTAL OF PLAN., PROGRAM. AND CONTROL	**51**	**83.047,543**	**5.776,719**	**88.824,252**
Manufacturing Quality Plan. and Man.	19	30.939,28	2.152,111	33.091,388
Metallic Jobshops Quality Control	4	6.513,532	453,076	6.966,608
Auxiliary Jobshops Quality Control	3	4.885,149	339,807	5.224,956
TOTAL OF QUALITY CONTROL	**26**	**42.337,958**	**2.944,994**	**45.282,952**
TRANSPORTATION	**8**	**13.027,060**	**906,152**	**13.933,216**
METALLIC JOBSHOPS	**223**	**363.129,409**	**25.258,987**	**388.388,396**
AUXILIARY JOBSHOPS	**122**	**198.662,726**	**13.818,818**	**212.481,544**
TOTAL	**506**	**823.961,798**	**57.314,114**	**881.275,912**

Metallic Jobshops Quality Control and Auxiliary Jobshops Quality Control operations are activities carried out by including both each product and the entire product group. Therefore, activity level of the quality control procedure changes between “unit” or “party”.

In Purchasing and Inspection, Warehousing and Distribution, Workload Planning, Production Programming and Control, Material Planning and Control, and Production Quality Control and Management activities, the order belonging to the product to be produced has to be handled as a whole. Briefly, these activities are done independent from order amount. Therefore these activities are taken into evaluation as “party” level.

Table 4.12 Total costs of the activities

ACTIVITIES	Personnel Costs	Material Costs	Other Costs	TOTAL
Purchasing and Inspection	14.163,966		4.755,900	**18.919,866**
Warehousing and Distribution	135.982,719		13.190,383	**149.173,102**
Research and Development	308.604,100		12.445,717	**321.049,817**
Work Standart Preparation	114.361,143		5.020,742	**119.381,885**
Manufacturing Engineering	210.738,978		8.597,052	**219.336,030**
Workload Planning	82.907,160		3.271,357	**86.178,516**
Production Programmig and Control	132.716,267		5.521,983	**138.238,250**
Material Planning and Control	156.231,137		8.232,017	**164.463,155**
System Analysis	133.703,481		5.954,152	**139.657,633**
Manufacturing Quality Plan. and Man.	144.483,208		6.367,777	**150.850,985**
Metallic Jobshops Quality Control	35.122,651		2.457,210	**37.579,862**
Auxiliary Jobshops Quality Control	25.240,380		1.911,382	**27.151,762**
Transportation	47.215,527		4.685,113	**51.900,640**
Lathe	401.169,419	45.408,70	105.644,918	**552.223,037**
Milling Machine	328.222,475	55,08	88.378,908	**416.656,463**
Grinding	181.898,821	28,22	110.977,694	**292.904,734**
Smoothing I	326.114,247	40,12	56.240,754	**382.395,120**
Smoothing II	145.583,225	17,68	79.042,168	**224.643,073**
Bomb	170.491,541		38.419,942	**208.911,483**
Casting	243.522,536	117,30	36.491,101	**280.130,937**
Forging	16.361,261	3,74	26.233,330	**42.598,331**
Heat Treatment	22.932,085		19.901,928	**42.834,014**
Welding	52.592,542	5,10	18.467,845	**71.065,487**
Rubber	185.533,400	798,66	59.388,044	**245.720,104**
Composite	53.167,856	981,58	15.982,001	**70.131,437**
Wood	104.363,012	4.874,92	28.914,383	**138.152,315**
Painting	132.369,887	0,34	32.219,795	**164.590,022**
Printing	34.370,641	2.040,00	12.984,788	**49.395,429**
Plating (Coating)	93.350,899	8.049,16	61.053,736	**162.453,795**
Textile	386.761,960	553,18	48.226,878	**435.542,019**
Inspection Without Damage	16.814,069	0,00	5.857,149	**22.671,219**
TOTAL	**4.437.090,596**	**62.973,780**	**926.836,147**	**5.426.900,523**

Table 4.13 Activities and activity levels

ACTIVITIES	ACTIVITY LEVELS
Purchasing and Inspection	Party Level
Warehousing and Distribution	Party Level
Research and Development	Product Level
Work Standart Preparation	Product Level
Manufacturing Engineering	Product Level
Workload Planning	Party Level
Production Programmig and Control	Party Level
Material Planning and Control	Party Level
System Analysis	Unit, Party and Product Level
Manufacturing Quality Plan. and Man.	Party Level
Metallic Jobshops Quality Control	Unit and Party Level
Auxiliary Jobshops Quality Control	Unit and Party Level
Metallic Jobshops	Unit Level
Auxiliary Jobshops	Unit Level

Resource&Development, Preparing Work Standards and Production Engineering are activities of product level. Here product is considered as a whole and these activities are related with the product itself regardless of the amount of product.

System analysis activity includes all kinds of analysis, evaluation and reporting operations of a product. Therefore all information on the “unit, party and product” levels is in the application field of this activity.

4.6.2 Choosing Cost Drivers

One of the important elements of the ABC system is cost drivers. They are used in transferring costs related to activities to cost objects, in other words products and consumers. For ABC to function properly, cost drivers should be chosen correctly in terms of quantity and quality. When deciding on the number of the cost drivers and the cost drivers to be used, all factors should be analyzed in detail. Most convenient

combination of the production structure and product line of the company must be chosen. Having a large number of cost drivers will increase details and help managers to obtain more information on every subject. However having a large number of cost drivers increases the cost of the system and makes it hard to monitor the activities. According to this, cost drivers related to the activities of the company are determined to be as Table 4.14.

Five different cost drivers have been determined related to the activities. When choosing the cost drivers, levels of the activities were taken into consideration, because activity and inclusion area are the main factors in determining cost drivers. According to this;

For Purchasing and Inspection, Warehousing and Distribution, and Material Planning and Control activities, “number of orders” has been chosen as the cost driver. These activities are part level activities and the order regarding the product is evaluated as a whole regardless of the amount.

In allocating the costs of Resource&Development, Work Standards Preparing, Production Engineering, Workload Planning, System Analysis, Manufacturing Quality Analysis and Management and Transportation activities “number of job orders” have been used as the driver. Job order is occured according to production line intensity for each product in company’s manufacturing capability pool concerning order and production technology (and management) of product. However in production period, for one work, only one job order is created while the number of orders can be more than one.

The products being produced in large amounts are being divided into little packages in order to render the production more efficient. Production Programming and Control, Metallic Jobshops Quality Control, and Auxiliary Jobshops Quality Control activities are using this package number as the cost driver. These activities are being repeated for each package.

Metallic Jobshops and Auxiliary Jobshops are using “machine hour” and “man

hour" respectively as cost drivers. Metallic Jobshops support machinery abundant production while Auxiliary Jobshops support labor abundant production. This indirectly reflects on cost allocation.

Table 4.14 Activities and cost drivers

ACTIVITIES	COST DRIVERS
Purchasing and Inspection	Number of Purchasing
Warehousing and Distribution	Number of Purchasing
Research and Development	Number of Job Order
Work Standart Preparation	Number of Job Order
Manufacturing Engineering	Number of Job Order
Workload Planning	Number of Job Order
Production Programmig and Control	Number of Package
Material Planning and Control	Number of Purchasing
System Analysis	Number of Job Order
Manufacturing Quality Plan. and Man.	Number of Job Order
Metallic Jobshops Quality Control	Number of Package
Auxiliary Jobshops Quality Control	Number of Package
Transportation	Number of Job Order
Metallic Jobshops	Machine Hour
Auxiliary Jobshops	Man Hour

4.6.3 Calculation of Distribution Ratios

Cost drivers determined for all activities, take into account the total amounts belonging to the last quarter of the year 2005. "Distribution Ratios" are calculated by dividing costs regarding the activities by drivers. Distribution Ratios given in Table 4.15 show activity costs per unit, party, and product level. With these ratios, costs of activities will be distributed to the related products.

4.6.4 Choosing Sample Products and Cost Factors

Some products produced in the period in which the calculations regarding product costs done have been chosen as samples. By using work plans of these products, consumptions regarding activities of production have been determined. By using some other information on products, usage values of activities have also been determined. This information is summarized in Table 4.16.

4.6.5 Calculation of Product Costs

In ABC system indirect cost of a product consists of all the costs belonging to all the indirect activities consumed during the manufacturing of that product. Table 4.16 provides information on activity consumption of the sample products. To find the product costs, distribution ratios given in Table 4.15 and cost factors of the sample products given in Table 4.16 have been used. Values found give us the total indirect manufacturig costs of each product. By dividing these numbers by production amounts, unit indirect manufacturing costs were found. These calculation and values are given in Tables 4.17 and 4.18 for all products.

As can be seen in the tables ABC system gives us the indirect cost elements of every product in detail. As a result the activities a product consumes and their costs can be clearly seen.

ABC also shows which activities are important in the total cost of a product. This information especially affects the decisions to be taken by the management. In application costs of jobshops have been evaluated separately. Accordingly, Resource&Development, Manufacturing Engineering, and Material Planning and Control costs are used by all four products and have important proportions in product cost. In Table 4.18 products are shown without the jobshop costs.

Table 4.15 Distribution ratios of activity costs

ACTIVITIES	Total Costs of Activities (A)	Values of Cost Drivers (B)	Distribution Ratios (A/B)
Purchasing and Inspection	18.919,866	662 ss	28,580 YTL/ss
Warehousing and Distribution	149.173,102	662 ss	225,337 YTL/ss
Research and Development	321.049,817	634 ie	506,388 YTL/ie
Work Standart Preparation	119.381,885	634 ie	188,300 YTL/ie
Manufacturing Engineering	219.336,030	634 ie	345,956 YTL/ie
Workload Planning	86.178,516	634 ie	135,928 YTL/ie
Production Programmig and Control	138.238,250	1434 suf	96,400 YTL/suf
Material Planning and Control	164.463,155	662 ss	248,434 YTL/ss
System Analysis	139.657,633	634 ie	220,280 YTL/ie
Manufacturing Quality Plan. and Man.	150.850,985	634 ie	237,935 YTL/ie
Metallic Jobshops Quality Control	37.579,862	1434 suf	26,206 YTL/suf
Auxiliary Jobshops Quality Control	27.151,762	1434 suf	18,934 YTL/suf
Transportation	51.900,640	634 ie	81,862 YTL/ie
Lathe	552.223,037	22.657,70 ms	24,372 YTL/ms
Milling Machine	416.656,463	19.610,10 ms	21,247 YTL/ms
Grinding	292.904,734	9.830,80 ms	29,795 YTL/ms
Smoothing I	382.395,120	17.744,10 ms	21,551 YTL/ms
Smoothing II	224.643,073	7.486,60 ms	30,006 YTL/ms
Bomb	208.911,483	9.012,50 ms	23,180 YTL/ms
Casting	280.130,937	10.899,00 ms	25,702 YTL/ms
Forging	42.598,331	966,30 ms	44,084 YTL/ms
Heat Treatment	42.834,014	1.396,00 ms	30,683 YTL/ms
Welding	71.065,487	2.510,20 ms	28,311 YTL/ms
Rubber	245.720,104	8.782,80 as	27,977 YTL/as
Composite	70.131,437	2.706,80 as	25,909 YTL/as
Wood	138.152,315	4.942,70 as	27,951 YTL/as
Painting	164.590,022	7.427,70 as	22,159 YTL/as
Printing	49.395,429	1.428,60 as	34,576 YTL/as
Plating (Coating)	162.453,795	4.639,00 as	35,019 YTL/as
Textile	435.542,019	21.775,30 as	20,002 YTL/as
Inspection Without Damage	22.671,219	869,50 as	26,074 YTL/as

Table 4.16 Sample products and cost objects

	PRODUCT TYPES				
COST OBJECTS	ICKFR1K	IAODP1K	IABDT1K	IA5S51K	IACOP1K
# of Purchasing	1	1	1	2	1
# of Job Order	1	1	1	1	1
# of Package	1	1	11	2	125
Machine Hour					
Lathe	100,10		720,00		
Milling Machine	27,65		390,00		
Grinding	0,66		140,00		
Smoothing I	59,50		930,00		8.593,20
Smoothing II	13,88		90,00		225,50
Bomb					10.629,90
Casting	2,80				8.918,10
Forging			610,00		1.439,10
Welding	6,48				1.054,90
Man Hour					
Rubber		76,50		41,00	
Composite	4,54				530,55
Wood					12,15
Printing					204,00
Textile		43,50			305,10
# of Production	**1**	**150**	**1.000**	**3.500**	**13.500**

In the production line the most suitable production procedure from the discontinuous or mass production models is used depending on the characteristics of the product and the annual need. Cost expenses belonging to the activities that support the manufacturing shown in Table 4.18. The determining factor here is the amounts of the products. In spite of the fact that the fifth product is manufactured in significantly larger amounts, the lowest unit cost is the fourth product's cost. This situation is caused from the production method used. All orders belonging to the fourth product have been manufactured in two times. In the last product however, the insufficient production line capacity causes the product to be manufactured by dividing into smaller parties.

Table 4.17 Indirect manufactring costs of products

	PRODUCT TYPES				
ACTIVITIES	ICKFR1K	IAODP1K	IABDT1K	IA5S51K	IACOP1K
Purchasing and Inspection	28,58	28,58	28,58	57,16	28,58
Warehousing and Distribution	225,34	225,34	225,34	450,67	225,34
Research and Development	506,39	506,39	506,39	506,39	506,39
Work Standart Preparation	188,30	188,30	188,30	188,30	188,30
Manufacturing Engineering	345,96	345,96	345,96	345,96	345,96
Workload Planning	135,93	135,93	135,93	135,93	135,93
Production Programmig and Control	96,40	96,40	1.060,40	192,80	12.050,06
Material Planning and Control	248,43	248,43	248,43	496,87	248,43
System Analysis	220,28	220,28	220,28	220,28	220,28
Manufacturing Quality Plan. and Man.	237,94	237,94	237,94	237,94	237,94
Metallic Jobshops Quality Control	26,21	26,21	288,27	52,41	3.275,79
Auxiliary Jobshops Quality Control	18,93	18,93	208,28	37,87	2.366,79
Transportation	81,86	81,86	81,86	81,86	81,86
Lathe	2.439,68	0,00	17.548,14	0,00	0,00
Milling Machine	587,48	0,00	8.286,34	0,00	0,00
Grinding	19,66	0,00	4.171,24	0,00	0,00
Smoothing I	1.282,26	0,00	20.042,01	0,00	185.188,19
Smoothing II	416,48	0,00	2.700,54	0,00	6.766,36
Bomb	0,00	0,00	0,00	0,00	246.403,13
Casting	71,97	0,00	0,00	0,00	229.216,97
Forging	0,00	0,00	26.891,22	0,00	63.441,23
Welding	183,45	0,00	0,00	0,00	29.864,94
Rubber	0,00	2.140,27	0,00	1.147,07	0,00
Composite	117,63	0,00	0,00	0,00	13.746,21
Wood	0,00	0,00	0,00	0,00	339,60
Printing	0,00	0,00	0,00	0,00	7.053,53
Textile	0,00	870,07	0,00	0,00	6.102,50
TOTAL	**7.479,16**	**5.370,89**	**83.415,45**	**4.151,51**	**808.034,28**

Table 4.18 Unit indirect manufacturing costs

	PRODUCT TYPES				
ACTIVITIES	ICKFR1K	IAODP1K	IABDT1K	IA5S51K	IACOP1K
Purchasing and Inspection	28,58	0,19	0,03	0,02	0,00
Warehousing and Distribution	225,34	1,50	0,23	0,13	0,02
Research and Development	506,39	3,38	0,51	0,14	0,04
Work Standart Preparation	188,30	1,26	0,19	0,05	0,01
Manufacturing Engineering	345,96	2,31	0,35	0,10	0,03
Workload Planning	135,93	0,91	0,14	0,04	0,01
Production Programmig and Control	96,40	0,64	1,06	0,06	0,89
Material Planning and Control	248,43	1,66	0,25	0,14	0,02
System Analysis	220,28	1,47	0,22	0,06	0,02
Manufacturing Quality Plan. and Man.	237,94	1,59	0,24	0,07	0,02
Metallic Jobshops Quality Control	26,21	0,17	0,29	0,01	0,24
Auxiliary Jobshops Quality Control	18,93	0,13	0,21	0,01	0,18
Transportation	81,86	0,55	0,08	0,02	0,01
Lathe	2.439,68	0,00	17,55	0,00	0,00
Milling Machine	587,48	0,00	8,29	0,00	0,00
Grinding	19,66	0,00	4,17	0,00	0,00
Smoothing I	1.282,26	0,00	20,04	0,00	13,72
Smoothing II	416,48	0,00	2,70	0,00	0,50
Bomb	0,00	0,00	0,00	0,00	18,25
Casting	71,97	0,00	0,00	0,00	16,98
Forging	0,00	0,00	26,89	0,00	4,70
Welding	183,45	0,00	0,00	0,00	2,21
Rubber	0,00	14,27	0,00	0,33	0,00
Composite	117,63	0,00	0,00	0,00	1,02
Wood	0,00	0,00	0,00	0,00	0,03
Printing	0,00	0,00	0,00	0,00	0,52
Textile	0,00	5,80	0,00	0,00	0,45
TOTAL	**7.479,16**	**35,81**	**83,42**	**1,19**	**59,85**

Table 4.19 Unit indirect manufacturing costs excluding jobshops

	PRODUCT TYPES				
ACTIVITIES	ICKFR1K	IAODP1K	IABDT1K	IA5S51K	IACOP1K
Purchasing and Inspection	28,58	0,19	0,03	0,02	0,00
Warehousing and Distribution	225,34	1,50	0,23	0,13	0,02
Research and Development	506,39	3,38	0,51	0,14	0,04
Work Standart Preparation	188,30	1,26	0,19	0,05	0,01
Manufacturing Engineering	345,96	2,31	0,35	0,10	0,03
Workload Planning	135,93	0,91	0,14	0,04	0,01
Production Programmig and Control	96,40	0,64	1,06	0,06	0,89
Material Planning and Control	248,43	1,66	0,25	0,14	0,02
System Analysis	220,28	1,47	0,22	0,06	0,02
Manufacturing Quality Plan. and Man.	237,94	1,59	0,24	0,07	0,02
Metallic Jobshops Quality Control	26,21	0,17	0,29	0,01	0,24
Auxiliary Jobshops Quality Control	18,93	0,13	0,21	0,01	0,18
Transportation	81,86	0,55	0,08	0,02	0,01
TOTAL	**2.360,54**	**15,74**	**3,78**	**0,86**	**1,47**

In Table 4.20 cost expenses of products in jobshops terms have been shown. Biggest shares in total costs of sample products belong to the jobshops (except fourth product). This is caused from the facts that the technology in the company is dependent on labor, the types of products and the high personnel wages because of the company's aviation sector. Since the fourth product is a simple one (gasket), it can be produced in one jobshop and can be produced thousands of them at one time; share of the jobshop is low in the total cost.

4.7 Comparison of the Results and Evaluation

In order to compare ABC and the current cost accounting in an accurate and realistic manner, the problems raised in detail within the application process of the current cost accounting should be analyzed. Referring to this specific matter;

- In the calculation of ABC and current cost accounting, the sums totally equivalent are used.
- Instead of Logistics man hour, total expended direct man hour values are taken into account.
- The labor costs are assigned amongst the jobshops as per the jobshops where the staffs are employed and direct man hour rates expended.
- Only basic personnel expenses are included in the direct labor costs.
- Only the direct labor man hour rates are used as cost driver.

Table 4.20 Unit indirect manufacturing costs of the jobshops

	PRODUCT TYPES				
ACTIVITIES	ICKFR1K	IAODP1K	IABDT1K	IA5S51K	IACOP1K
Lathe	2.439,68	0,00	17,55	0,00	0,00
Milling Machine	587,48	0,00	8,29	0,00	0,00
Grinding	19,66	0,00	4,17	0,00	0,00
Smoothing I	1.282,26	0,00	20,04	0,00	13,72
Smoothing II	416,48	0,00	2,70	0,00	0,50
Bomb	0,00	0,00	0,00	0,00	18,25
Casting	71,97	0,00	0,00	0,00	16,98
Forging	0,00	0,00	26,89	0,00	4,70
Welding	183,45	0,00	0,00	0,00	2,21
Rubber	0,00	14,27	0,00	0,33	0,00
Composite	117,63	0,00	0,00	0,00	1,02
Wood	0,00	0,00	0,00	0,00	0,03
Printing	0,00	0,00	0,00	0,00	0,52
Textile	0,00	5,80	0,00	0,00	0,45
TOTAL	**5.118,61**	**20,07**	**79,64**	**0,33**	**58,38**

As a consequence, a cost calculation approach which is common to ABC in terms of the data (all the costs of the company) used and which operate almost similar to the employment conditions of the current cost accounting, has been developed. In addition, several minor ambiguities and negations determined in the expenses are concluded in the manner that they affect the calculation method in the minimum level.

As a result of the calculation and the allocation, the costs of the output items included in the current cost accounting and the costs as per the departments (based on the jobshops of the manufacturing department) are shown in Table 4.21. The costs of the selected sample products are calculated with the operating unit costs of the jobshops and the man hour values expended in such jobshops for the products listed in Table 4.16. These costs are summarized in Table 4.22.

The costs of the products found through comparison of ABC with current cost accounting are presented in Table 4.23.

The current cost accounting loads the costs utilizing only from the man hour criterion as cost driver. The unit man hour rate is a distribution criterion. In the calculation of the cost for any selected product, the quantity of the product and unit production time is two basic factors which may have impact on the cost to be calculated. Consequently, the current cost accounting assigns the cost according to the total man hour rates.

When compared with the current cost accounting, ABC follows up a much constructive approach through segregating the cost pool into different ranges of activities and using so many different cost drivers. Thus it assists the allocation of the costs within the pool to the products in an accurate manner.

Both ABC and the current cost accounting's cost values are compared taking Table 4.23 as the basis and the results thus obtained are presented below:

- Since the quantity of the first product is only one, there observed no negation resulted from the quantity of the selected product within the current cost accounting. However, unit manufacturing time is quite high when compared with the others. ABC inflicted less cost on the product at a ratio of 3.4 % according to the current system.

Table 4.21 Expenditures and operating unit costs according to the current cost accounting system

		DIRECT LABOR	INDIRECT LABOR	*Off., Noncommissioned Off., Clerk Salary*	INDIRECT MATERIAL	DEPRECIATION	GENERAL ADMINISTR.	FACTORY MANAGEMENT	TOTAL	OPERATING UNIT COST
AIRCRAFT FASBAT		**1.256.198,721**	**2.744.265,945**	***66.953,130***	**376.832,000**	**130.162,341**	**350.972,052**	**1.321.573,294**	**6.246.957,48**	**43,732**
MANUFACTURING	Lathe	222.969,942	448.218,031	*6.554,073*	45.408,700	50.302,141	59.346,957	223.468,944	**1.056.268,79**	46,619
	Milling Machine	192.979,113	387.929,949	*5.672,510*	55,080	41.388,728	51.364,427	193.410,997	**872.800,80**	44,508
	Grinding	96.742,957	194.474,365	*2.843,704*	28,220	80.817,579	25.749,660	96.959,466	**497.615,95**	50,618
	Smoothing I	174.616,176	351.016,456	*5.132,742*	40,120	21.976,700	46.476,842	175.006,964	**774.266,00**	43,635
	Smoothing II	73.674,149	148.101,048	*2.165,609*	17,680	65.467,097	19.609,534	73.839,030	**382.874,15**	51,141
	Bomb	88.690,229	178.286,631	*2.606,998*	0,000	8.601,957	23.606,300	88.888,716	**390.680,83**	43,349
	Casting	107.254,902	215.605,658	*3.152,696*	117,300	11.492,604	28.547,579	107.494,936	**473.665,68**	43,460
	Forging	9.509,167	19.115,492	*279,517*	3,740	20.727,153	2.531,014	9.530,448	**61.696,53**	63,848
	Heat Treatment	13.737,760	27.615,882	*403,814*	0	14.365,836	3.656,521	13.768,505	**73.548,32**	52,685
	Welding	24.702,381	49.657,154	*726,112*	5,100	9.051,848	6.574,927	24.757,665	**115.475,19**	46,002
	Rubber	86.429,797	173.742,671	*2.540,554*	798,660	33.506,464	23.004,650	86.623,225	**406.646,02**	46,300
	Composite	26.637,083	53.546,325	*782,982*	981,580	7.947,241	7.089,879	26.696,696	**123.681,79**	45,693
	Wood	48.640,133	97.777,235	*1.429,749*	4.874,920	6.928,523	12.946,336	48.748,988	**221.345,88**	44,782
	Painting	73.094,526	146.935,879	*2.148,572*	0,340	3.820,712	19.455,258	73.258,110	**318.713,40**	42,909
	Printing	14.058,570	28.260,780	*413,244*	2.040,000	1.357,015	3.741,910	14.090,033	**63.961,55**	44,772
	Plating (Coating)	45.651,481	91.769,396	*1.341,899*	8.049,160	9.444,567	12.150,860	45.753,648	**214.161,01**	46,165
	Textile	214.286,418	430.762,261	*6.298,826*	553,180	3.564,793	57.035,701	214.765,987	**927.267,17**	42,583
	Inspection Without Damage	8.556,577	17.200,580	*251,516*	0	1.490,246	2.277,468	8.575,727	**38.352,11**	44,108
GROUND SYSTEM		**785.291,010**	**1.676.141,146**	***42.508,505***	**42.952,000**	**55.445,078**	**215.011,223**	**809.617,428**	**3.626.966,39**	**41,446**
TOTAL		**3.563.721,092**	**7.480.422,883**	***154.206,750***	**482.757,780**	**590.282,529**	**971.149,097**	**3.656.828,807**	**16.886.945,032**	**42,723**

Table 4.22 Product costs according to the current cost accounting system

	PRODUCT TYPES				
COST OBJECTS	ICKFR1K	IAODP1K	IABDT1K	IA5S51K	IACOP1K
Lathe	3.681,45	0,00	26.479,97	0,00	0,00
Milling Machine	958,54	0,00	13.520,10	0,00	0,00
Grinding	26,91	0,00	5.708,82	0,00	0,00
Smoothing I	2.010,76	0,00	31.428,72	0,00	290.401,37
Smoothing II	573,25	0,00	3.717,04	0,00	9.313,25
Bomb	0,00	0,00	0,00	0,00	356.186,40
Casting	94,13	0,00	0,00	0,00	299.815,39
Forging	0,00	0,00	32.944,52	0,00	77.722,07
Welding	234,33	0,00	0,00	0,00	38.146,85
Rubber	0,00	2.789,15	0,00	1.494,84	0,00
Composite	162,77	0,00	0,00	0,00	19.021,38
Wood	0,00	0,00	0,00	0,00	424,54
Printing	0,00	0,00	0,00	0,00	7.126,00
Textile	0,00	1.424,30	0,00	0,00	9.989,78
TOTAL	**7.742,15**	**4.213,45**	**113.799,16**	**1.494,84**	**1.108.147,03**
UNIT COSTS	**7.742,15**	**28,09**	**113,80**	**0,43**	**82,08**

Table 4.23 Comparison of the product unit costs

Product Type	**Number of Prod. (Unit)**	**Total Prod. Time (Min.)**	**Unit Prod. Time (Min.)**	**Product Unit Costs (YTL)**		**Difference (YTL)**	**(%)**
				Current Cost Accounting	**Activity Based Costing**		
ICKFR1K	1	215,61	215,61	7.742,15	7.479,16	**262,99**	**3,4%**
IAODP1K	*150*	*120,00*	*0,80*	*28,09*	*35,81*	***-7,72***	***-27,5%***
IABDT1K	1.000	2.880,00	2,88	113,80	83,42	**30,38**	**26,7%**
IA5S51K	*3.500*	*41,00*	*0,01*	*0,43*	*1,19*	***-0,76***	***-177,7%***
IACOP1K	13.500	31.912,50	2,36	82,08	59,85	**22,23**	**27,1%**

- As for the second product, unit product cost calculated through the current cost accounting is less than ABC at a rate of 27.5 %. The current system calculated a relatively low cost value due to the fact that the quantity of the product manufactured is less and that only two jobshops dealt with the production process. As is seen, the unit production time for the said product is quite low. This is the most accurate indicator of the fact that the current system calculated

according to the production time. The more the total production time increases, the lower the costs to be calculated through ABC will be when compared with the current system.

- Referring respectively to the third and the fifth products, ABC presented better results when compared with the current cost accounting. Accordingly, for the third product lower cost values rated as 26.7 % and 27.1 % fort he fifth product are attained.
- Referring to the fourth product, a result similar to the second product has been achieved. The current cost accounting calculated a lower cost rated as 117.7 % when compared to ABC.

When the unit cost value for the selected products calculated through both current cost accounting and ABC are taken into account;

1) Referring to the current cost accounting, it has been determined that;
    a. For cost driver, mostly the direct man hour data (production quantity, number of personnel) are used,
    b. Total production time of the product the unit cost of which is to be calculated and the jobshops where the product is treated pursuant to the production process and the production quantity directly affect the calculations,
    c. The more the total production time (production quantity x unit production time) increase, the more the cost will be whereby the unit costs also increase (or vice versa),
2) In ABC
    a. Cost accuracy and verification vary depending on the cost driver to be selected,
    b. It is a requisite to select cost drivers in different types and characteristics,
    c. Where there exist abundance of details, it takes a long time to calculate things but the costs increasingly are denominated in a much more accurate and verified manner.

When comparing ABC with the current cost accounting, it should be taken into account that costing system used by the enterprise does not possess all of the elements that any traditional costing system should have. Therefore, it is not possible to compare ABC with the traditional cost accounting method, fully. However, in general, it has been observed that the calculation approach through ABC is concluded with much more consistent and affirmative results when compared with the traditional costing methods.

In practice, it is possible to make ABC, which is currently being used in a restricted manner, commonplace for the entire factory and turn it into a much more accurate costing system through the new activities to be determined and the cost drivers to be enriched. In particular, it is seen that this specified approach can be used at ease in an environment supported with computers. However, when evaluated from the point of view of the manager, the usage and the expectations of the method to be applied, the status of the company within the sector, etc will be determinative for the cost model to be tailored as well as.

It is possible to provide significant information pertinent to the activities of the company using ABC. It is easy to determine which of the products consumed activities most and which of the activities cost highly. Thus, ABC will be assisting the management in establishing the program for “decreased cost” in any field of activity. It has also been observed that ABC gives the most favorable results in the environments where “labor” is the major issue. In the companies where the application is made, labor costs are the most important cost item.

In the application, a similar result has been achieved through ABC which is theoretically expected to present a more detailed and much more accurate costing data, when compared with the traditional costing systems. In this system, apart from costs, the activities of company are systematically analyzed. The preparatory period should be evaluated in the best manner in order to implement ABC successfully. However, it is of great importance to enter the correct data in the system in order to attain the most healthful results through ABC.

CHAPTER FIVE
CONCLUSION

Nowaday's companies are changing due to the effects of technological development and global competition. New automation based production systems are arising by integration of technology with production process. Global competition forces to produce high quality, cheaper and different kinds of products. So, the companies have to use new technologies and new production techniques such as just-in-time, flexible manufacturing, and computer aided manufacturing, etc.

Enterprises carrying out labor-intensive production using traditional ways can produce only few types of products. So, the direct labor cost constitutes the most important part of the production costs and the percentage of indirect manufacturing costs in production costs is low. However, the workforce is substituted by automation in today's production systems. So, direct labor cost has become less important than indirect manufacturing cost. The increase in the percentage of indirect manufacturing costs causes an increase in the importance of distribution of indirect manufacturing costs to product. The enterprise which does not take into consideration the realistic distribution of costs loses the competition power.

ABC is a new costing system which aims to load the costs according to the cause and effect relation between indirect manufacturing cost and products. This costing system uses activities to ensure this relation. Main cause of the cost is not products but the activities which have been done during the production. While the activities consume the enterprise's resources, the products consume these activities.

ABC differs from the traditional costing systems by two ways. Firstly, it uses activities rather than cost centers as in traditional systems and defines different cost centers for each activity group. Secondly, cost factors, which are used to load activity cost collected in cost centers to product, are different from cost drivers that are used in traditional systems. Furthermore, the number of cost drivers in traditional costing systems is less than the number of cost drivers in ABC.

Implementation results of ABC show that it is not only a product costing method but also an important management tool. In practice, ABC is used in cost reduction, continuous improvement, performance evaluation, making decision about the product, budgeting, making profit analysis, defining the product mix, etc. So, it can be considered as a costing system that provides detailed information about the consumption of activities and presents accurate cost information used in decision making process by managers.

One of the important properties of ABC is its flexibility to be adapted to different kinds of systems from simple to complex. So, it is proper to use it in all kinds of enterprises with their processes and their job costing systems. In this subject, the distinctive property is the expectation of the enterprise from the ABC system. As a result, ABC is not only an alternative to costing system but a complementary system.

In general, it is accepted that ABC provides correct costing information. However, it must be known that ABC has several disadvantages. This new system can not be seen as the system which solves all the problems of product costing. Since some of the activities do not have relations with the products directly, the costs found by the ABC system may not be the “real cost”. There may be costs which do not depend on cause and effect relation in enterprise. In general, common costs caused by managerial activities or activities like factory cleaning, security providing and the costs about the building such as, rent, depreciation, insurance, estate duty, etc., are in this category. So, this is an important disadvantage that restricts the ABC to calculate the real product costs. For these kinds of costs, there are two possible solutions. The first one is not to load these costs to the products. The second one is to load these costs to products by using some kinds of distribution measurements. So, ABC provides the correct cost information rather than traditional systems, but this information is not the perfect one.

Although ABC has several weak points, this costing system is widely used in developed countries such as, USA, England, Germany. Using this system, the company will make better managerial decisions, check its price politics and obtain

much realistic cost information. It must be noted that implementing ABC system is very complex and it requires lots of information.

The enterprises which want to implement this system must determine that the system is proper for them. For this purpose, the importance of indirect manufacturing cost in cost structure must be analyzed and examined in detail by taking into consideration the factors such as, product variety, complexity of production process, and percentage of automation in production process, etc.

The enterprises which want to use this system for the first time must set a team that work for these procedures in implementing ABC. Since the information system needs to concern all department of enterprise, all the departments must support the system. Successful implementation also requires support of the management boards.

In establishment phase; as in the most examples in the world, it is proper to establish a separate system from the current costing system. Mostly, in this phase, the test application is advised. So, there would be a chance to compare the results by the current system and to see the differences. If the results of this comparison are encouraging, the implementation scope would be enlarged.

Increasing the degree of the information and the results causes high level of establishment costs. Because of that, in the first phase, “not exactly wrong but approximately true” understanding is accepted as a general criterion. As a result, at the first establishment of the system, a “simple” system can be modeled not a “complex” one. However, the system must be both simple and sustainable to form a general opinion about results. The ABC system in this study may be evaluated as a simple system.

It can be seen that so many ABC systems would be established in the enterprise in which the implementation is done. This is the main benchmark of ABC’s flexible structure which may be different from enterprise to enterprise. On the other hand, it is assumed that ABC performs well at labor-intensive mediums.

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