ACTIVITY BASED COSTING SOFTWARE FOR MANUFACTURING INDUSTRIES

AZRULHIZAM BIN SHAPI'I

A project report submitted in partial fulfilment of the
requirements for the award of the degree of
Master of Science (Information Technology-Manufacturing)

Faculty of Computer Science and Information System
Universiti Teknologi Malaysia

MARCH, 2004

UNIVERSITI TEKNOLOGI MALAYSIA

BORANG PENGESAHAN STATUS TESIS◆

JUDUL : **ACTIVITY BASED COSTING SOFTWARE FOR MANUFACTURING INDUSTRIES**

SESI PENGAJIAN : **2003/2004**.

Saya **AZRULHIZAM BIN SHAPI'I**
(HURUF BESAR)

Mengaku membenarkan tesis (PSM/Sarjana/Doktor Falsafah)* ini disimpan di Perpustakaan Universiti Teknologi Malaysia dengan syarat-syarat kegunaan seperti berikut :-

1. Tesis adalah hakmilik Universiti Teknologi Malaysia
2. Perpustakaan Universiti Teknologi Malaysia dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan tesis ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. **Sila tandakan (✓)

☐	SULIT	(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972)
☐	TERHAD	(Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)
☑	TIDAK TERHAD	

Disahkan oleh

(TANDATANGAN PENULIS) (TANDATANGAN PENYELIA)

Alamat Tetap :

NO 79, TAMAN RIA, JALAN SALLEH, 84000 MUAR, JOHOR DARUL TAKZIM.

DR. MUHAMMAD SHAFIE ABD LATIFF
Nama Penyelia

Tarikh : 29/3/2004 Tarikh : 23/3/2004

CATATAN :
- * Potong yang tidak berkenaan
- ** Jika tesis ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh tesis ini perlu dikelaskan sebagai SULIT atau TERHAD
- ◆ Tesis dimaksudkan sebagai tesis bagi Ijazah Doktor Falsafah dan Sarjana secara penyelidikan, atau disertasi bagi pengajian secara kerja kursus dan penyelidikan, atau Laporan Projek Sarjana Muda (PSM)

"I/We* hereby declare that I/we* have read this thesis and in my/our* opinion this thesis is sufficient in terms of scope and quality for the award of the degree of Master of Science (Information Technology-Manufacturing)

Signature : .....

Name of Supervisor I : Dr. Mul ammad Shafie Abd Latiff

Date : 24/3/2004

Signature : .....

Name of Supervisor II : En. Wan Harun Wan Hamid

Date : 29/03/2004

Signature : .....

Name of Supervisor III : En. Jafri Mohd Rohani

Date : 24/3/04

* *Delete as necessary*

I declare that this thesis entitled " *Activity Based Costing Software for Manufacturing Industries* " is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : .....

Name : AZRULHIZAM BIN SHAPI'I

Date : 29 MARCH 2004

To my beloved mother and father... Puan Hajah Norpipah and Tuan Haji Shapi'i

ACKNOWLEDGEMENTS

First and foremost, I am indebted to my principal supervisor, Dr. Muhammad Shafie Abd Latiff, who has been very supportive at every stage of this study. I wish to express my utmost gratitude to him for his invaluable advice and patience in reading, correcting and commenting on the drafts of the project. His kindness and spiritual support has made me feel more confident during the study period. Without his generous assistance and encouragement, this study could never have been completed. I am especially grateful to my co-supervisors, En. Wan Harun Wan Hamid, En. Jafri Mohd Rohani, and Pn. Nurulhuda Firdaus for their kindness and encouragement. I appreciate their reading, guidance and comments on this study, as well as their provision of kind support and valuable information for the research. I wish to express my thanks to all lecturers, staff and friends from Faculty of Computer Science and Information System, University Technology Malaysia, for helpful comments.

Finally, I am particularly indebted to my dearest parents. I wish to give my heartily thanks to them for their continuous support and encouragement throughout my studies and my entire life, even though the value of my appreciation cannot compare with everything they have done for me. This thesis is lovingly dedicated to them.

ABSTRACT

Manufacturing companies in Malaysia face ever-increasing competition in today's global marketplace. Companies must react quickly and manufacture high quality, low cost products to be successful in this new environment. Nowadays, complexity-manufacturing technology has led to increasing indirect cost or overhead cost in the calculation of the total production cost. The failure of traditional costing method in tracing overhead cost to products has caused the distortion of product cost. A new costing method named Activity Based Costing (ABC) has been introduced as an alternative for solving the problem. This ABC method has been implemented for product costing. The main purpose for this study is to develop computerized ABC system for the manufacturing companies. This software enables the companies to identify the characteristics of activities and the costs involved in activities. ABC can assign dollar values to every activity or process. The ABC software is hoped to improve further the process planning and action of manufacturing companies through cost savings and improving revenue.

ABSTRAK

Syarikat-syarikat pembuatan di Malaysia pada hari ini sedang bersaing untuk menempatkan diri dalam pasaran global. Syarikat pembuatan ini perlu bertindak pantas dan perlu menghasilkan produk yang berkualiti tinggi, harga kos yang rendah supaya boleh berjaya di pasaran hari ini. Pada masa sekarang, harga kos untuk sesuatu produk dikira berdasarkan jumlah kos langsung dan kos tak langsung yang digunakan ketika mengeluarkan produk tersebut. Biasanya kegagalan kaedah pengekosan secara tradisional adalah mengenalpasti kos tak langsung yang boleh menyebabkan perubahan pada kos produk. Satu kaedah baru yang dinamakan kaedah pengekosan berasaskan aktiviti (ABC) telah diperkenalkan sebagai alternatif untuk menyelesaikan masalah tersebut. Kaedah ABC ini digunakan sebagai salah satu kaedah untuk mengekoskan produk. Tujuan utama kajian ini dilaksanakan adalah membangunkan perisian ABC yang boleh digunakan di syarikat-syarikat pembuatan. Perisian ini mampu untuk mengenalpasti ciri-ciri aktiviti dan kos untuk setiap aktiviti yang terlibat semasa pengeluaran produk. Penggunaan perisian ini diharap dapat membantu syarikat pembuatan membuat perancangan pengeluaran dan mendapat keuntungan melalui maklumat kos yang tepat.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Introduction

The present era of global competition leading all companies towards a renewed commitment to excellence in manufacturing. Attentions to the quality of products and process, level of inventories of workforce policies have provided an edge to become world-class companies (Gunasekaran, 1999). However, most manufacturing companies today still use the same traditional costing that were developed decades ago for competitive environment which is drastically different from today. The main reasons for adopting new costing system is traditional costing systems tend to distort product costs and lead to poor strategic decision-making (Kaplan, 1990). One innovative costing method designed to deal with the deficiencies of traditional costing systems is Activity Based Costing (ABC) which was first introduced by Kaplan and Cooper in 1980's. ABC is an information system that maintains and processes data on a firm's resources, activities and products (Wan Harun, Jafri, and Zailis, 2001). It is used to traces resources costs to each activity and uses various cost drivers to trace the cost of activities to product. The use of ABC can be extended to identify performance of each activity and

cost objects. In this study I will develop ABC software that can be use in manufacturing companies. This ABC software will be programmed to facilitate the company in product costing that use ABC method.

1.2 Project Title

Activity Based Costing (ABC) Software for Manufacturing Industries.

1.3 Problem Statement

Manufacturing companies in Malaysia face ever-increasing competition in today's global marketplace. Companies must react quickly and manufacture high quality and low cost products to be successful in this new environment. Examples of companies succeed in implementing ABC are Volkswagen (Canada) and Cummins Engine Company (UK) (Gurses, 1999). As the manufacturing environment moves to computer-integrated manufacturing and the products that are manufactured are diverse, conventional cost systems can report seriously distorted product costs.

To make proper decisions, managers must have accurate and up to date costing information. Traditional costing systems based on volume-based allocation of overhead have lost relevance in a manufacturing environment (Roztocki, et. al, 1999). Traditional

costing systems tend to distort product costs and lead to poor strategic decision making. This is why a new cost management system is needed. The managers must determine the "true" cost for a product. Inaccurate cost information can result in incorrect decisions, because not all of the consequences have been taken into account. Furthermore, because of distorted cost information, an insufficient analysis/allocation of overhead costs can result in overpriced high-volume products and under priced special products. These problems led to the idea of Activity Based Costing (ABC), particularly in companies producing a range of products. ABC aims not only to allocate overhead costs more accurately but also to pinpoint areas of waste. Underlying ABC is the assumption that activities (such as purchasing, receiving, setting-up and running a machine, etc.) consume resources, and products consume activities. The performance of activities triggers the consumption of resources that are recorded as costs in the accounts. This means that ABC traces costs to products according to the activities performed on them. The result is more accurate cost information, with less distortion. Three benefits accrue from this: a focused manufacturing strategy, products designed to increase customer value, and continuous improvement of operating activities throughout the manufacturing organisation (Helberg, Galletly and Bicheno, 1994).

ABC is a costing method used to trace overhead costs directly to cost objects (i.e. product, services). ABC is a method that calculates costs based on activities and it is suitable especially for multi-products company. It is more accurate method to calculate product's cost. ABC allocates all resources cost, first to activities and then to product. Resources are economics element that applied or used in the performing of activities and indirectly support cost objects. The ABC software shows how ABC system is using to reduce process and product costs.

1.4 Project Purpose

Develop the software that can be using by manufacturing industries. The software that have be developed shows how ABC system can reduce product costs using ABC method.

1.5 Project Objectives

i. To demonstrate the ABC costing system in calculating product cost and compare with traditional method.
ii. To analyze the current ABC software limitations (Excel Programming).
iii. To developed prototype ABC software.

1.6 Project Scope

i. The costing method that using in this project is Activity Based Costing method.
ii. The software that has been developed is using only in manufacturing companies.
iii. Using Borland Delphi 5 to develop the ABC software.

CHAPTER 2

LITERATURE REVIEW

2.1 A General Look at Activity Based Costing (ABC)

ABC is a costing method that assigns costs first to activities then to products based on each product's use of activities. Based on the concept that products consume activities and activities consume resources (Cooper and Kaplan, 1991). ABC has received a great deal of attention as a cost management innovation. Numerous proponents of ABC argue that its methods are necessary to trace overhead costs to cost object, and thus properly account for batch and product-level costs (Cooper, 1990). Many also recommend using ABC to support process improvement and to develop cost-effective product designs (Cooper and Turney, 1989). Although ABC systems are most often associated with manufacturing companies, they also can be applied in all types of organizations (Cagwin and Bouwman, 2000). The two fundamental components of ABC are costs and activities (Abrahams and Reavely, 1998).

ABC on the other hand, focuses on activities performed in manufacturing the product. ABC is defined by Computer Aided Manufacturing-International (CAM-I) as "the collection of financial and operating performance information tracing the significant activities of the firm to product costs" (Raffish and Turney, 1991).

2.1.1 Costs

Costs are based on resources or inputs. These costs correspond to various manufacturing company charts of accounts generally consisting of salaries, materials, equipments, facilities, and overhead.

2.1.2 Activity

Activities are the steps or sequences of events that convert inputs to outputs. Activities have a set of three distinct characteristics that define them. Every activity has inputs, a sequence of actions and an output. An output may be something other than a product or service, e.g., a student graduating with a specific set of skills, and a certain level of competencies and knowledge (Abrahams and Reavely, 1998).

2.2 Typical Situation In a Manufacturing Firm Today

These are typical situation in small manufacturing firm in Malaysia. These situations just not happening in Malaysia only but at almost manufacturing firm in the world;

i. Technically good products/service

ii. Products/service delivered on time

iii. Satisfied customers

iv. Productivity around or above branch average

v. Very successful growth in the first years being founded

vi. Unacceptable level of profitability for period of time

Common beliefs to the situations;

i. Not enough sales to be profitable

ii. Times are harder now (economic downturn)

iii. End products are sold for too low a price.

The reality to these situations;

i. An increase in sales does not necessarily increase profit

ii. Some products are money makers and some money losers

iii. They are too many money losers

iv. Nobody is sure where money is being made and lost

Based on the situations, it is important to determine the true production costs. This true cost should able to identify moneymakers and money losers.

2.3 Problems on Traditional Cost Systems

There are many problems on traditional cost systems. The problems are explained below.

2.3.1 Designed Based on the Manufacturing Environment in the Early Twentieth Century

i. Material and labor were the principle cost
ii. Indirect and support expenses were less important cost component, difficult to measure
iii. Cost measurement system were expensive

2.3.2 Characteristics of Today's Manufacturing Environment

i. Indirect and support expenses costs are significant percentage of cost.
ii. Direct material and labor costs are no more the principle cost components.
iii. Cost measurement system is no more expensive.

2.3.3 Inaccurate Product Costing System Lead to Price Distortion

i. Overhead cost "absorbed" to cost unit by using labor hour/machine hour (the costs are unrelated to product being produced - not reflected by the actual use of resources).
ii. Using the average cost/price
iii. Inaccurate information on product performance/profitability- difficult to make decision on make/buy decision, special offers, drop/continue decision, product mix decision.

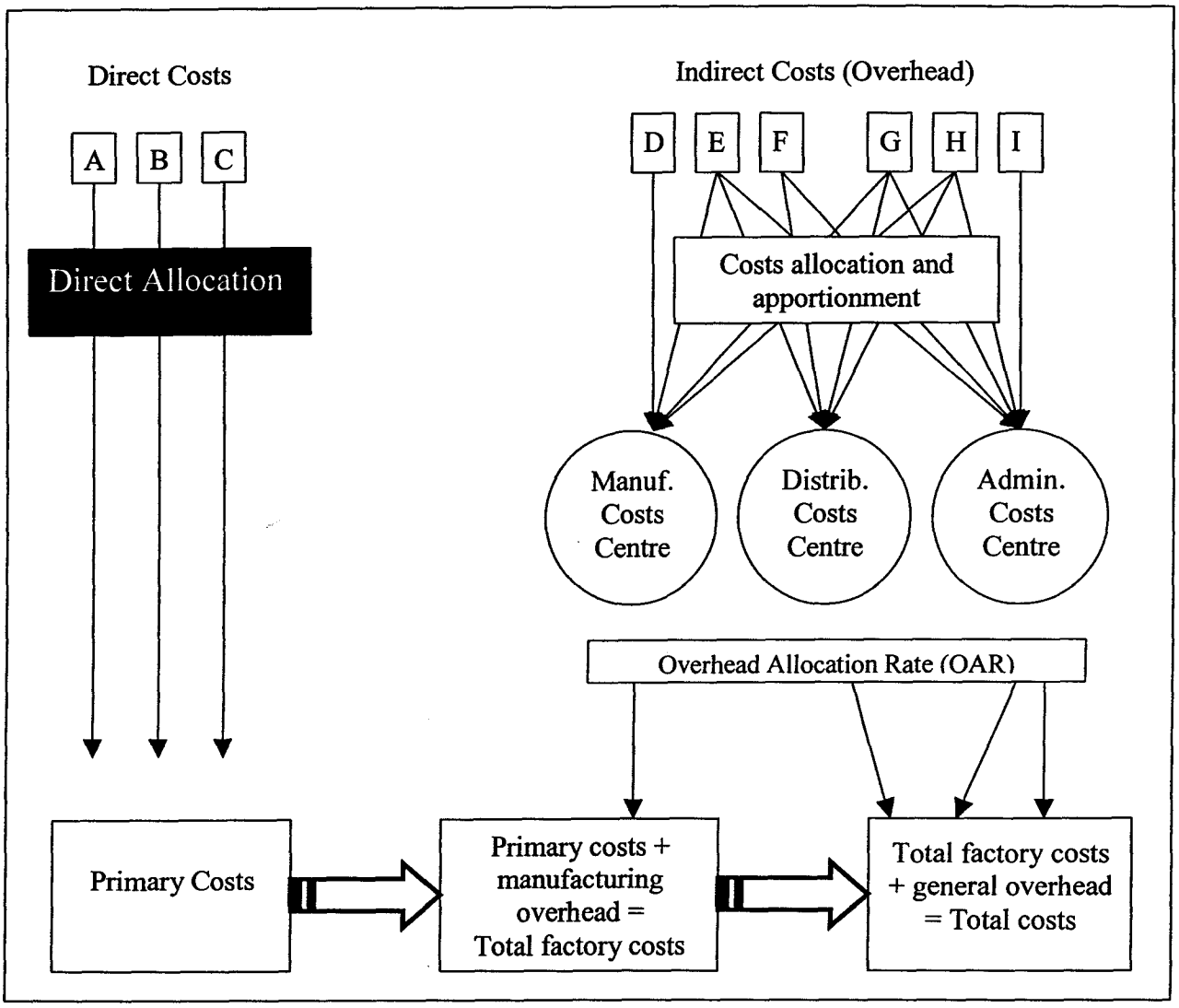


Figure 2.1: Traditional costing method (adapted from Esculier, 1997)

2.4 Justification for a New Costing System

The present era of global competition is leading all companies towards a renewed commitment to excellence in manufacturing. Attention to the quality of

products and processes, level of inventories and improvement of workforce policies is given by companies to become world-class companies (Gunasekaran and Singh, 1999). However, most companies still use the same traditional costing system and management controls systems that were developed decades ago for a competitive environment drastically different from today (Cooper and Kaplan, 1991). The main reasons for adopting the new cost system are discussed hereunder.

2.4.1 The Traditional Costing System Does Not Provide non-Financial Information

Gunasekaran (1999) states the traditional costing system does not provide non-financial information such as cycle time, and turnover rate in a company. It provides little useful information about what matters to the customers. Factors such as quality and service are out of their domain. They report only financial information such as rate of return on investment, profit level and market share. Non-financial information including defect rates and throughput rates in each activity is outside the scope of the traditional costing system.

The financial information in traditional costing has limited utility because of the following factors:

i. Cost information is an indirect measure of quality and time. Direct measure of defects and throughput time are easier to interpret than a number of cost variances.

ii. Cost information not reported by activity. It is not known how much it costs for each activity to serve its customers. Instead, traditional costing system reports costs by classification of items such as salaries and depreciation and by function such as engineering or marketing. This information is too aggregated (related to several activities) to permit analyzing the value customers receive from any one activity.

iii. Cost information is typically reported too late to support improvement efforts. Cost system reports are prepared monthly and distribution usually occurs a few days after. A monthly report released in the middle of the following month contains information, which is on average 30 days old. By this time the trail has gone cold, reducing the likelihood that action will be taken.

2.4.2 Inaccurate Costing System

An important factor that determines customer profitability is the type, number and cost of product or services purchased. Traditional cost systems do not measure the manufacturing cost of each type of product accurately. The traditional cost system often reports error in product cost by hundreds of percentage (Turney, 1996). The problem is in the underlying methodology of the traditional cost system. They adhere to the assumption that product causes cost. Each time a unit of the product is manufactured, it is assumed that cost is incurred. This assumption does make sense for a certain type of cost. For example, the cost of activities performed directly on the product unit such as direct labour fits this assumption. However, it does not work with activities that are not performed directly on the product units. For example, some activities are performed on batches of product like machine set-up. The traditional cost system deals with units, not

batches (Green and Flentov, 1991). Other activities are performed by product type. When engineering specifications of a product change, all future product units will be affected, not just a single unit. Again this does not fit into the volume-based cost allocations and assumptions of the traditional costing system (Gunasekaran, 1999).

2.4.3 Costing System Should Encourage Improvements

Traditional cost systems are dominated by functional classification. These functional classifications are accompanied by cost variance as performance measures. These measures often cause behaviour that improves functional performance at the expense of overall performance (Miller, 1996). To get going in the right direction, companies need some kind of signals to guide them. For example, cost measures are signals that stimulate action. People pay attention to cost signals because they are often used to gauge and reward performance. It is important for a cost system to send the right signals. The wrong signals may misdirect improvement efforts, encourage action that interferes with improvement and even endanger the company's existence (Miller, 1992). Improvement focuses on the work – the activities of the organization. However, traditional costing does not report useful information about those activities that have the most potential for improvement. Traditional costing can give information about salaries and depreciation at the department level. Such functional overhead reports tell us nothing about the value-adding activities by the workers in the department.

Good information about activities does help focus efforts to improve. It helps to set improvement priorities and gives feedback about progress. Moreover, traditional cost

system does not report the activity information needed to gain insights about how to improve.

2.4.4 Overhead Cost is Predominant

Production and non-production overheads have grown up in relative importance as more resources have been committed to the organization and management of production and to the provision of quality and services to the customer. The need to control and account for the cost elements has thus become of increasing significance.

The nature of overhead costs has changed from costs, which were predominantly influenced by the output volume to a composition determined largely by the complexity and diversity of production. Increasingly, overhead costs have been generated by the quest to exploit economies of scope as well as economies of scale. Higher the overhead, higher is the chance for distortion in reported costs. As a rule of thumb, overheads that exceed 15% of total costs may cause inaccuracies in a traditional cost system.

Many companies making fundamental changes in the organization and technology of their manufacturing process, but they ignore the costing system. It is clear that information available from the traditional cost system is not sufficient for continuous improvement programs, which are essential for companies to compete in a rapidly changing environment. The traditional costing system does not give accurate information about the consumption of different resources and the activities of the

organization. The ABC system is an information-rich cost system, which is necessary for the success of companies.

2.5 History and Development of ABC

ABC are pioneered by Robin Cooper, Robert Kaplan and H. Thomas Johnson in 1980's. ABC was originally developed in the late 1970's and early 1980's to supplement traditional cost accounting methods in the management of operations. Accounting professionals and operations managers were slowly realizing the existing cost systems were providing information that was not useful in decision making because of its lack of predictive value, feedback value and timeliness (Foote, 1994). Cost accounting systems developed in the 1960's and 1970's were developed with different objectives and in a significantly different manufacturing environment. The primary objectives of these early costing systems were to provide proper inventory valuations and to facilitate financial reporting by closing the monthly books. Current cost systems must do more than recording, analyzing, verifying and reporting costs, they must be able to provide information to allow for cost management.

Traditional management accounting has been reported to distort product cost in several ways. First, allocating overhead with volume-sensitive cost drivers provides reliable product cost information only if all overhead cost are triggered by or varied in proportion to units of outputs (Lea, 1998). Secondly, factory overhead costs are allocated rather than traced to products. The total overhead component of product cost has historically grown faster than direct cost. As overhead becomes a larger percentage of product cost, the distortion inherent in the allocation process causes the total product cost to be distorted.

Recognition of problems with traditional management accounting grew during the 1970's. As early 1971, George J. Staubus proposed management systems built on activities. In that year, he published *Activity Costing and Input Accounting*. Unfortunately, there was little interest in this new approach at that time. Moreover, the computer system needed to efficiently collect activity data did not yet exist (Lea, 1998).

In 1984 two accounting professors, Robert Kaplan of Carnegie-Mellon University and Tom Johnson of Portland State University began to expound the shortcomings of traditional management accounting. Concurrently, Robin Cooper of the Harvard business School developed a new type of cost system that allocated costs on activity. This method was called activity based costing (ABC), and begins to gain attention. However ABC was practically impossible until the advent of low cost computer technologies and MRP style databases made it economical to collect and compile the large amounts of information needed to apply ABC (Lea, 1998).

2.6 ABC's Structure

Cooper describes two stages in the ABC model. In the first stage, it assigns all costs of resources to the activities in activity centers based on the resource drivers (Gurses, 1999). In other words, costs are assigned to cost pools within an activity center, based on cost driver. There is no equivalent step in a traditional costing approach. In the second stage, costs assigned to the cost pools are then assigned to the products based on the product's consumption of each activity. This stage is similar to a traditional costing approach except that the traditional approach uses solely volume related characteristics of the product without consideration for non-volume related characteristics. Some

examples of cost drivers not related to volume include setup hours, number of setups, ordering hours, and number of orders. Allocating non-volume related costs using volume-based methods distort the product costs (Roztocki, et. al, 1999). The final costs assigned to a product are called a cost object. Cost drivers are used to assign the costs of activities to products. At least one cost driver is required for each activity. It is the second stage described above that separates ABC from traditional systems (see Figure 2.2). In traditional systems, costs are allocated to products based on just one cost driver, direct labor hours, instead of using more realistic cost drivers (Gurses, 1999).

Another unique feature of ABC is that the focus of this approach is on activities and the cost of those activities, rather than on products as in the traditional costing systems. It is this feature of ABC that gives management the necessary information to identify opportunities for process improvements and cost reduction. By using ABC information, managers can see the cost of each major overhead activity performed in a plant separately, and therefore can give right decisions about where to focus efforts to reduce costs.

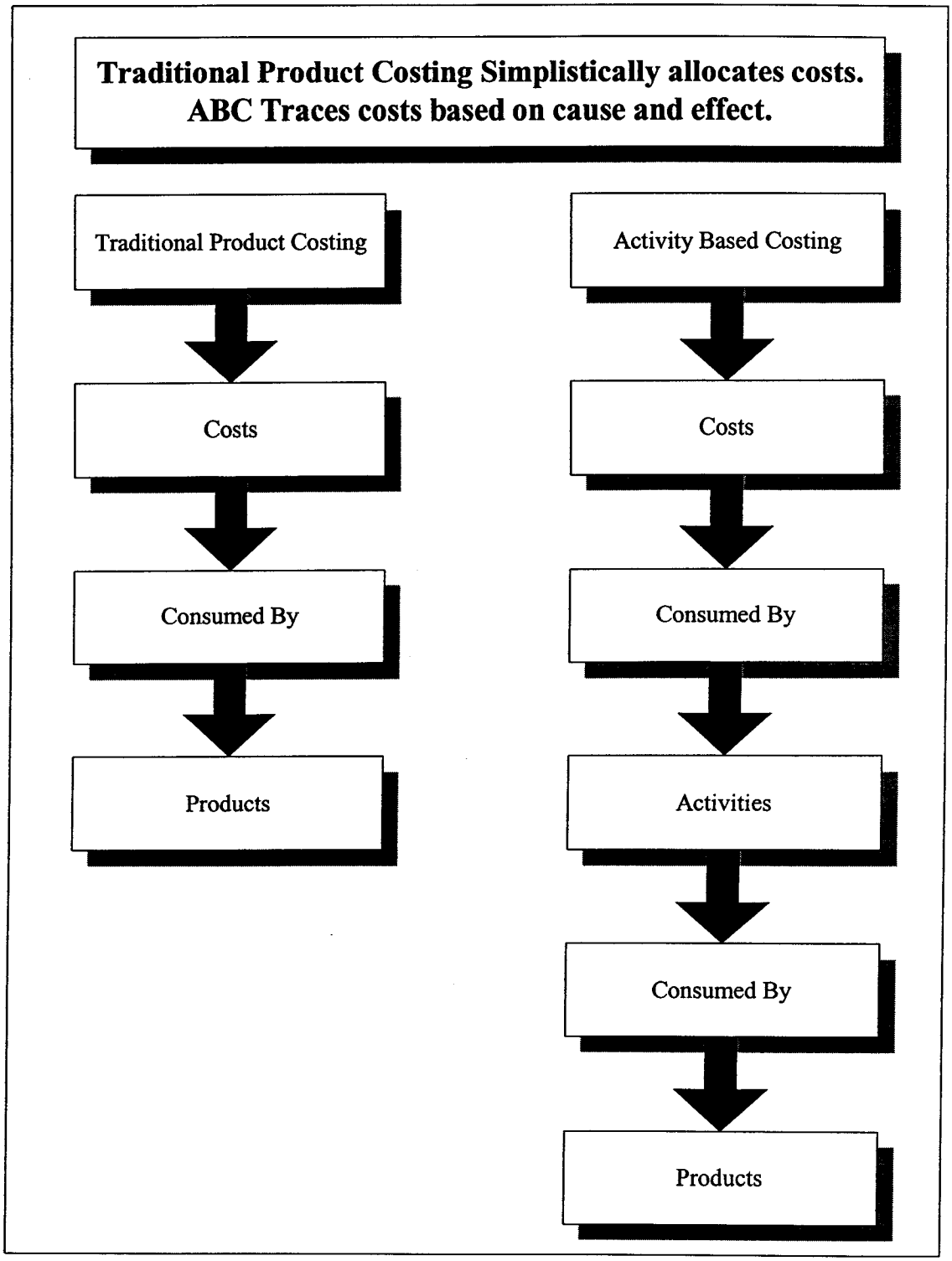


Figure 2.2: Traditional costing method vs. ABC (adapted from Mahidhar, 2002)

2.7 ABC Methodology

In the ABC model, overhead expense categories such as administration, transportation, and rent are identified. This cost data can be obtained easily from accounting. The next step is to determine the main activities that simplify the tracing cost information. This can be accomplished by grouping actions into activities and activities (or cost pools) into activity centers using the ABC approach (Roztocki, et. al, 1999). Some examples of activities for small manufacturing company are receiving a customer inquiry, customer quotes, production supervision, and shipping products. Expenses are going to be assigned to the previously define activities via the first stage cost drivers. Following the second stage, activity cost drivers is determined to allocate overhead to individual products. Figure 2.3 illustrates the relationship among expense categories, activities, and products.

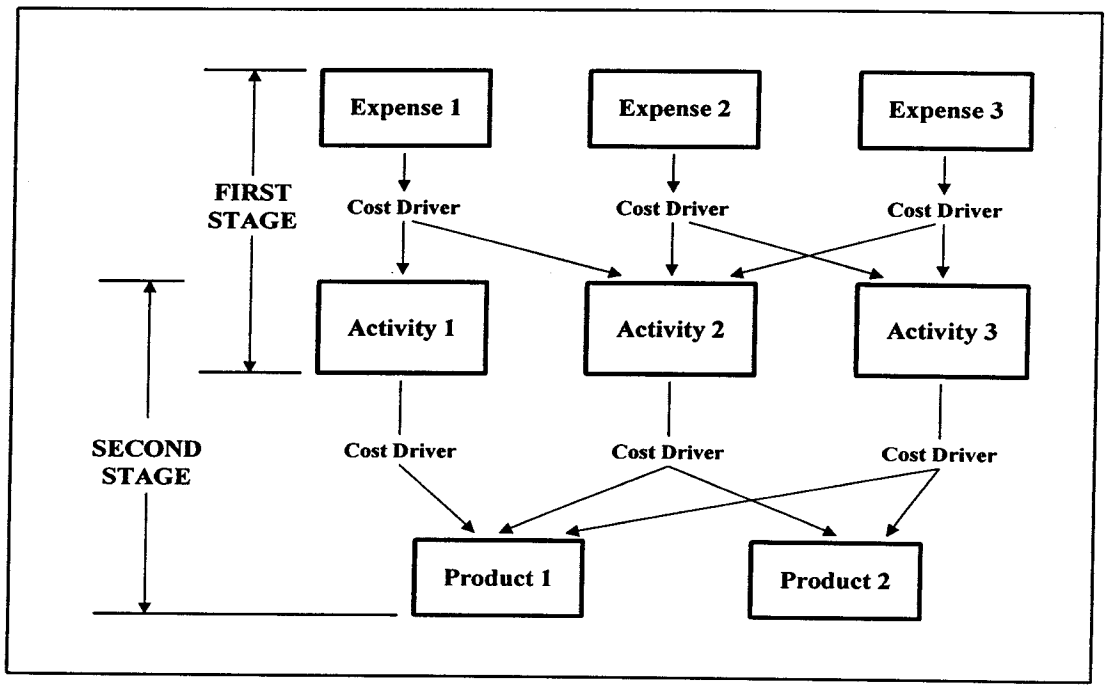


Figure 2.3: Relationship among expense categories, activities, and products (adapted from Roztocki, 1999)

The proposed methodology (Roztocki, et. al, 1999) assumes that the overhead cost and its categorization are available, generally from accounting. Expense categories refer to the traditional way in which a company divides manufacturing overhead. This information will assist the manufacturing companies in validating that the total overhead calculated at the beginning of the process matches the total obtained when summing the overhead that is assigned to each individual product using ABC method (Roztocki, et. al, 1999).

2.7.1 Identifying Activities or Cost Pools

In order to implement ABC, the complete business process should be divided into a set of activities. A flowchart of the process is a commonly used tool for identifying these main activities. Each box represents activities and arrows denote the flow of the system. Thus, in order to establish the needed activities for ABC, homogeneous processes must be grouped together (Roztocki, et. al, 1999). In other words, product driven activities and customer driver activities must be separated in order to establish two individual homogeneous activities. Examples of activities for manufacturing companies are quote preparation, production supervision, and material handling.

2.7.2 Activities and First Stage Cost Drivers

Once the main activities have been defined, a total cost of each activity can be calculated. First, the expense categories related to each activity are identified. For example, the activity cost for "quote preparation" includes costs from various expense categories such as salary, rent, utility, and office supplies. To properly trace the expenses to each activity, cost drivers, also called first stage cost drivers, have to be identified for each expenses category. For instance, the expense category "rent" associated with the activity "quote preparation" may be driven by square feet, whereas, the expense category "salary" may be driven by the amount of time the employees spends on this activity.

2.7.3 Second Stage Cost Drivers

In the second stage, activities are traced to products using second stage cost drivers. As with first stage cost drivers, data needed for second stage drivers may not be readily available to represent the proportion of cost pools that correspond to the products. For instance, mileage can be difficult to trace to individual product. In the absence of actual data there becomes a need to estimate the amount of activity cost consumed by each product.

2.7.4 Information Gathering Procedures

Gathering information is essential in order to achieve accuracy of final product costs. An important part of the required data is the proportions needed in each stage of an ABC costing system. Each activity consumes a portion of an expense category. Similarly, each product consumes a portion of an activity. As discussed previously, a proportion usually represents this portion. For instance, the activity "quote preparation" consumes 0.1 (10%) of administration expenses. There are many ways to obtain these proportions and the selected procedure will impact the desired accuracy. Three levels of data accuracy can be used in estimating these proportions: educated guess, systematic appraisal, and collection of real data.

i. Educated Guess

In the case where real data cannot be obtained or data collection effort cannot be financially justified, and educated guess can be made in order to obtain proportions (Roztocki, et. al, 1999). These guesses should be done collaboratively by management, financial organizers, and operational employees associated with the costing center of interest. This team can provide an educated guess of the proportions of costs allocated in both stages of an ABC costing methodology. The level of accuracy obtained is based on a combination of the team's diversity and their knowledge of the cost center of interest.

ii. Systematic Appraisal

A more scientific way to obtain the proportions for tracing costs is using a systematic technique such as Analytic Hierarchical Process (AHP)

(Saaty,1982; Golden, Wasil, and Harker, 1989). AHP is suitable tool for pulling subjective individual opinion into more representative information. For example, assuming that the allocation of a gasoline expense is needed between three cost pools namely sales, delivery and maintenance. By questioning the departments that consume this resource and by asking them to evaluate what percentage of mileage they accumulate in a certain period of time, AHP can generate the percentage of this expense and allocate it to the appropriate cost pool.

A second area in which AHP can be used is to allocate the expense from the cost pool to each individual product. At this step it is important to determine and appropriate cost driver in order to achieve the desired level of accuracy. For example, suppose one manufacturing company wish to trace the sales cost pool to each product. One approach is to estimate the level of sales activity needed for each of the individual products. Let assume the following scenario: a company produces five products. Product A is a very well established product requiring minimal effort from the sales representatives when they talk to potential consumers. On the other hand, products B, C and D are in the middle of their life cycle. Finally, product E, is a new product that consumes a lot of time from the sales representatives. Instead of allocating an equal amount of sales expenses to each one of the products, AHP can provide an estimation that can allow the company to more accurately traces this cost to the products.

The methodology followed by AHP requires first determining factors that account for cost relationship between activities and products. In this specific illustration, locations of travel for sales and time spent with the client discussing each individual product may be some examples of these factors. Secondly, the sales representative assigns a ranking among products according to the distance needed to support them. A second raking among products is established in proportion to the time spent with customer. Finally, the subjective rankings of

sales representatives are combined by AHP and ratios for sales expenditure among the five products are obtained.

iii. Actual Data Collection

The most accurate and most costly procedure for computing proportions is the collection of real data (Roztocki, et. al., 1999). In most cases, a data collection procedure must be developed and data collection equipment may need to be purchased. Moreover, collection of the data will need to be timely and skilled collectors may be required. The results often have to be analyzed using statistical methods. For example, job sampling can be used to estimate the time proportion dedicated to supervise the manufacturing of a particular product. In this case, the supervising engineer is asked, at random time intervals, to specify the product being currently supervised. Based on this data, the needed information can be obtained.

2.7.5 Proposed Procedure for Tracing Overhead Expenses to Cost Objects

Roztocki et. al. (1999) suggests a procedure to trace overhead expenses to cost objects. The steps are as follows:

Step 1: Get the expense categories

The initial step is to examine the expense/resource categories included in the income statement of the manufacturing company.

Step 2: Identify main activities

Step 2 can be performed in parallel with Step 1.

Step 3: Relate expenses to activities by establishing and EAD matrix

In this step, the activities that contribute to each expense are identified and the Expense-Activity-Dependence (EAD) matrix is created. The expense categories represent the columns of the EAD matrix, whereas the activities identified in Step 2 represent the rows. If the activity *i* contributes to the expense category *j*, a checkmark is placed in the cell *i, j*.

Step 4: Replace checkmarks by proportions in the EAD matrix

Each cell that contains a checkmark is replaced by a proportion which is estimated using any of the procedures previously mentioned. Each column of the EAD matrix must add up to 1.

Step 5: Obtain dollar values of activities

To obtain the dollar values of each activity, the following equation is applied.

$$TCA(i) = \sum_{j=1}^{M} Expense(j) \times EAD(i, j) \qquad (1)$$

Where:

TCA(i) = Total cost of activity i

M = number of expense categories

Expense(j) = Dollar value of expense category j

EAD(i,j) = Entry i, j of Expense-Activity-Dependence matrix

Step 6: Relate activities to products by establishing and APD matrix

In this step, the activities consumed by each product are identified and the Activity-Product-Dependence (APD) matrix is created. The activities represent the columns of the APD matrix, whereas the products represent the rows. If the product *i* consumes the activity *j*, a checkmark is placed on the cell *i, j*.

Step 7: Replace checkmark proportions in the APD matrix

Each cell that contains a checkmark is replaced by a proportion which is estimated using any of the procedures previously mentioned. Each column of the APD matrix must add up to 1.

Step 8: Obtain dollar values of products

To obtain the dollar values of each product the following equation is applied.

$$OCP(i) = \sum_{j=1}^{N} TCA(j) \times APD(i, j) \qquad (2)$$

Where:

OCP(i) = Overhead cost of product i

N = Number of activities

TCA(j) = Dollar value of activity j

APD(i,j) = Entry i, j of Activity-Product-Dependence matrix

The procedure described can be easily implemented using common standard spreadsheet software.

2.8 Growing Interest in ABC

Activity-based Costing is being implemented by a growing number of companies around the globe. The main motivation for a company to implement and use ABC is the needed for reliable cost information. Reliable product cost information is considered to be a powerful tool in increasing a company's profitability and competitiveness. Specific ABC applications vary from organization to organization. A few organizations use ABC as their basic, ongoing cost accounting system. But many applications are selective-special studies within subparts of the organization such as business divisions or particular functions.

One study (Hongren, Foster, and Datar, 2000) of 162 U.S.-based companies (including 9 service-sector implementations) reported the following ranking;

Table 2.1: Implementation of ABC in USA (adapted from Hongren, Foster, and Datar, 2000)

	Ranking
Primary application of ABC	1. product/service costing 2. cost reduction 3. process improvement
Significant or very significant changes in decision	1. pricing strategy 2. processes 3. product mix

Among Canadian companies, one survey (Hongren et al., 2000) indicates that 14% of the interviewed businesses have implemented ABC and another 15% are

considering using it. What attracts Canadian firms to ABC? The ABC system has replaced existing system for 24% of the Canadian respondents, and it is a supplementary (off-line) system for 76%.

Table 2.2: ABC attraction among Canadian Company (adapted from Hongren, Foster, and Datar, 2000)

ABC attraction	Percentage (%)
More accurate cost information for product pricing	61
More accurate profit analysis	61
By product	22
By customer	20
By process	24
By department	43
Improved performance measures	43
Improved insight into cost causation	37

A United Kingdom survey found that "just fewer than 20% of 251 respondents had used ABC." The ranking of the application areas was:

Table 2.3: ABC application areas in UK (adapted from Hongren, Foster, and Datar, 2000)

	Ranking
Application areas	1. cost management 2. performance measure 3. product/service pricing 4. cost modeling

Table 2.4: Implementation benefits of ABC (adapted from Hongren, Foster, and Datar, 2000)

Nations	Benefits experienced
New Zealand	1. improved cost management 2. more accurate product/service pricing 3. accurate inventory valuation
Irish	1. more accurate cost information for product pricing (71%) 2. improved cost control and management (66%) 3. improved insight into cost causation (58%) 4. better performance measures (46%) 5. more accurate customer profitability analysis (25%)

Table 2.5: Implementation barrier of ABC (adapted from Hongren, Foster, and Datar, 2000)

Nations	Difficulties/problems
Canada	1. difficulties in defining activities 2. difficulties in selecting cost drivers
Ireland	1. identifying activities and assigning cost to those pools. 2. identifying and selecting cost drivers. 3. inadequate computer software 4. lack of adequate resources
New Zealand	1. obtaining reliable data 2. lack of middle management acceptance

2.9 Why ABC is Needed?

Manufacturing companies around the world include Malaysia are changing and becoming more information intensive, highly flexible, and immediately responsive to the customer expectations. Due to the changing manufacturing environment, traditional cost accounting is rapidly disappearing. Traditional accounting systems were developed at a time when direct labour was a large percentage of the total product costs (Gurses, 1999). Changes in manufacturing technologies, such as the just-in-time philosophy, robotics, and flexible manufacturing system decreased the direct labour component of production and increased overhead costs. The characteristics of the new manufacturing environment listed by Sullivan (1992) are shown in Table 2.6.

Table 2.6: The changes in manufacturing environment (Sullivan, 1992)

Yesterday	New Paradigm
High volume, long production runs, long product life cycles	Low volume, short product runs, short product life cycles
Small number of product variations in a domestics market	Large number of product variations in an international market
Large direct labour component ; high cost of processing information	Relatively high technology costs; relatively low information processing costs
Small indirect/overhead costs in relation to direct labour	Large indirect/overhead costs in relation to direct labour

In today's manufacturing environment, direct labour accounts for only 10% of the costs, whereas material accounts for 55% and overhead 35% (see Figure 2.4 and Figure 2.5). As a result, product cost distortion occurs due to allocating overhead costs to the products arbitrarily on the basis of direct labour hours used by each product (Harsh et. al, 1993). Several situations that can cause distortions to occur, such as

production volume diversity, complexity diversity, material diversity, and setup diversity (Cooper, 1988).

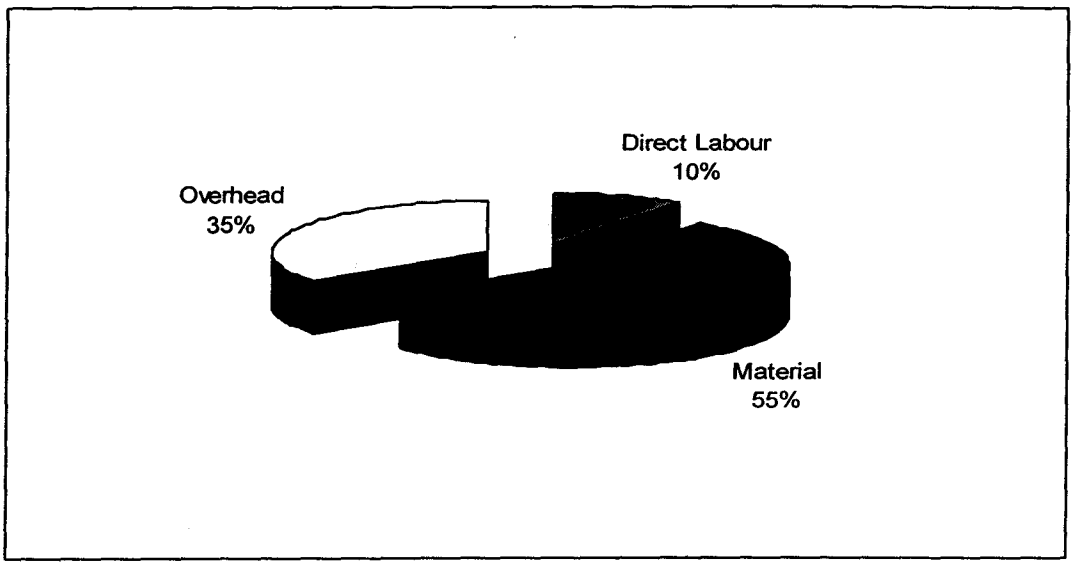


Figure 2.4: The proportion of material, direct labor and overhead costs in today's world (adapted from Pryor)

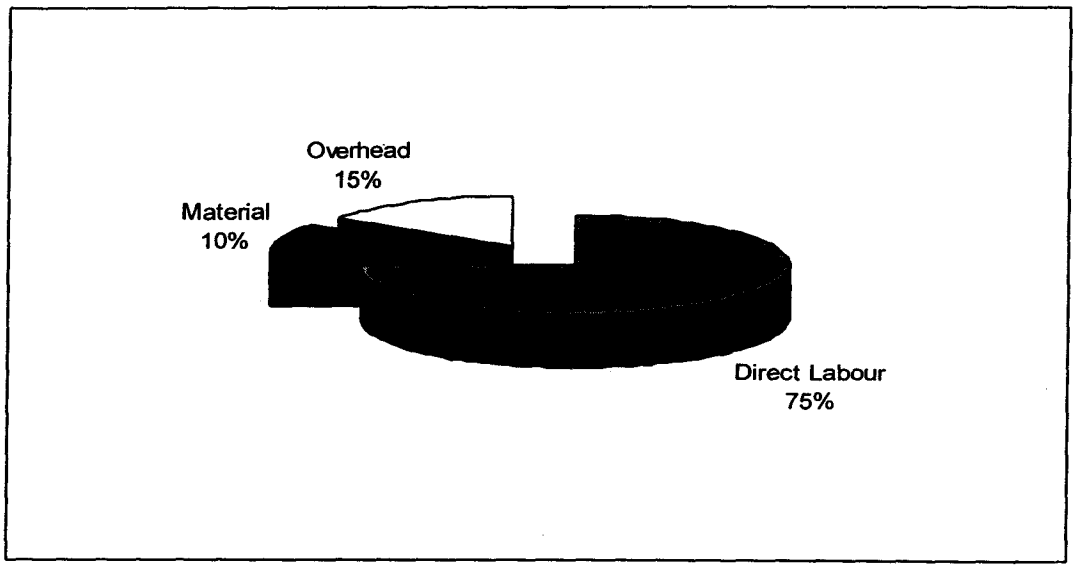


Figure 2.5: Where the traditional cost systems focus their attention (adapted from Pryor)

We use ABC to solve the product cost distortion problem. ABC provides the information to identify the components of overhead more precisely such that product design, development, production, and distribution decisions are better grounded (Gurses, 1999). ABC assigns resource costs to products more accurately, and as a result it acts as a decision support tool for companies. Decisions are not arbitrary, which is the case in traditional accounting systems, but based on facts (Harsh, 1993). The information obtained by using ABC can improve decision making in manufacturing companies.

2.10 When to Use ABC?

As with any course of action, the implementation of ABC is justified if the costs of installing and operating the system are more than offset by the long term benefits. The cost drivers used in an ABC system require the measurement of some unique attributes of each product. For example, using raw material invoices as a cost driver requires measuring the number of raw material invoices consumed by each product. Measuring these attributes can be expensive (Gurse, 1999). On the other hand, not using an ABC system may increase the cost of erroneous decisions made with inaccurate product costs. As the diversity of products increases, both the measurement costs associated with ABC and the cost of erroneous decisions associated with traditional costing system increased. Cost of measurement, cost of errors, and product diversity are continuously changing over time (Gurses, 1999). The decisions of when to implement an ABC system should be made by analyzing and balancing the costs of using ABC against the costs of not using it (Cooper, 1987).

In fact, quantifying these costs is very difficult. Fortunately, management can identify the need for ABC by observing the symptoms listed in Table 2.7.

Table 2.7: The symptoms to identify need for ABC

SYMPTOMS	Products that are very difficult to produce are reported to be very profitable, although they are not premium priced
	Profit margins are difficult to explain
	The results of bids are difficult to explain
	The competitor's high volume products are priced at unrealistically low levels
	Customers do not react to price increases, although there is no corresponding increase in costs

2.11 Vital Factors In ABC Implementation

Gurses (1999) states there are many factors that affect the success of ABC implementations. Based on search of the literature, the most important eight factors are as follows; top management support, other major initiatives, linkage to performance evaluation and compensation, training, non-accounting ownership, resources, and information technology sophistication. These factors are explained detail in the next sections.

2.11.1 Top Management Support

The most crucial factor in the success of ABC implementation is top management support. Almost all successful innovations require support of top management. Top management should focus resources, goals, and strategies on the implementation of ABC. They must demonstrate a commitment to ABC by using it as the basis for decision-making. To encourage the use of ABC information, top management must use ABC information in communications and agreements with other employees (Shields and McEwen, 1996).

2.11.2 Other Major Initiatives

According to a survey conducted by the Cost Management Group of the Institute of Management Accountants (IMA), 62% of the manufacturing firms trying to implement ABC but not having reached the usage stage report other major initiatives being implemented currently. Several companies expressed that they cannot commit enough resources to the implementation of ABC because of their need to implement other initiatives such as Total Quality Management (TQM), lean manufacturing, Just-in-Time, and balanced scorecard (Gurses, 1999 and Krumwiede, 1998).

2.11.3 Linkage to Performance Evaluation and Compensation

Shields and McEwen articulate that the importance of the linkage between performance evaluation and compensation, and ABC implementation is natural because employees pay attention to those things that affect their welfare. The welfare of most employees is affected by the system used to evaluate and compensate them. Therefore, when ABC is linked to performance measurement and compensation, and when employees believe that the resulting system fairly represents their performance, they will be motivated to help ABC succeed (Shields and McEwen, 1996).

2.11.4 Training

Training is important to help people understand how ABC differs from traditional cost accounting and why ABC provides a superior economic measurement and information system. ABC requires training from the senior management to the shop floor. Training can include readings, lectures, hand-on projects, and on-the-job training (Campi, 1992).

2.11.5 Non-Accounting Ownership

When ABC is owned only by accountants, there is a danger that it might be used only to satisfy their needs. An important reason why some companies have not had good implementation experiences is that the accountants have retained ownership and have not succeeded in sharing ownership with non-accountants (Shields and McEwen, 1996). For this reason, not only accountants but also non-accountants should be seen as the owner of the new system. Non-accountants should be involved in the initial decisions to invest in ABC, and in the design and implementation of ABC. In this way the chances that non-accountants will support and promote ABC, and be committed to its use and success will increase (Shields and McEwen, 1996).

2.11.6 Resources

The process of designing and implementing an ABC system requires companies to have adequate resources. The necessary resources primarily include the time and commitment of accountants, top management, operating employees, software, and external consultants (Roberts and Silvester, 1996). The implementation of ABC often takes more time than expected. The manufacturing companies who have participated in the survey of IMA report an average of 3 years for implementation before they can start to use ABC. The amount of time necessary to reach the usage stage varies with the size of the company (Krumwiede, 1998).

2.11.7 Information Technology Sophistication

A high level of information technology (IT) sophistication appears to be an important factor in getting to the usage stage for the majority of the manufacturing companies. ABC implementation will be much easier if the IT of the companies has the following characteristics: good ABC software; good subsystem integration; user-friendly query capability; available sales, cost, and performance data going back 12 months; and updates of all these types of data (Krumwiede, 1998).

2.12 The Benefits of ABC

ABC is claimed to furnish many significant benefits over traditional costing methods (Chongruksut, 2002):

- Enhanced product cost accuracy.
- More comprehensive cost information for performance measurement.
- More pertinent data for management's decision-making.
- More potential for sensitivity analysis.
- Providing a model prospect on value-adding organizational transactions and activities.

The major benefits that adopters of ABC received from the implementation of ABC were more precise profit analyses, more accurate costing, better allocation of overhead, improved cost control and cost management. Moreover, several survey results (Innes and Mitchell, 1991) show that ABC information is utilized to support the manager's operating decisions, such as performance measurement, product design and process improvement. It is also used to advocate for strategic decisions, such as customer profitability and pricing and product mix. Due to the increasing accuracy of output costs, ABC information enables managers to make better decisions on product, product design, process improvement, market segments and customer mix (Cooper and Kaplan, 1988).

According to Innes and Mitchell (1991), ABC is a significant source of information for decision-making about product costs and product-line profitability. Kaplan (1990) and also claim that accurate product costs are critical to pricing decisions, new product introductions, decisions to drop out-of-date products and decisions on how to respond to the products of competitors correctly and on time since product costs identify causes of resource consumption and ways of saving resources, especially at the product and process design stage (Morrow 1992). It can lead product designers to decisions on trade-offs between minimizing cost and desired performance (Kaplan, 1992) and it provides the cost information of diverse designs that product designers can compare.

In addition, Morrow (1992) indicates that ABC information is an exemplary method of understanding the collection of costs at each cost layer because it provides a meaningful combination between each customer and market segment and the resources they consume. Building cost layers of the ABC system increases revenue values to create profitability analysis. The results of profitability analysis support management for future decisions on customer and market and for prediction of the likely cost of

alteration in each market segment (Morrow 1992). ABC information can help to determine the segments and customers that can be satisfied profitably. In addition, Bukovinsky et al. (2000), who studied a U.S. distributor for industrial robots manufactured by a major Japanese company, found that ABC established the advantages in the sales and administrative areas because the ABC system considered all costs, as opposed to only costs of the products. It helps to increase the monthly operating income of the product line (Chongruksut, 2002).

Several studies (Innes and Mitchell 1991) report that the key areas of ABC benefits are cost control and cost reduction, as well as improved profitability. Turney (1996) states that in cost-reduction analysis, ABC does not decrease cost, but that cost can only be diminished by changing the activities performed and by redeploying the redundant resources, such as reducing the time to set up a machine or removing unnecessary activities. Cost analysis of ABC leads to operational improvement opportunities and increased profitability (Kaplan 1992).

O'Guin (1991) state that ABC is a system that gets rid of the distortions of information in the traditional cost system and non-value-added activities, which do not add to the customer's satisfaction with the product. Seeing that it identifies the activities occurring and the resources they consume, and links the activities to processes as 'cost objects', an ABC system assists management to understand and to analyze business processes and their effects on the cost base. ABC's providing accurate cost information at the business process level, which is at the same level that total quality management (TQM) operates, also supports TQM to evaluate costs and to manage poor quality.

The analysis of the business processes by using activity analysis guides management to process improvement, including elimination of non-value-added

activities (Morrow, 1992; Roberts and Silvester, 1996), and then the process improvement leads to cost reductions, one of the most important benefits of ABC (Adler et al. 2000) and one of the major subjects of TQM. Thus, Krumwiede and Roth (1997) claim that if ABC is designed to facilitate the other strategic initiatives, such as TQM, ISO and so on, it will support their implementation more effectively.

As continuing process improvement is the successive identification and elimination of waste in operating activities, it helps to eliminate non-value-added activities, decrease time to perform activity, select the low-cost activity and share activities with other products to yield economies of high-volume production. These ways of process improvement further reduce costs (Turney 1991). Hence, O'Guin (1991) claims that ABC can reduce costs of companies and increase quality contemporaneously.

In the more competitive environment of a turbulent economy, the importance of superior cost control, of coherent performance measurement and of precise knowledge of product costs increases because cost advantage is the essential component of differentiation strategies in competition (Johnson and Kaplan 1991). O'Guin (1991) also claims that the ABC system is a cost planning system that provides information for managers to plan not only differentiation strategies, but also low-cost strategies since ABC determines core activities and helps analyse systems and policies that drive costs.

2.13 Existing ABC Software

There are many ABC software developed for manufacturing companies. Many ABC software today developed using spreadsheet programming. Despite spreadsheet suitability for numerical calculation, it sacrifices user-friendly whenever users try to do a complex scripting in the spreadsheet environment. However many software vendors in the U.S. for example provide user-friendly ABC software. One of them is Integrated Cost Management Systems, Inc. (ICMS). ICMS is a training, coaching, and software firm specializing in Activity Based Management (ABM). Founded in 1988 and headquartered in Dallas/Ft. Worth, ICMS provides ABC products and services to clients all over the world. The clients include manufacturing, service and governmental organizations of all sizes.

ICMS developed ABC software called CMS-PC 4.0. CMS-PC 4.0 is software for Activity Based Costing, Activity Based Management and Activity Based Budgeting. CMS-PC 4.0 is a complete package that will give user insight into activity cost, product cost and profitability and business process improvement opportunities. Figure 2.6 shows the interface of CMS-PC4.0.

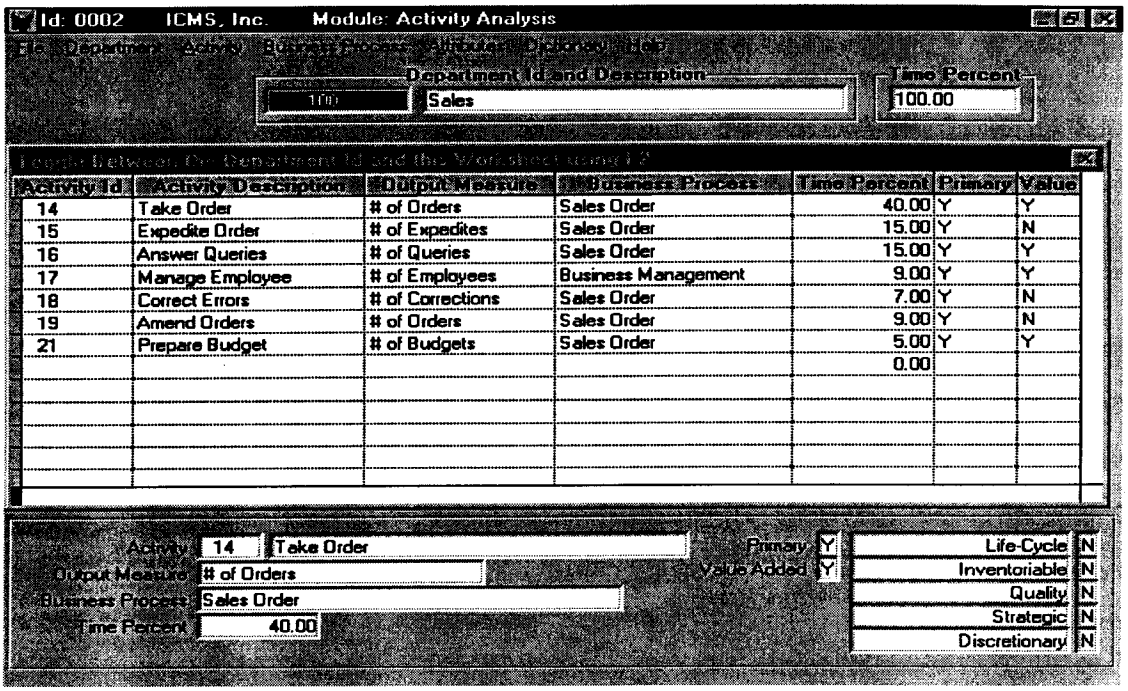


Figure 2.6: Activity Analysis interface of CMS-PC4.0 software

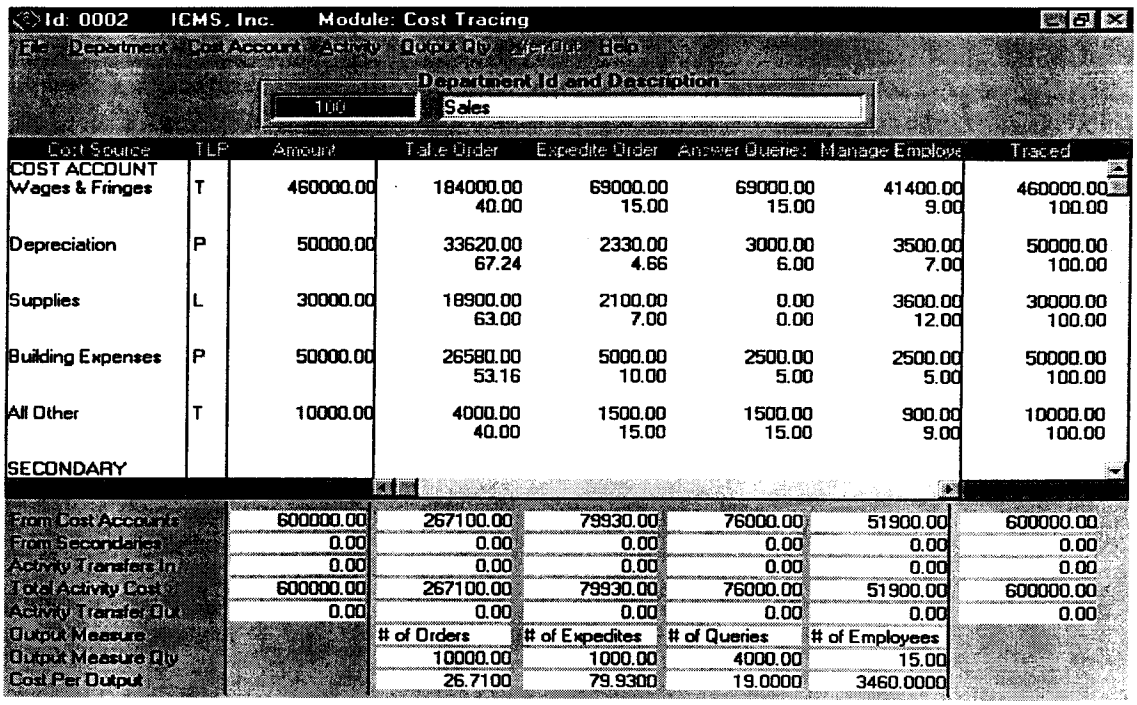


Figure 2.7: Cost Tracing

Although the CMS-PC 4.0 is good software but the U.S.D. 4000 price tag is quite expensive for local scenario. Nevertheless, by studying this software, the researcher will obtain ideas concerning a successful development of good ABC software.

CHAPTER 3

PROBLEM ANALYSIS

3.1 Introduction

To understand what ABC is and how ABC solve the manufacturing companies problems, some case studies must be done. In this chapter, the case study is presented shows how to calculate product's cost using ABC method. Based on this case study, factors critical to successful implementation ABC systems and software are identified.

3.2 Case Study: ABC System At Nistel

Note that the name of the company has been disguised to protect confidentiality. The company, referred here as "Nistel", is based in Johor Bahru and manufactures automotive components. Nistel is part of a larger group of companies and currently

employs just over 150 people. Nistel is a British company. It has many branches distributed all over the world such as India, Indonesia, Brazil, Argentina, China and Malaysia.

Nistel produces more than 30 types of product. It is divided into two production modules that are factory A (straight-line flow, high volume products) and factory B (low volume, high variety product). Overall, the company purchases raw materials from 81 suppliers and produces 33 types of product. The principal activities of Nistel are the manufacturing of vehicle security systems, multifunction timers, pre post heat, and flashers. Basically, the products are made for exportation to other countries but it is also doing same local sales such as the product that used in this project. At this moment, Nistel has been exporting as much as 89.8% product to other countries and 10.2% for local market.

There are six main departments on overall organization chart, which are Quality and Reliability Department (Q&R), Production Engineering Department (PED), Manufacturing Department, Finance and Administration Department, Work Engineering Department and Machine Tools Department.

The quality policy of Nistel is committed to the achievements and maintenance of a superior competitive position by providing products and services, which fully satisfy all customers' needs. Achievements of this commitment are based on the principles of:

- A Total Quality Management (TQM)
- Development of products with inherent levels of Quality and Reliability.
- Advance Quality Planning

- Defect prevention
- Total involvement and development of all employees within this policy

As an international standard company, Nistel applying the concept of continuous improvement and improvement tools to improve the quality of the products and company. For example, the Kaizen report and review, Six-Sigma, TQM meeting, weekly production meeting and daily stand up meeting for the purpose of quality improvement. Improvement tools are also practiced here such as internal quality audit, housekeeping audit conveyor system, monthly TQM meeting, and control chart to ensure the quality of the products.

To determine the total cost for every product, the conventional costing system is used where overheads were allocated to products based on labor hours. In recent four years, this company had lost their customers that were stated by an amount of descending number of products. Consequently, the company had to reduce their workers by reducing the number of shift from two shifts to only one.

With the current costing system, the company is not aware of the areas, which contributed to the improving of profit margins. It is clear that the existing accounting system is not adequate and appropriate decisions cannot be made on pricing, etc due to insufficient information. The ABC system can generate true costing and pricing automatically and gives performance measures product profitability and provide a variety of information for management decision-making.

3.3 Problem Analysis

The first problem to be solved is to make sure that every activity involve in producing product (PC Clock) is identified. With the existing flow chart (Appendix B) produced by the company, the activity actually can be easily identified. But the activity that only shown in the flow chart consisting Printed Circuit Board (PCB), which is not yet been printed until the product is packed for delivery to customers.

Activities for non-value added such as maintenance, material handling and others are not mentioned. As consequence, these activities must be added during performing studies. Later on, the cost driver for every activity must be certain and exact because it can influence the coming result.

3.4 Process Structure in ABC System

Figure 3.1 shows the ABC process structure used in this project.

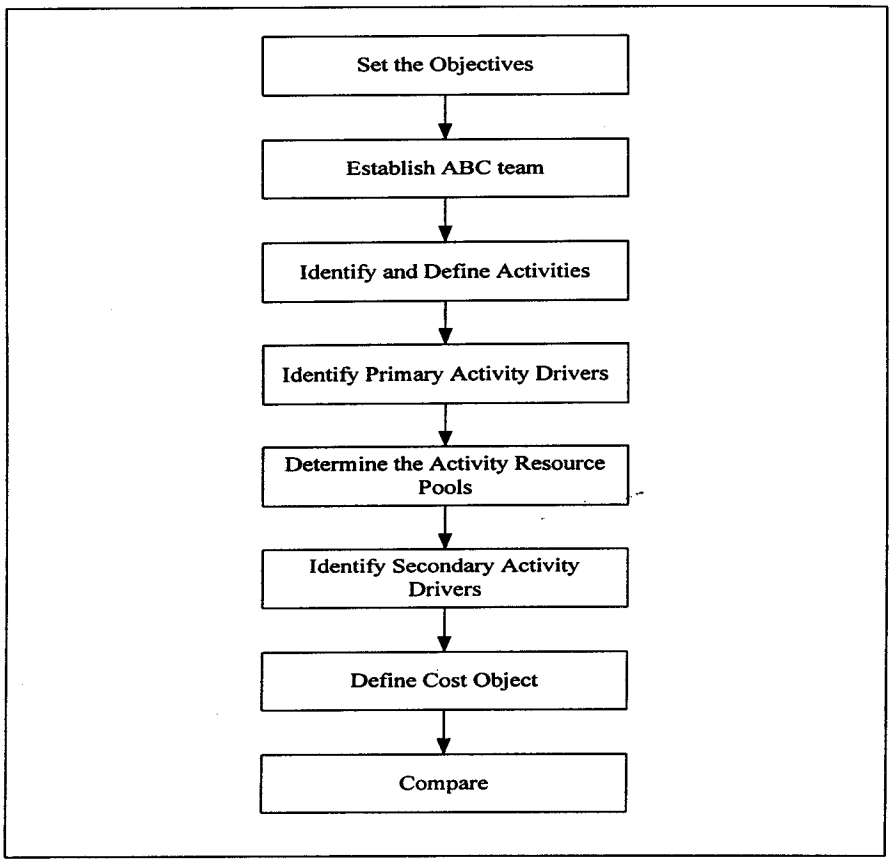


Figure 3.1: Methodology for ABC system

3.4.1 Set the objectives of ABC System

The first step in the methodology is to identify the problem and set up the objectives. Objectives of this ABC project have been described in Chapter 1 of this thesis.

3.4.2 Establish ABC team

In accomplishing the ABC project, a group of members was formed. They are researcher (the author), four academic supervisor and students from Faculty of Mechanical, Universiti Teknologi Malaysia. The purposes of establishing the team are:

i. Discussion.
ii. Data collection.
iii. Software testing.

3.4.3 Identify and Define Activities

The basic principle of ABC system is to identify the activities that involves in producing the product and calculate the cost of each activity and then costing the product based on the consumption of activities. This is a critical step in the design of an ABC system because the cost of the system and the accuracy of the product cost depend upon this step. Definition of activity has clearly understand to avoid any disappoint result. The meaning of activity is the aggregations of actions performed within an organization.

There are 24 activities are identified and it can be divided into two groups; the first group is 'production activities' which includes surface mount technology (SMT), wave soldering, manual soldering, cleaning, assembly and so on. Second group of activities is 'support activities' that include material handling, maintenance/engineering,

purchasing/inventory, production management, sales/marketing and administration personnel.

3.4.4 Identify Primary Activity Drivers

Each activity has different primary activity drivers and consumes different type and amount of resources. For example, the primary activity drivers for the material handling; the amount of resources consumed for each movement of material per day is calculated.

3.4.5 Determine the activity Resource Pools

The activity cost pool is the total cost associated with an activity. The cost of all activities is calculated by adding the cost of all primary activity drivers. Five resource pools were identified namely depreciation, rentals, utilities, manufacturing overhead and administration.

3.4.6 Identify Secondary Activity Drivers

Activity driver associates activities with their respective cost object. It measure the frequency and intensity of the demand placed on activities by cost objects. They are typically a one-to-one relationship with the activity. For example, the activity driver for the activities of PCB separation; number of tabs per panel. PCB separation cost decreases when the number of tabs per panel decreases. The activity driver for every activity shows in Table 3.1.

Table 3.1: Name of activity driver

Activity	Activity Driver
SMT	Number of panel
Inspect Cured Component	Number of inspection
Radial Component	Number of component
Wave Soldering	Number of panel
Cleaning	Number of panel
PCB Separation	Number of tabs
Apply Hot Melt Onto Crystal	Time used
Solder Inspection & Solder S3	Time used
Solder Trimmer, S1,S2 to PCB Soldering	Number of solder points
Segment Check	Number of units
Immediate Testing	Number of trimmers tested
Solder Wires to Lucar & Short Circuit Test	Time used
Final Assembly	Number of components
Final Testing	Number of test sequence
Date Code Stamping & 100% Functional	Number of test sequence
Inspect & Packing	Number of test sequence
Sealing	Number of box
Palletization	Number of pallet
Material Handling	Number of movement
Maintenance/Engineering	Number of maintenance hour
Production Management	Number of batch
Inventory/Purchasing	Number of order
Sales/Marketing	Number of order
Administration Personnel	Head Count

3.4.7 Define Cost Object

Cost object is defined as any customer, product, service, contract, project, or other work unit for which a separate cost measurement is desired.

3.4.8 Compare Product Cost with Traditional Cost

After the total cost of the product has been carried out, the comparison between ABC system and traditional system has to be done.

3.5 Calculation

There are several calculations that have to be calculated manually in order to key in the input values.

3.5.1 Normal Time

To determine the normal time for this product, five data were collected. Average actual cycle time is then calculated to get accurate values. The average actual cycle time is the arithmetic mean of the times for each element measured, adjusted for unusual influence for each element (Heizer and Barry, 1999).

$$\text{Average actual cycle time} = \frac{\begin{pmatrix}\text{Sum of the times recorded}\\ \text{to perform each element}\end{pmatrix}}{\text{number of cycles observed}}$$

For example, average actual cycle time for inspect cured component activity is:

$$\text{Average actual cycle time} = \frac{(9.50+11.63+13.20+16.68+14.14)}{5}$$

$$= 13.03 \text{ sec}$$

Then, the normal time for each activity is calculated. Normal time for every activity is calculated using this equation:

Normal time = (average actual cycle time) x (rating factor)

In order to determine normal time, several assumptions have to be considered. These assumptions are based on company's policy.

Assumption:
Rating = 110%

Normal time for inspect cured component activity = 13.03 x 1.1

= 14.33 sec

Table 3.2 shows the collected time, average time and normal time.

Table 3.2: Collected time, average time and normal time

Activity	1	2	3	4	5	Average (sec)	Normal Time (Sec)
SMT	38.53	39.53	38.56	38.50	38.63	38.75	42.63
Inspect Cured Component	9.50	11.63	13.20	16.68	14.14	13.03	14.33
Radial Component	82.44	80.93	73.63	78.16	76.64	78.36	86.20
Wave Soldering	45.75	45.47	46.60	45.56	44.62	45.6	50.16
Cleaning	51.75	48.69	50.72	51.22	44.62	49.4	54.34
PCB Separation	36.28	26.03	45.60	39.15	40.84	37.58	41.34
Apply Hot Melt Onto Crystal	59.95	59.53	57.44	56.03	60.65	58.72	64.60
Solder Inspection & Solder S3	18.48	21.59	20.44	24.26	21.58	21.27	23.40
Solder Trimmer	22.55	22.69	22.90	22.11	23.50	22.75	25.03
Segment Check	30.30	28.45	20.69	25.91	25.10	26.09	28.70
Immediate Testing	30.58	28.40	28.83	29.79	27.85	29.09	32.00
Solder 4 wires to Lucar and Short Circuit Test	49.26	50.08	54.80	48.36	43.75	49.25	54.18
Final Assembly	49.47	51.55	49.78	48.25	43.55	48.52	53.37
Final Testing	30.56	29.29	29.14	28.65	27.41	29.01	31.91
Date Code Stamping	28.08	27.84	29.89	28.66	29.18	28.73	31.60
Inspect & Packing	24.83	23.93	26.48	29.05	29.56	26.77	29.45
Sealing	10.98	10.77	11.26	11.36	10.63	11.00	12.1
Palletization	10.22	11.69	11.59	10.10	11.40	11.00	12.1

3.5.2 Standard Time

In order to determine standard time, several assumptions have to be considered. These assumptions are based on company's policy.

Assumption:

Allowance:

Personal = 4

Fatigue = 8

Relay = 3

Total Allowance = 15%

Standard time for every activity is calculated using this equation:

$$\text{Standard time} = \frac{\text{normal time}}{1 - \text{allowance factor}}$$

Calculation for standard time for every activity is exactly the same. Therefore, only one example of calculation is shown below:

$$\text{Standard time for inspect cured component activity} = \frac{14.33}{1 - 0.15}$$

$$= 16.86 \text{ sec}$$

Standard time for non-manual activities like SMT, wave soldering and cleaning is same as the normal time because rating and allowance are ignored. Table 3.3 shows standard time for every activity.

Table 3.3: Standard time

Name of Activity	Normal Time (sec)	Standard Time (sec)
Surface Mount Technology (SMT)	42.63	42.63
Inspect cured component	14.33	16.86
Radial component	86.19	101.4
Wave Soldering	50.16	50.16
Cleaning	54.34	54.34
PCB Separation	41.34	48.64
Apply hot melt onto crystal	64.60	76.00
Solder inspection & solder S3	23.40	27.53
Solder Trimmer, S1, S2 to PCB soldering	25.03	29.45
Segment Check	28.70	33.76
Immediate Testing	32.00	37.65
Solder 4 wires to Lucar & short circuit test	54.18	63.74
Final Assembly	53.37	62.79
Final Testing	31.91	37.54
Date code stamping & 100% functional	31.60	37.18
Inspect and packing	29.45	34.65
Sealing	12.10	14.24
Palletization	12.10	14.24

3.5.3 Capacity per Month

Assumption for the number of panel per month is done by considering total unit production for six months from October 2002 to March 2003. Table 3.4 shows number of production that is considered.

Table 3.4: Production between October 2002 and March 2003

Month	Oct	Nov	Dec	Jan	Feb	Mac
No of panel	6400	5960	6210	6380	5870	6044

$$\textbf{Average panel per month} = \frac{6400+5960+6210+6380+5870+6044}{6}$$

$$= 6144 \text{ panels}$$

There are four units at every panel.

Number of unit per month = 6144 x 4

= 24,576 units

1. SMT

   Name of activity driver: number of panel.

   Capacity per month = 6144 panels

2. Inspect Cured Component

   Name of activity driver: number of inspection

   Capacity per month = 6144 inspections

3. Radial Component

   Name of activity driver: number of component

   Number of component per unit = 8 components

   Number of component per panel = 8 x 24 = 32 components

Capacity per month = 196,608 components

4. Wave Soldering

Name of activity driver: Number of panel

Capacity per month = 6144 panels

5. Cleaning

Name of activity driver: Number of panel

Capacity per month = 6144 panels

6. PCB Separation

Name of activity driver: Number of tabs

Number of tabs per panel = 12 tabs

Capacity per month = 12 x 6144

= 73728 tabs

7. Apply Holt Melt Onto Crystal

Name of activity driver: time used

Standard time = 76.00 sec

Capacity per month = standard time x number of units

= 76.00 x 24,576

= 1,867,776 sec

= 518.83 hours

8. Solder Inspection and Solder S3

Name of activity driver: time used

Standard time = 27.53 sec

Capacity per month = 27.53 x 24,576

= 676,577 sec

= 187.94 hours

9. Solder Trimmer, S1, S2 to PCB

Name of activity driver: Number of solder points

Number of solder point per unit = 7

Capacity per month = 7 x 24,576

= 172,032 points

10. Segment Check

Name of activity driver: number of units

Capacity per month = 24,576 units

11. Immediate Testing

Name of activity driver: number of trimmer tested

Number of trimmers = number of units

Capacity per month = 24,576 units

12. Solder 4 wires to Lucar and Short Circuit Test

Name of activity driver: time used

Standard time = 63.74 sec

Capacity per month = 63.74 x 24,576

= 1,566,474 sec

= 435.13 hours

13. Final Assembly

Name of activity driver: number of components

Number of components per unit = 10

Capacity per month = 10 x 24,576

= 245,760 components

14. Final Testing

Name of activity driver: number of test sequence

Number of test sequence per unit = 7

Capacity per month = 7 x 24,576

= 172,032 sequences

15. Date Code Stamping and 100% Functional

Name of activity driver: number of test sequence

Number of test sequence per units = 6

Capacity per month = 6 x 24,576

= 147,456 sequences

16. Inspect and Packing

Name of activity driver: number of test sequence

Number of test sequence per units = 3 sequences

Capacity per month = 3 x 24,576

= 7,728 sequences

17. Sealing

Name of activity: number of box

1 box = 15 units

Capacity per month = $\frac{24,576}{15}$ = 1639 boxes

18. Palletization

Name of activity driver: number of pallet

Capacity per month = 6 pallets

19. Material Handling

Name of activity driver: number of movement

Number of movement per production = 3

Number of production per month = 6

Capacity per month = number of move x number of production

= 18 movements

20. Maintenance/Engineering

Name of activity driver: number of maintenance hour

Maintenance hour per production = 10 minutes

Capacity per month = maintenance hour per production x number of production per month

= 10 minutes x 6

= 60 minutes

= 1 hour

21. Production Management

Name of activity driver: number of batch

Capacity per month = number of production per month

= 6 batches

22. Inventory/Purchasing

Name of activity driver: number of order

Capacity per month = 1 month

23. Sales Marketing

Name of activity driver: number of order

Capacity per month = 1 order

24. Administration Personnel

Name of activity driver: head count

Capacity per month = 12 persons

3.5.4 Total Available Capacity

Assumption:

1 day = 8 hours 30 minutes

1 month = 19 days

There are 13 operators involve in the line production to produce this product.

Available time per month = 8 hours 30 minutes x 19 days x 13 operators

= 2099.5 hours

= 7,558,200 sec

1. SMT

Standard time = 42.63 sec

$$\text{Total available capacity} = \frac{\text{Available time per month}}{\text{Standard time}}$$

$$= \frac{7{,}558{,}200}{42.63}$$

= 177,298 panel

2. Inspect Cured Component

Standard time = 16.86 sec

$$\text{Total available capacity} = \frac{\text{Available time per month}}{\text{Standard time}}$$

$$= \frac{7{,}558{,}200}{16.86}$$

= 1,834,515 inspection

3. Radial Component

Standard Time = 101.40 sec

$$= \frac{\text{Available time per month}}{\text{Standard time}} \text{ x component per panel}$$

$$= \frac{7,558,200}{101.40} \times 32$$

$$= 2,385,231 \text{ components}$$

4. Wave Soldering

Standard time = 50.16 sec

$$\text{Total available capacity} = \frac{\text{Available time per month}}{\text{Standard time}}$$

$$= \frac{7,558,200}{50.16}$$

$$= 150,682 \text{ panel}$$

5. Cleaning

Standard time = 54.34 sec

$$\text{Total available capacity} = \frac{\text{Available time per month}}{\text{Standard time}}$$

$$= \frac{7,558,200}{54.34}$$

$$= 139,091 \text{ panels}$$

6. PCB Separation

Standard time = 48.64 sec

$$\text{Total available capacity} = \frac{\text{Available time per month}}{\text{Standard time}} \times \text{tab per panel}$$

$$= \frac{7,558,200}{48.64} \times 12$$

$$= 1,864,688 \text{ tabs}$$

7. Apply Hot Melt Onto Crystal

Standard Time = 76.00 sec

Total available capacity = Available time per month = 2099.5 hours

8. Solder Inspection & Solder S3

Total available capacity = Available time per month

= 2099.5 hours

9. Solder Trimmer, S1, S2 to PCB Soldering

Standard time = 29.45 sec

$$\text{Total available capacity} = \frac{\text{Available time per month}}{\text{Standard time}} \text{ x no. of solder point}$$

$$= \frac{7{,}558{,}200}{29.45} \text{ x } 7$$

= 1,796,516 points

10. Segment Check

Standard time = 33.76 sec

$$\text{Total available capacity} = \frac{\text{Available time per month}}{\text{Standard time}}$$

$$= \frac{7{,}558{,}200}{33.76}$$

= 223,880 units

11. Immediate Testing

Standard time = 37.65 sec

$$\text{Total available capacity} = \frac{\text{Available time per month}}{\text{Standard time}} \text{ x no. of trimmer}$$

$$= \frac{7{,}558{,}200}{37.65} \text{ x } 1$$

= 200,749 trimmers

12. Solder 4 Wires to Lucar & Short Circuit Test

Total available capacity = Available time per month

= 2099.5 hours

13. Final Assembly

Standard time = 62.79 sec

$$\text{Total available capacity} = \frac{\text{Available time per month}}{\text{Standard time}} \text{ x no. of component}$$

$$= \frac{7{,}558{,}200}{62.79} \text{ x } 10$$

$$= 1{,}203{,}727 \text{ components}$$

14. Final Testing

Standard time = 37.54 sec

$$\text{Total available capacity} = \frac{\text{Available time per month}}{\text{Standard time}} \text{ x no. of test}$$

$$= \frac{7{,}558{,}200}{37.54} \text{ x } 7$$

$$= 1{,}409{,}361 \text{ sequences}$$

15. Date Code Stamping & 100% Functional

Standard time = 37.18 sec

$$\text{Total available capacity} = \frac{\text{Available time per month}}{\text{Standard time}} \text{ x no. of test}$$

$$= \frac{7{,}558{,}200}{37.18} \text{ x } 6$$

$$= 1{,}219{,}720 \text{ sequences}$$

16. Inspect & Packing

Standard time = 34.65 sec

$$\text{Total available capacity} = \frac{\text{Available time per month}}{\text{Standard time}} \text{ x no. of test sequence}$$

$$= \frac{7{,}558{,}200}{34.65} \text{ x } 3$$

$$= 654{,}390 \text{ sequences}$$

17. Sealing

Standard time = 13.92

18. Palletization

Total available capacity = 19 pallets

19. Material Handling

Total available capacity = no. of move per production x no. of day

= 3 x 19

= 57 movements

20. Maintenance/Engineering

Total available capacity = no. of maintenance hour x no of day

= 10 minutes x 19

= 190 minutes

= 3.17 hours

21. Production Management

Total available capacity = 19 batches

22. Inventory/Purchasing

Total available capacity = 3.17 orders

23. Sales/Marketing

Total available capacity = 3.17 orders

24. Administration Personnel

Total available capacity = 38 persons

This numbers can be summarized in Table 3.5. From this table, high-unused capacity percentage is contributed by more than half of the activities namely 80%. It also shows that this product is produced at low volume compared to other product.

Table 3.5: Bill of activities

Activity	Capacity per month	Total Available Capacity	Unused Capacity	Unused Capacity (%)
SMT	6144	780000	773856	99.21
Inspect Cured Component	6144	1834515	1828371	99.67
Radial Component	196608	9760387	9563779	97.97
Wave Soldering	6144	663000	656856	99.07
Cleaning	6144	612000	605856	98.99
PCB Separation	73728	7621714	7547986	99.03
Apply Hot Melt Onto Crystal	63.42	2099.5	2036.08	96.98
Solder Inspection & S3	183.71	2099.5	1915.79	91.25
Solder Trimmer	172032	1838339	1666307	90.64
Segment Check	24576	229036	204460	89.27
Immediate Testing	24576	205386	180810	88.03
Solder 4 Wires to Lucar	425.30	2099.5	1674.2	79.74
Final Assembly	245760	1231378	985618	80.04
Final Testing	172032	1441619	1269587	88.07
Date Code Stamping	147456	1247914	1100458	88.18
Inspect & Packing	7728	669657	661929	98.84
Palletization	6	19	13	68.42
Material Handling	18	57	39	68.42
Maintenance Engineering	1	3.17	2.17	68.45
Production Management	6	19	13	68.42
Inventory Purchasing	1	3.17	2.17	68.45
Sales Marketing	1	3.17	2.17	68.45
Administration Personnel	12	38	26	68.42
Sealing	1639	9834	8195	83.33

3.6 ABC Software Using Excel 2000

There are number of worksheets in this ABC simulator software. There are divided into 3 sections, namely as input, calculation, and output sections. In the first section, user must fills in the table with data that have been collected from factory/company. In the second section, based on data from the first section, the system will calculate and gives the results. Finally, on the third section, the system will analyze the results such as calculation results and provided the reports in form of tables, charts and graphs.

Figure 3.2 shows the first worksheet in this software. It starts with the introduction notes for the software and the instruction on how to use the software.

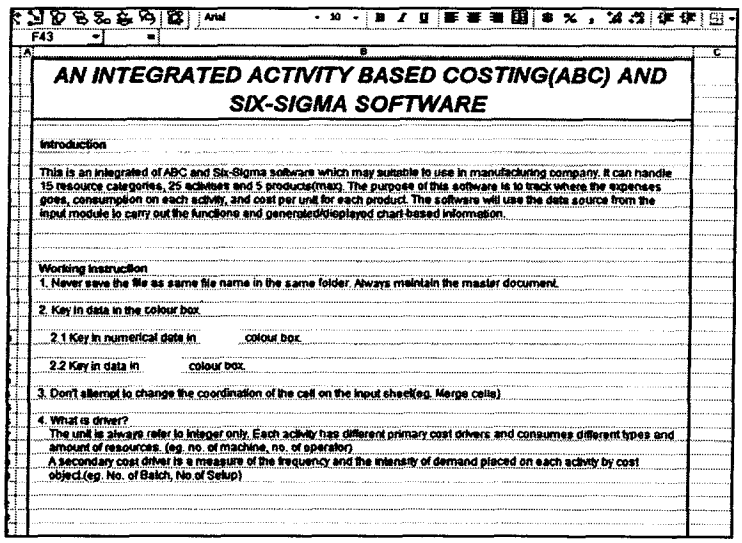
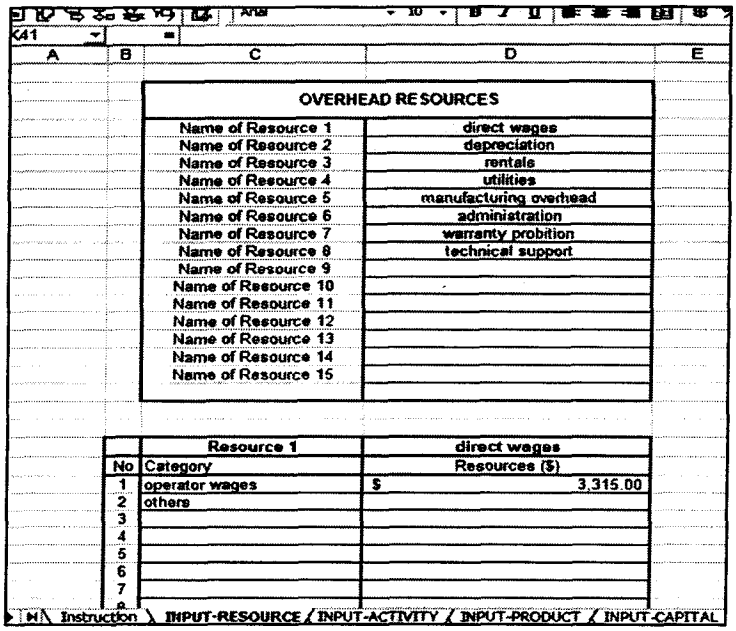


Figure 3.2: Notes on how to use the software

When using the system for the first time, user must go through the INPUT-RESOURCE worksheet by clicking the tab form at the bottom of the system. There are

15 resources available for user to key in the relevant data according to category. For examples, direct wages, depreciation, rentals, utilities and others. Figure 3.3 shows INPUT-RESOURCE worksheet with real data resources collected at an automotive components manufacturer in Johor Bahru.



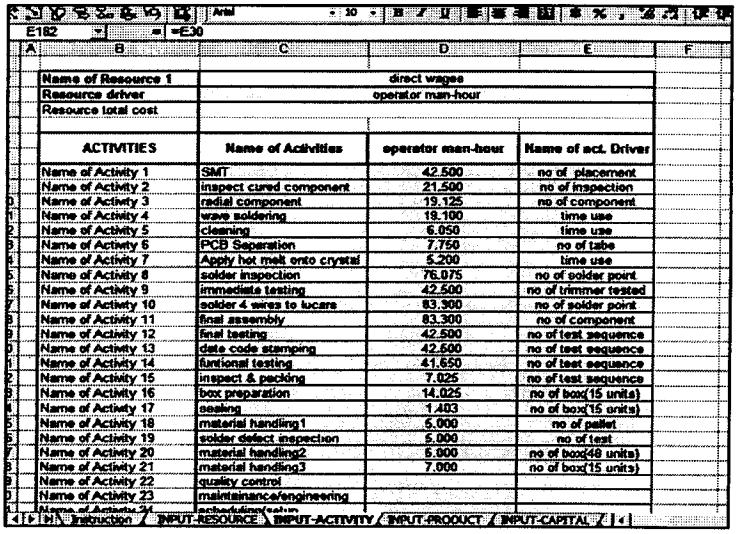
OVERHEAD RESOURCES	
Name of Resource 1	direct wages
Name of Resource 2	depreciation
Name of Resource 3	rentals
Name of Resource 4	utilities
Name of Resource 5	manufacturing overhead
Name of Resource 6	administration
Name of Resource 7	warranty probition
Name of Resource 8	technical support
Name of Resource 9	
Name of Resource 10	
Name of Resource 11	
Name of Resource 12	
Name of Resource 13	
Name of Resource 14	
Name of Resource 15	

	Resource 1	direct wages
No	Category	Resources ($)
1	operator wages	$ 3,315.00
2	others	
3		
4		
5		
6		
7		

Figure 3.3: Input resource worksheet

After inserting the name of resources, user can key in categories and their values for each resource detailed.

After completing the INPUT-RESOURCE worksheet, user can proceed to key in the INPUT-ACTIVITY worksheet. In this worksheet, maximum of 25 activities are provided for each resource category. The main input data that will be inserted are resource driver, name of activities, value of resource drivers and name of activity drivers. Figure 3.4 shows INPUT-ACTIVITY worksheet with related data.

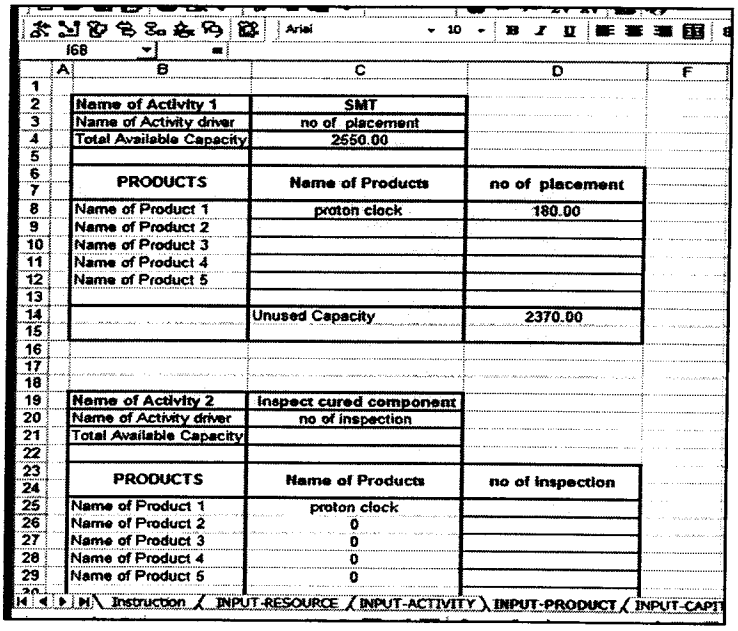


Name of Resource 1	direct wages	
Resource driver	operator man-hour	
Resource total cost		

ACTIVITIES	Name of Activities	operator man-hour	Name of act. Driver
Name of Activity 1	SMT	42.500	no of placement
Name of Activity 2	inspect cured component	21.500	no of inspection
Name of Activity 3	radial component	19.125	no of component
Name of Activity 4	wave soldering	19.100	time use
Name of Activity 5	cleaning	6.050	time use
Name of Activity 6	PCB Seperation	7.750	no of tabe
Name of Activity 7	Apply hot melt onto crystal	5.200	time use
Name of Activity 8	solder inspection	76.075	no of solder point
Name of Activity 9	immediate testing	42.500	no of trimmer tested
Name of Activity 10	solder 4 wires to lucars	83.300	no of solder point
Name of Activity 11	final assembly	83.300	no of component
Name of Activity 12	final testing	42.500	no of test sequence
Name of Activity 13	date code stamping	42.500	no of test sequence
Name of Activity 14	funtional testing	41.650	no of test sequence
Name of Activity 15	inspect & packing	7.025	no of test sequence
Name of Activity 16	box preparation	14.025	no of box(15 units)
Name of Activity 17	sealing	1.403	no of box(15 units)
Name of Activity 18	material handling1	5.000	no of pallet
Name of Activity 19	solder defect inspection	5.000	no of test
Name of Activity 20	material handling2	5.000	no of box(48 units)
Name of Activity 21	material handling3	7.000	no of box(15 units)
Name of Activity 22	quality control		
Name of Activity 23	maintainance/engineering		

Figure 3.4: Input activity worksheet

Next worksheet is INPUT-PRODUCT. User will insert the name of product for each activity. The system provided up to 5 products that may used all those activities. User should fill in total available capacity of cost driver amount for each activity. User also must inserts quantity of activity driver used by each product. Figure 3.5 shows INPUT-PRODUCT worksheet.



Name of Activity 1	SMT	
Name of Activity driver	no of placement	
Total Available Capacity	2550.00	

PRODUCTS	Name of Products	no of placement
Name of Product 1	proton clock	180.00
Name of Product 2		
Name of Product 3		
Name of Product 4		
Name of Product 5		
	Unused Capacity	2370.00

Name of Activity 2	Inspect cured component	
Name of Activity driver	no of inspection	
Total Available Capacity		

PRODUCTS	Name of Products	no of inspection
Name of Product 1	proton clock	
Name of Product 2	0	
Name of Product 3	0	
Name of Product 4	0	
Name of Product 5	0	

Figure 3.5: Input product worksheet

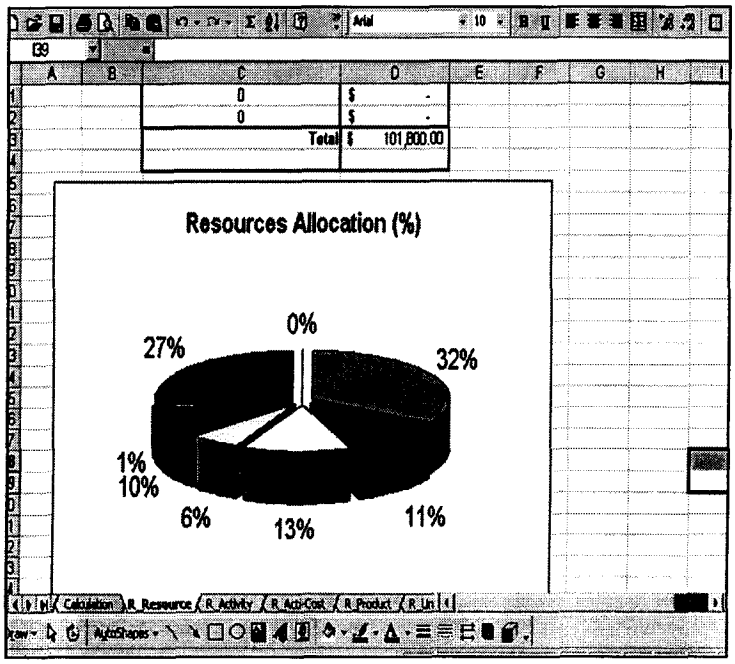


Figure 3.6: Resources allocation report

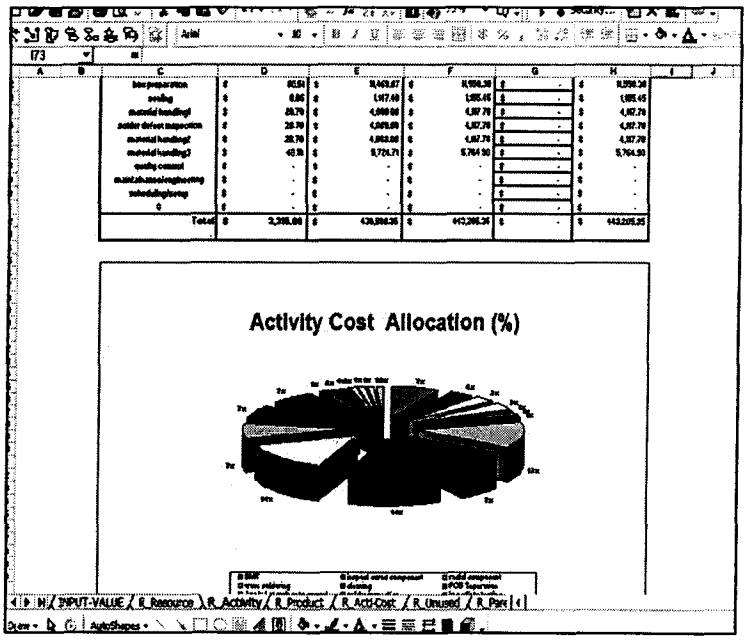


Figure 3.7: Activity cost allocation report

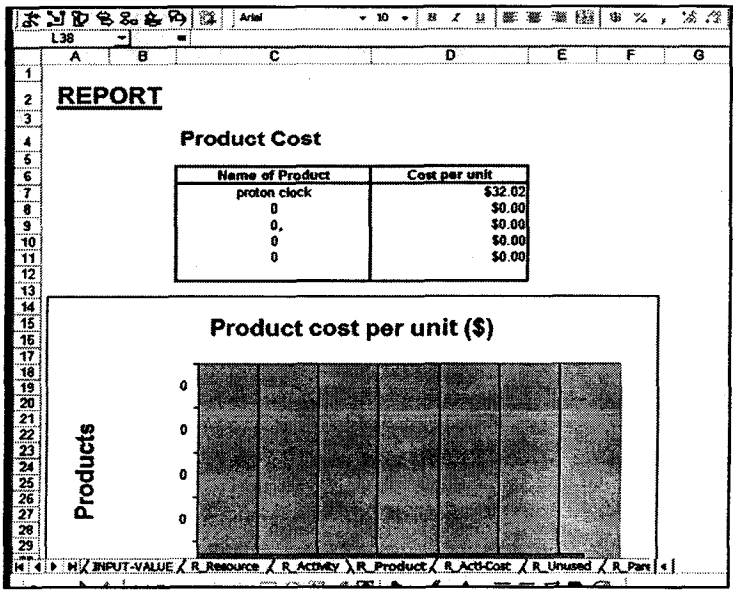


Figure 3.8: Summary of product cost report

There are number of reports that can be generated from the system. The first report is the resources allocation report, which is presented in pie chart (Figure 3.6), activity cost in the form of pie chart and identification of critical activities that have to be further investigated for improvements (Figure 3.7). Figure 3.8 is cost object per unit report that is calculated using ABC system, which can be compared with the results of traditional cost system.

3.6.1 Current ABC Software Disadvantages

There are several disadvantages in this prototype software. User may experience confusions while using this software. Amongst the disadvantages are:

i. No password at start up
ii. Unable to detect false input such as negative number or negative answer.
iii. Limited activities and products. The maximum number of activities is 25 and for products is 5.
iv. The spreadsheet lacked the formatting flexibility and textual capabilities of a database option.

Therefore using Borland Delphi, Visual Basic or suitable programming language is expected to overcome all these disadvantages.

3.7 Summary

ABC is more complex but more accurate than traditional cost accounting. In today's world, manufacturing companies must using specialize ABC software because two main reasons; manual calculation is very difficult to calculate and was deemed too time consuming. Secondly, the spreadsheet alternative offered an economical option that appeared attractive initially, but careful consideration of the mechanics of using a spreadsheet ranked this alternative below that of customizing a prototype database model. The spreadsheet lacked the formatting flexibility and textual capabilities of a database option (Dikolli and Smith, 1996). Further, while the linking and macro capabilities of spreadsheets were impressive, the ability of spreadsheets to handle paragraphs of text without disrupting the visual content of other cells in a row or column was a potential problem. Finally, the spreadsheet tends to be one dimensional in its appearance when compared with a multi-view capability of a database (Dikolli and Smith, 1996).

CHAPTER 4

RESEARCH METHODOLOGY

4.1 Introduction

In this chapter, the research methodology to be utilized in the study is described and the research observations relating to the objectives of the study are stated. The research operational framework will be designed in order to be adopted as a guideline for the whole study. The methodology for system development will be determined and justified its selection. Subject or data sources for this study will then be identified, followed by the system and software requirement involved in the system development. Various methods available for collecting ABC data are also set out in this chapter.

4.1.1 Research Proposal

The research proposal is the initiation phase of conducting this study. Title selection is made and the basic scope and objective of the study is being determined at this stage. Once the proposal is approved, the subsequent processes such as literature review and case studies can be carried out.

4.1.2 Literature Review

Literature review is one of the important methods that could contribute a lot of ideas to design and develop software. Journals, articles, books and internet are the sources of this literature study. The information collected from literature review range from the basic of software development, concept, method and current trends of development, in which all of these can be used as references for new innovative ideas for developing the proposed software. The literature review conducted for this study is already presented in Chapter 2.

4.1.3 Case Study and Problem Analysis

This study refers to the case study on the implementation of activity based costing (ABC). The case study discuss the introduction of ABC and the benefits and

problems experienced during implementation in manufacturing company. Based on the case study, factors critical to successful implementation of ABC software is identified.

4.1.4 Report Writing

Report writing, which include writing up of user manual and system documentation will be carried out in the last part of the study. This is an important phase whereby all the result and discussion will be presented and discussed in detail.

4.1.5 Research Milestones

Please refer to the Gantt chart of this project at Appendix A.

4.2 Research Observation

Based on study on ABC case studies and ABC related journals, it can be concluded that ABC is a powerful tool for pricing. Today, the manufacturing industry

experiences dramatic changes. To manage today's manufacturing organisations managers require information which is relevant, accurate and readily available (Sohal and Chung, 1998). This information is needed to formulate strategies and to make decisions on product costs.

To remain competitive, a manufacturing company must continuously adapt to the rapidly changing environment. They must reinvent their business practice through the use of new technology. Technology such as Bill of Material (BOM) and Manufacturing Resource Planning (MRP II) computer software are available for better asset utilization. New philosophy such as those of Activity Based Costing (ABC) and Quality Function Deployment has created new methods for improved business practices.

Traditional cost accounting methods, which were introduced decades ago when most companies manufactured a narrow range of products, can today result in distorted cost information (Helberg, Galletly and Bicheno, 1994). Many traditional cost accounting systems often allocate overheads in proportion to direct labour. These traditional costing systems tend to distort product costs. Inaccurate cost information can result in incorrect decisions, because not all of the consequences have been taken into account. Furthermore, because of distorted cost information, an insufficient analysis/allocation of overhead costs can result in overpriced high-volume products and under priced special products.

These problems led to the idea of activity-based costing (ABC), particularly in companies producing a range of products. ABC aims not only to allocate overhead costs more accurately but also to pinpoint areas of waste. Underlying ABC is the assumption that activities (such as purchasing, receiving, setting-up and running a machine, etc.) consume resources, and products consume activities. The performance of activities

triggers the consumption of resources that are recorded as costs in the accounts. This means that ABC traces costs to products according to the activities performed on them. The result is more accurate cost information, with less distortion. Three benefits accrue from this: a focused manufacturing strategy, products designed to increase customer value, and continuous improvement of operating activities throughout the manufacturing organization.

4.3 Methodology for ABC System

ABC system focuses on activities rather than products (Norkiewicz, 1994). The basic principle of ABC system is to identify the activities of an organization and to calculate the cost of each activity and then allocate activity costs to cost objects. Based on this principle, Sharman (1996) has outlined the different steps required to design an activity based costing method as explained below.

4.3.1 Identify and Assess Needs

This is the planning phase for the ABC system where the needs of the organization are established. People who have a strong understanding of the operations of the business, finance department, engineers, logistics and operations people should be involved. A multi-functional team is more productive than just working with a finance staff. In this stage the company's critical issues, difficult decisions are assessed. Senior

management buy in is essential for a successful implementation of the ABC system. Accuracy and adequacy of the existing cost system is assessed. Two factors – the organization culture and current approach to the financial management are critical success factors and an essential part of the design process (Londer and Ginter, 1999).

4.3.2 Training Requirements

Training in ABC concepts is valuable for all employees in preparing for an implementation. Implementation training is extremely useful for the team members assigned to the pilot project. The training could be on the job in the first part involving procedural documentation that trains the team to interview departmental heads to ascertain the department's function and obtain information on the activities, drivers, and flowcharts of the processes. The second part of the training is to expose the team to expense analysis.

4.3.3 Define Project Scope

This step requires the management team to evaluate what is required and what is possible within a reasonable time frame. The objectives, organization structure, business units, product or services, cost elements to be included or excluded, facilities etc are outlined.

4.3.4 Identify Activities and Drivers

This is an important step and is difficult when ABC is conducted using the cost decomposition approach based on the general ledger analysis. In order to identify a driver, it is important to assess the physical resources and their application. The driver is the cause of an expense and the activity is the effect. Londe and Ginter (1999) state the fundamental difference between a traditional cost accounting system and an ABC system is the process of applying overhead costs to the products produced (sold). In a traditional cost system overhead costs are gathered and allocated to products based on some measure of volume, typically direct labor hours. On the other hand, the ABC system tracks overhead as a function of activities that generate it.

4.3.5 Create a Cost and Operational Flow Diagram

A cost and operational flow schematic diagram captures in flowchart style how resources are used in performing activities. A detailed flowchart of the entire manufacturing process starting from procurement of raw materials to shipment of finished goods is necessary to determine all of the manufacturing activities. Such a diagram helps understanding how resources are used in performing activities and what are the drivers for these activities. It also identifies how general ledger line items should be assigned.

4.3.6 Collect Data

The cost and operational flow diagram identifies relationships that exist in the organisation. Data has to be collected to include the effort of people and machines measured in units of time. Quantities of each product or service delivered with revenue and cost information is to be identified. Driver quantities produced by each activity are measured to determine how much each activity is performed and consumed in a given period.

4.3.7 Build a Software Model

A computer model is built by entering all data and relationships as inputs to the software to calculate costs of drivers, activities, processes, products and services. The data may include activity attributes such as indicators for value added and non-value added processing time. Attribute analysis permits the organization to examine how much money is spent on non-value added activities or cost of quality.

4.3.8 Interpret results and prepare management reports

Initial project objectives can be addressed using reports and comparisons of profitability by product, customer or services as well as costs of products. Interpreting

results of these reports will identify significant issues that the management needs to address.

4.3.9 Integrate data collection and reporting

The success/failure of the pilot project decides the future of ABC implementation in an organization. Integration of data collection and reporting follows the initial ABC pilot project. Systems integration could be manual or automated or a combination of both. Organisations can take this further to have an activity based management system. Ownership and accountability within the organization for every aspect of each step in each stage needs to be managed carefully for the success of such a project. Figure 4.1 shows an ABC methodology.

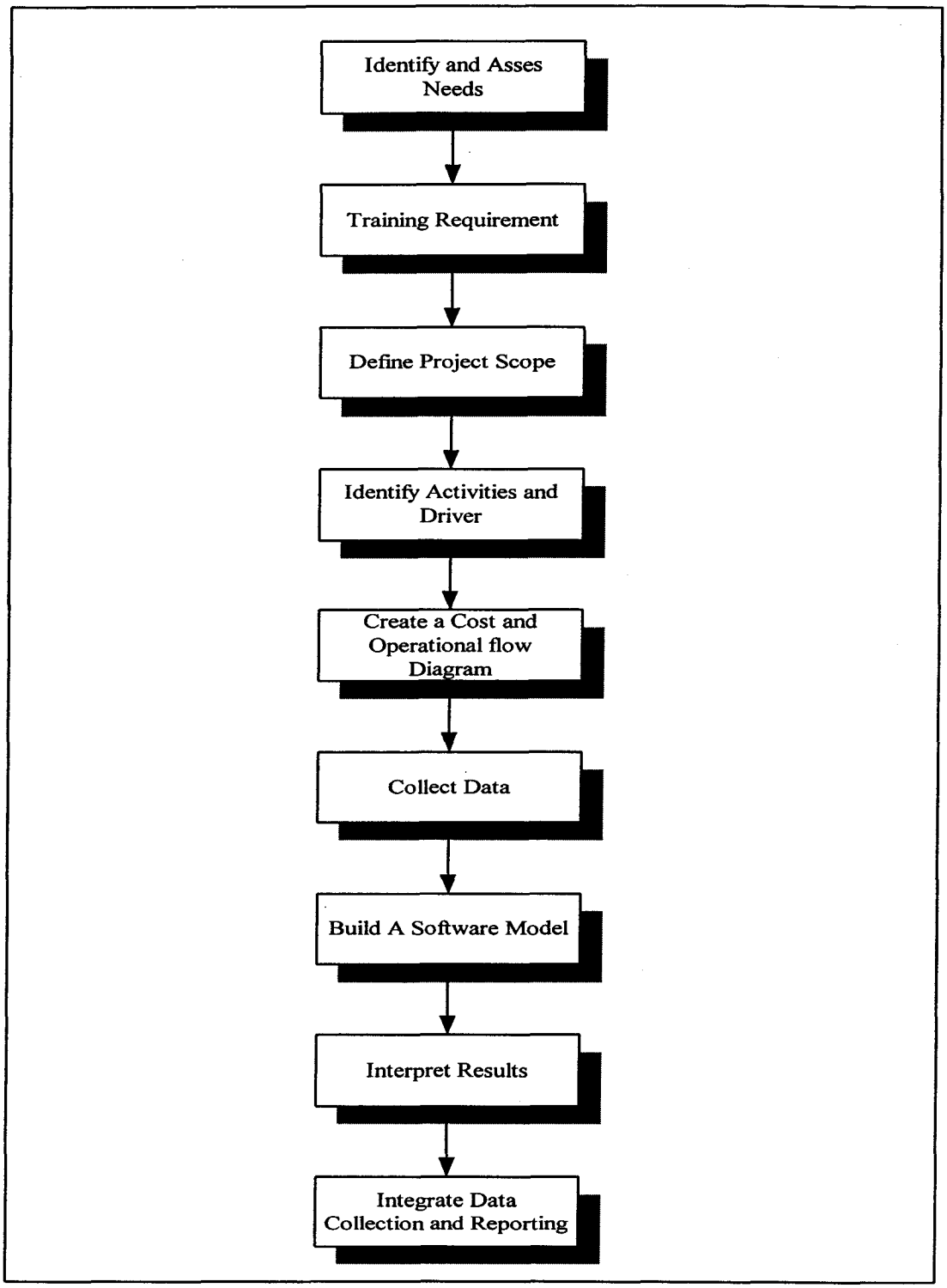


Figure 4.1: The ABC methodology

4.4 Hypothesis: Manufacturing Company Needs An Appropriate ABC Software

There are many software solutions designed for ABC. Using manual calculation was deemed too time consuming. The capabilities of the different software range from highly sophisticated to very simple. A conceptual understanding of the goals of activity based costing in the different operations must be established before selecting or develop software (Foote, 1994). One important thing to understand is software is only a minor tool in achieving these goals, not the solution.

Many ABC software today using spreadsheet software such as Microsoft Excel. Spreadsheet software is powerful tool for calculation, but it has many disadvantages. The spreadsheet lacked the formatting flexibility and textual capabilities of a database option. Further, while the linking and macro capabilities of spreadsheets were impressive, the ability of spreadsheets to handle paragraphs of text without disrupting the visual content of other cells in a row or column was a potential problem. Finally, the spreadsheet tends to be one dimensional in its appearance when compared to a multi-view capability of a database (Dikolli and Smith, 1996).

4.5 Software Development Methodology

To develop ABC software, the author will use Rational Unified Process (RUP) methodology. RUP is an object-oriented approach. The Rational Unified Process is a

Software Engineering Process. It provides a disciplined approach to assigning tasks and responsibilities within a development organization. Its goal is to ensure the production of high-quality software that meets the needs of its end users, within a predictable schedule and budget.

The Rational Unified Process is an iterative process. Given today's sophisticated software systems, it is not possible to sequentially first define the entire problem, design the entire solution, build the software, and finally test the product. An iterative approach is required that allows an increasing understanding of the problem through successive refinements, and to incrementally grow an effective solution over multiple iterations. This approach gives better flexibility in accommodating new requirements or tactical changes in business objectives, and allows the project to identify and resolve risks earlier.

The Rational Unified Process is a controlled process. This iterative approach is only possible however through very careful requirements management, and change control to ensure at every point in time a common understanding of the expected functionality, the expected level of quality, and to allow a better control of the associated costs and schedules. Activities of the Rational Unified Process create and maintain models. Rather than focusing on producing large amounts of paper documents, the Rational Unified Process emphasizes the development and maintenance of models - semantically rich representations of the software system under development.

4.5.1 Process Architecture

The static content of the process is organized in core workflows that are described in terms of activities, workers and artifacts. The Rational Unified Process is composed of nine core workflows; consisting of six engineering process workflows:

- **Business Modeling:** The goal of the Business Modeling workflow is to describe the processes of an organisation. The organisation is described both from an external viewpoint that focuses on what value is delivered to the customer, and from an internal viewpoint that focuses on roles, deliverables, and their relations in the business. These descriptions serve as"map" system analysts can use when identifying requirements on automation - the systems.

- **Requirements:** The goal of the Requirements workflow is to describe what the ABC system should do and allows the developers and the customer to agree on that description. To achieve this, we delimit the system - define its surroundings and the behavior it is supposed to perform. Customers and potential users are important sources of information as well as any system requirements that may exist. Requirements results in a use-case model and some supplementary requirements. The use-case model is essential for both the customer, who needs the model to validate that the system will become what he expected, and for the developers, who need the model to get a better understanding of the requirements on the system.

- **Analysis & Design:** Analysis & design results in a design model that serves as an abstraction of the source code; that is, the design model acts as a "blueprint" of how the source code is structured and written. Design also results in "inside-view" descriptions of the use cases, or use-case realizations, which describe how the use cases are realized in terms of the participating objects/classes.

- **Implementation**: The system is realized through implementation producing the sources (source-code files, header files, makefiles, and so on) that will result in

an executable system. The sources are described in an implementation model that consists of modules structured into implementation packages. The design model is the basis for implementation.

- **Test:** Test verifies the entire system. The developer first test each use case separately to verify that its participating classes work together correctly. Then test (certain aspects of) the system as a whole with use cases as input to this test. At the end of test, the system can be delivered.

The Rational Unified Process also divides one development cycle in four consecutive phases:

- **Inception Phase:** During the inception phase, the developers establish the business case for the system and define the project scope. To accomplish this you must identify all external entities with which the system will interact (actors) and define the nature of this interaction at a high-level. This involves identifying all use cases, and describing a few significant ones. The business case includes success criteria, risk assessment, an estimate of the resources needed, and a phase plan showing dates of major milestones. At the end of the inception phase, you examine the lifecycle objectives of the project and decide whether or not to proceed with the development.

- **Elaboration Phase:** The goals of the elaboration phase are to analyse the problem domain, establish a sound architectural foundation, develop the project plan, and eliminate the highest risk elements of the project. Architectural decisions must be made with an understanding of the whole system. This implies that we describe most of the use cases, and take into account some of the constraints: supplementary requirements. To verify the architecture, implement a system that demonstrates the architectural choices, and executes significant use cases.

- **Construction Phase:** During the construction phase, we iteratively and incrementally develop a complete product that is ready to transition to its user community. This implies describing the remaining use case, fleshing out the design, completing the implementation, and testing the software. At the end of the construction phase, we decide if the software, the sites, and the users are all ready to "go operational".

- **Transition Phase:** During the transition phase the developer transition the software to the user community. Once the product has been put in the hands of the end users, issues often arise that require additional development to adjust the system, correct undetected problems, or finish some of the features that may have been postponed. This phase typically starts with a "beta release" of the system. At the end of the transition phase we decide whether the lifecycle objectives have been met, and possibly if we should start another development cycle. This is also a point where we wrap up some of the lessons learned on this project to improve the process.

The details explanation of ABC software development will be discussed in Chapter 5.

4.6 Data Collection

This study is an attempt to develop the software for ABC designed for the usage of the manufacturing industries. To develop this software, some related data are needed. Data collection can be conducted in a variety of ways and from various sources. Each data collection method has advantages and disadvantages. Sekaran (2000) states that although personal interviews or face-to-face interviews have the advantages of

flexibility in adapting and clarifying the questions, they have cost, time and geographical limitations.

Several researchers in the literature of ABC used the mail questionnaire survey method for similar reasons. For example, Shields (1995), who studied the firms' degree of success with ABC and variables associated with ABC success, used a mail-out survey in gathering data because it is a cost-effective method and suitable for analyzing a large sample of firms' experience with ABC. Similarly, Gosselin (1997), who studied the effect of strategy and organizational structure on the adoption and implementation of ABC, chose a mail survey to collect data because it enabled him to survey a large sample of the population at low cost. Moreover, this method causes less pressure on an immediate answer and a comfortable feeling of anonymity and concentrates on fact rather than subjective views (Gosselin 1997). However, a disadvantage of the mail questionnaire is possible ambiguity in the questions.

For this study, all the manufacturing firms' data are collected from the Faculty of Mechanical, University Technology Malaysia. The example of data collected from company is listed in the tables as follows:

Table 4.1: Types of overhead resources

Overhead Resources	
Name of Resouce 1	direct wages
Name of Resouce 2	depreciation
Name of Resouce 3	rentals
Name of Resouce 4	utilities
Name of Resouce 5	manufacturing overhead
Name of Resouce 6	administration

Table 4.2: Resource 1 category

	Resource 1	Direct Wages
No	Category	Resources (RM)
1	Operator Wages	72,000.00
2	Others	14,000.00
3		
4		
5		
6		

Table 4.3: List of activities for resource 1

Name of Resource 1	direct wages		
Resource driver	operator man-hour (per day)		
Resource total cost			
ACTIVITIES	**Name of Activities**	**operator man-hour (per day)**	**Name of act. Driver**
Name of Activity 1	SMT	42.500	no of panel
Name of Activity 2	inspect cured component	21.500	no of inspection
Name of Activity 3	radial component	19.125	no of component
Name of Activity 4	wave soldering	19.100	no of panel
Name of Activity 5	cleaning	6.050	no of panel
Name of Activity 6	PCB Separation	7.750	no of tabs
Name of Activity 7	Apply hot melt onto crystal	5.200	time use
Name of Activity 8	solder inspection	76.075	no of panel
Name of Activity 9	immediate testing	42.500	no of trimmer tested
Name of Activity 10	solder 4 wires to lucars	83.300	no of solder point
Name of Activity 11	final assembly	83.300	no of component
Name of Activity 12	final testing	42.500	no of test sequence
Name of Activity 13	date code stamping	42.500	no of test sequence
Name of Activity 14	funtional testing	41.650	no of test sequence
Name of Activity 15	inspect & packing	7.025	no of test sequence
Name of Activity 16	box preparation	14.025	no of box(15 units)
Name of Activity 17	sealing	1.403	no of box(15 units)
Name of Activity 18	in process handling	5.000	no of pallet
Name of Activity 19	solder defect inspection	5.000	no of panel
Name of Activity 20	material handling	12.000	no of move
Name of Activity 21	maintenance/engineering	56.000	no of maintanance hour

4.7 Instrumentation

Generally, the instrumentation involves in developing the software can be divide in two types; hardware and software. The hardware involves in this study refers to the minimum requirements of developing, designing and implementation of the proposed software. Table 4.4 shows the minimum hardware requirement to develop ABC software.

Table 4.4: Minimum hardware requirement

Hardware	Minimum Requirement
Processor	Pentium IV 1.5 Ghz
RAM	128 Megabyte
Hard Drive	20 Gigabyte
Monitor	15 Inches
Graphic Card	TNT 2 Ultra
Printer	HP Laserjet

On the other hand, software requirements can be further divided into the software technology and software application. Software technology is the technology or knowledge required to design and develop the software whilst the software application are used as case tool for the analysis, design, documentation and implementation for developing the ABC software. The identified software requirements for this study are as follows:

i. Database Software Technology
   Microsoft Access for database management
   Microsoft Excel for comparisons

ii. Implementation Tools
   Borland Delphi 5.0

iii. Documentation and Design Tools
   Microsoft Office 2000
   Rational Rose 2000
   Microsoft Project 2000
   Visio Professional
   Microsoft Windows 98 Second Edition

The reasons for choosing the Delphi programming language are stated below:

i. Delphi is easy to learn.
ii. Programming syntax is more understandable.
iii. It can design graphical user interface (GUI) easily, user just need to click and draw the interface.
iv. Have a lot of free component on the web, which can be used in this thesis.

4.8 Summary

This chapter has described the operational framework that integrates the research methodology as a guideline to be followed for the whole study. The Rational Unified Process (RUP) approach is selected as the software development methodology that will used to design and construct the proposed software. The recommended hardware and software requirements are identified based on technical requirements of the working environment.

CHAPTER 5

SYSTEM DESIGN AND IMPLEMENTATION

5.1 Introduction

As mentioned in Chapter III, There are many software solutions designed for ABC. Many vendors provide software designed exclusively for activity based reporting. Software is essential in providing ABC information, not because ABC is difficult, but because many of the relationships remain constant and the tedious number generation is eliminated (Foote, 1994). Many software today used spreadsheet software such as Excel to solve ABC calculation.

The significant barrier to the adoption of specialized ABC software is there is no user-friendly software use in manufacturing companies in Malaysia. Software imported from other country especially United States and United Kingdom is very expensive. So this study is going to develop special ABC software. This software will test and use in several manufacturing firms in Malaysia.

This chapter will discuss about ABC system design as well as the implementation, the software development methodology and database design.

5.2 How ABC System Could Be Achieved

In any simulated ABC model, the following factors require evaluation:

- resources required to compile the product cost information,
- deficiencies in the data collection process and the feasibility of implementing new collection procedures (Dikolli and Smith, 1996), and
- differences from the existing system in the calculating the product costs.

The objectives of an ABC system are to:

- allocate costs according to the activities consumed,
- provide information for control purposes,
- improve all operating activities.

The ABC software is designed as a commercial tool, to demonstrate the functioning of ABC. It is necessary to define an overhead, production structure and other manufacturing data for the software.

5.3 Overview of the Software

The software is user-friendly in term of its interface. The software proceeds in four stages.

- Input – data entry
- Activity Analysis
- Calculation stage
- Output stage -report

Figure 5.1 shows ABC software stages.

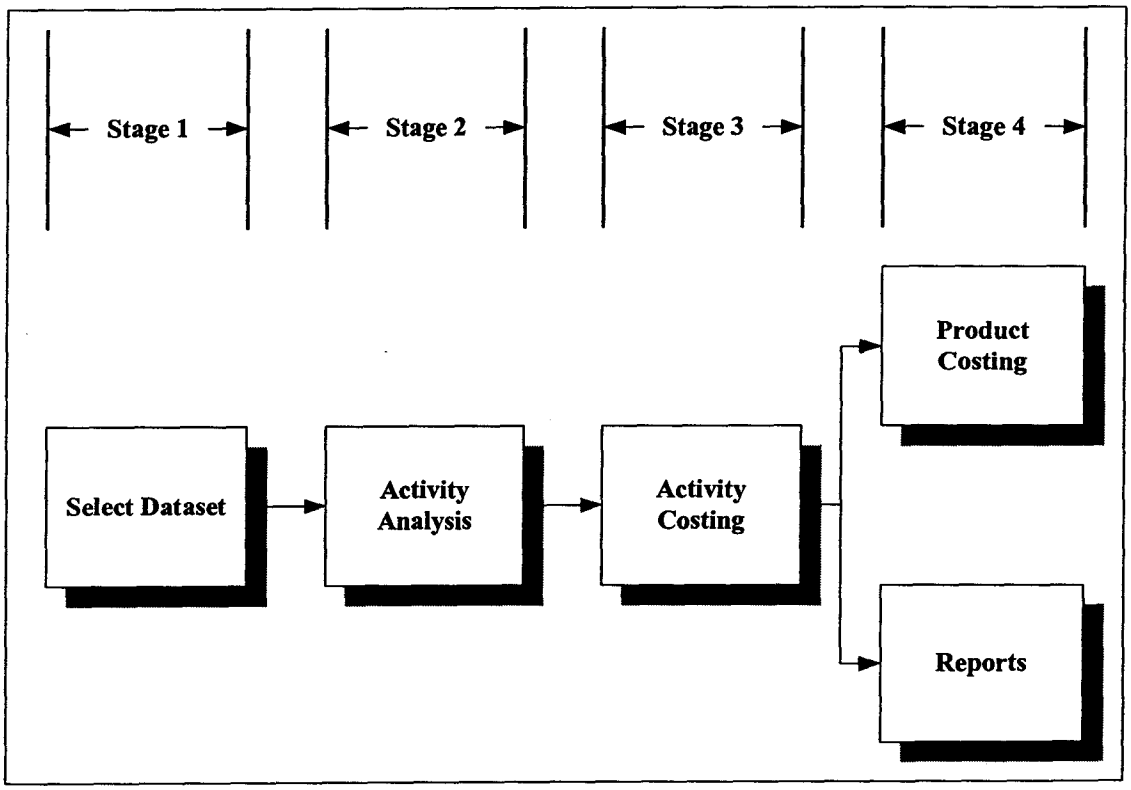


Figure 5.1: ABC software stages

5.4 System Design

The purpose of the design phase is to define the high-level software architecture that will best satisfy the requirements and specifications for the ABC system. During preliminary design, the developer uses the updated requirements and specifications document to develop alternative designs and to select an optimum approach. The developer partitions the system into major subsystems, specifies all system and subsystem interfaces, and documents the design using *structure charts* or annotated *design diagrams*. Developers use an iterative design process that proceeds somewhat differently, depending on whether a functional decomposition or object-oriented design approach is chosen.

To develop the ABC software, the author will use RUP as a software development methodology. The Rational Unified Process is a Software Engineering Process. It provides a disciplined approach to assigning tasks and responsibilities within a development organization. Its goal is to ensure the production of high-quality software that meets the needs of its end users, within a predictable schedule and budget. The Rational Unified Process captures many of the best practices in modern software development in a form that can be tailorable for a wide range of projects and organizations.

The Rational Unified Process supports **object-oriented techniques**. Several of the models are object-oriented models, based on the concepts of objects, classes, and associations between them. These models, like many other technical artifacts, use the Unified Modeling Language (UML) as the common notation. This approach is used for ABC software development and it is easy to understand and manage.

The beginner programmer might begin coding without a good design. Programmers who do so may find themselves going back to modify pieces of code they've already written as they move through the project. With a good design, the likelihood of this happening will be reduced dramatically. The end result is a program that will behave in the way it was intended, and will generally have with a shorter overall program development time.

5.4.1 Class Diagram for ABC System

Class diagrams are the backbone of almost every object-oriented method. They describe the static structure of a system. Figure 5.2 shows main class diagram for ABC system. Figure 5.3 shows all the class diagrams for ABC system.

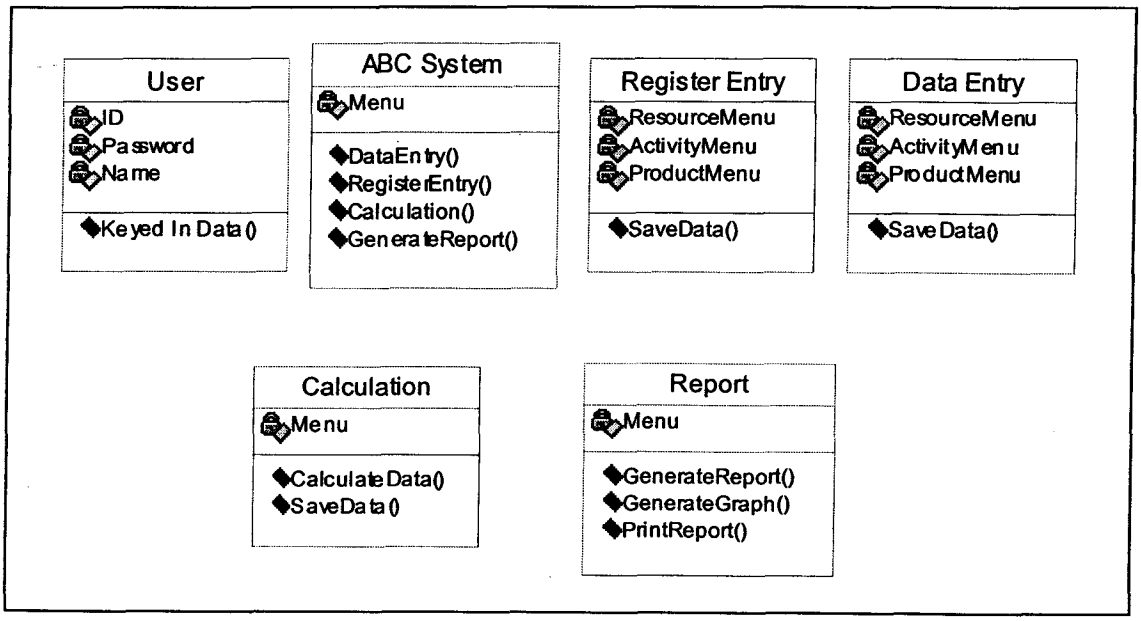


Figure 5.2: Main class diagrams for ABC System

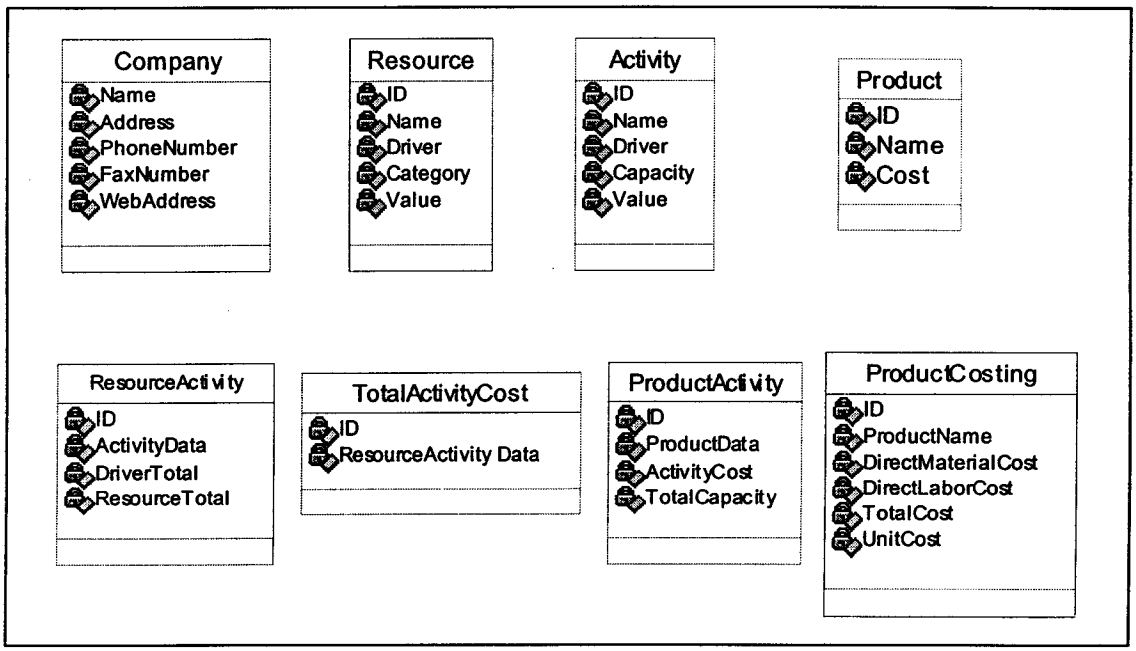


Figure 5.3: Detail class diagram for ABC System

5.4.2 Use Case Diagram for ABC System

A use case is a set of scenarios that describes an interaction between user and system. A use case diagram displays the relationship among actors and use cases. The two main components in a use case diagram are use cases and actors (see Figure 5.4).

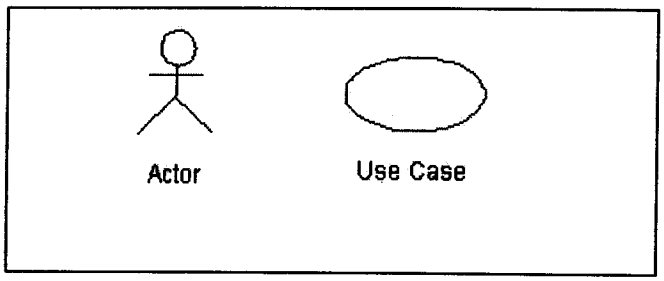


Figure 5.4: Symbol for actor and use case

An actor is represents a user or another system that will interact with the system. A use case is an external view of the system that represents some action the user might perform in order to complete a task. Use cases are used in almost every project. There are helpful in exposing requirements and planning the project. During the initial stage of a project most use cases should be defined, but as the project continues more might become visible. Figure 5.5 shows the use case diagram for ABC system.

This diagram shows the user is an actor is using the ABC system. The admin could also be included in this use case diagram because the admin is also interacting with the ABC system. From this diagram the requirements of the ABC system can easily be derived. The system will need to be able to perform actions for all of the use cases listed. As the project progresses other use cases might appear. This diagram can easily be expanded until a complete description of the ABC system is derived capturing all of the requirements that the system will need to perform.

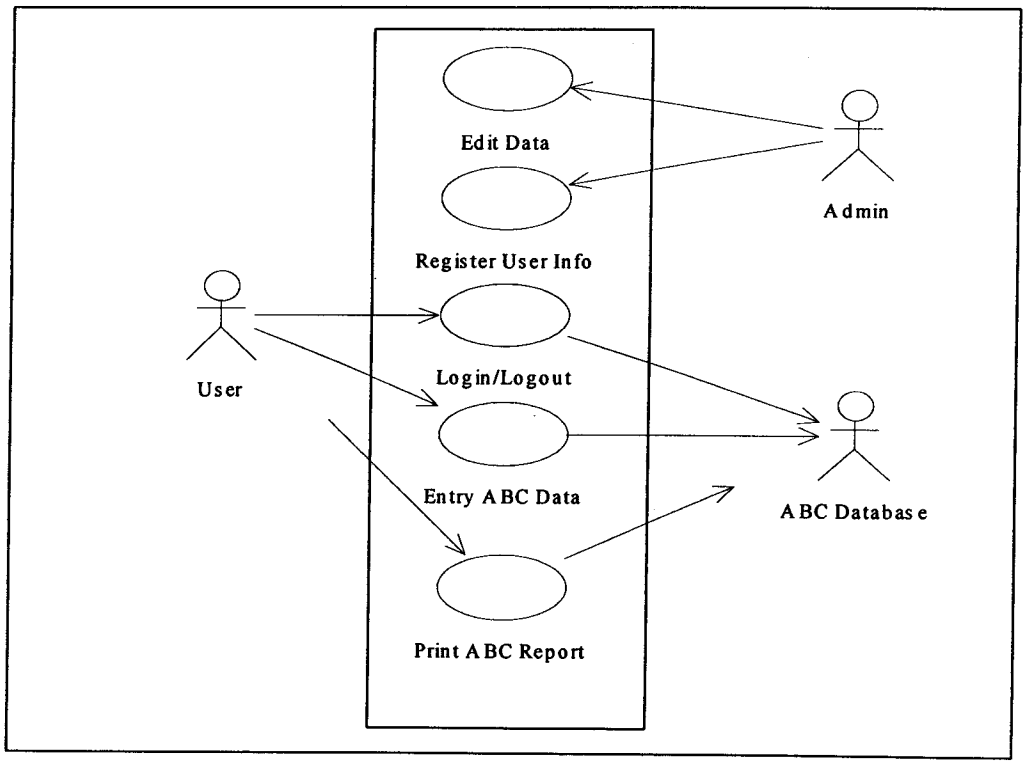


Figure 5.5: Use case diagram for ABC System

PERPUSTAKAAN SULTANAH ZANARIAH
Universiti Teknologi Malaysia
08 JUL 2004

5.4.3 Sequence Diagram

Sequence diagrams demonstrate the behavior of objects in a use case by describing the objects and the messages they pass. The diagrams are read left to right and descending. The example shows in Figure 5.6 is an object of class 1 starts the behavior by sending a message to an object of class 2. Messages pass between the different objects until the object of class 1 receives the final message.

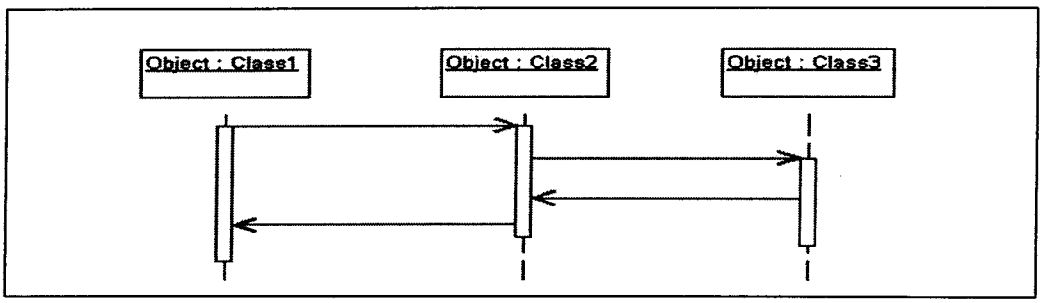


Figure 5.6: Examples of sequence diagram

Figure 5.7 shows the sequence diagram for registration process. The object admin is created and sends a message to registration menu object for preparing the registration. After that, admin fills the user information using registration form. New user data will save into the ABC database. Figure 5.8 and Figure 5.9 show another sequence diagram for ABC system.

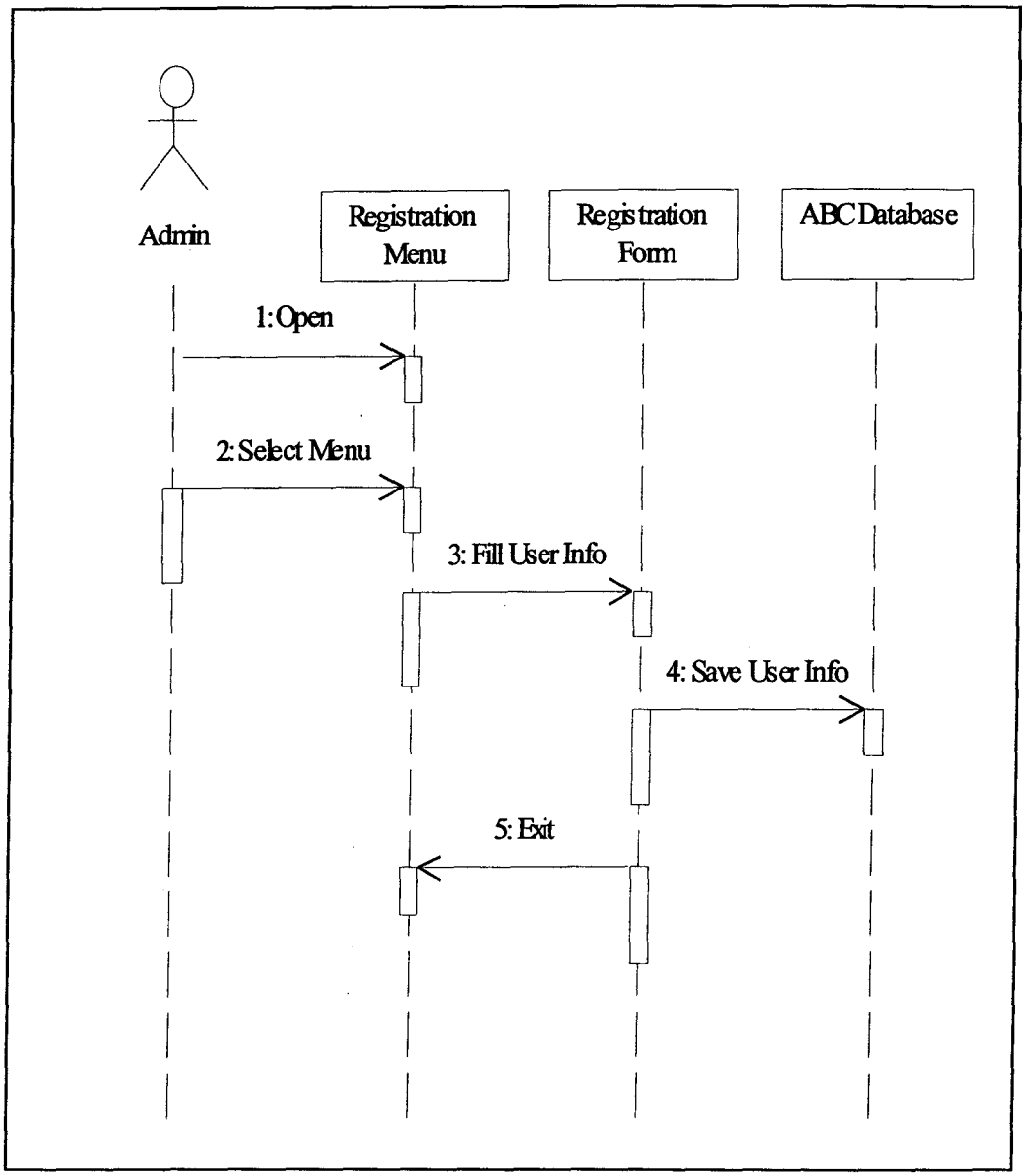


Figure 5.7: Sequence diagram for user registration by admin

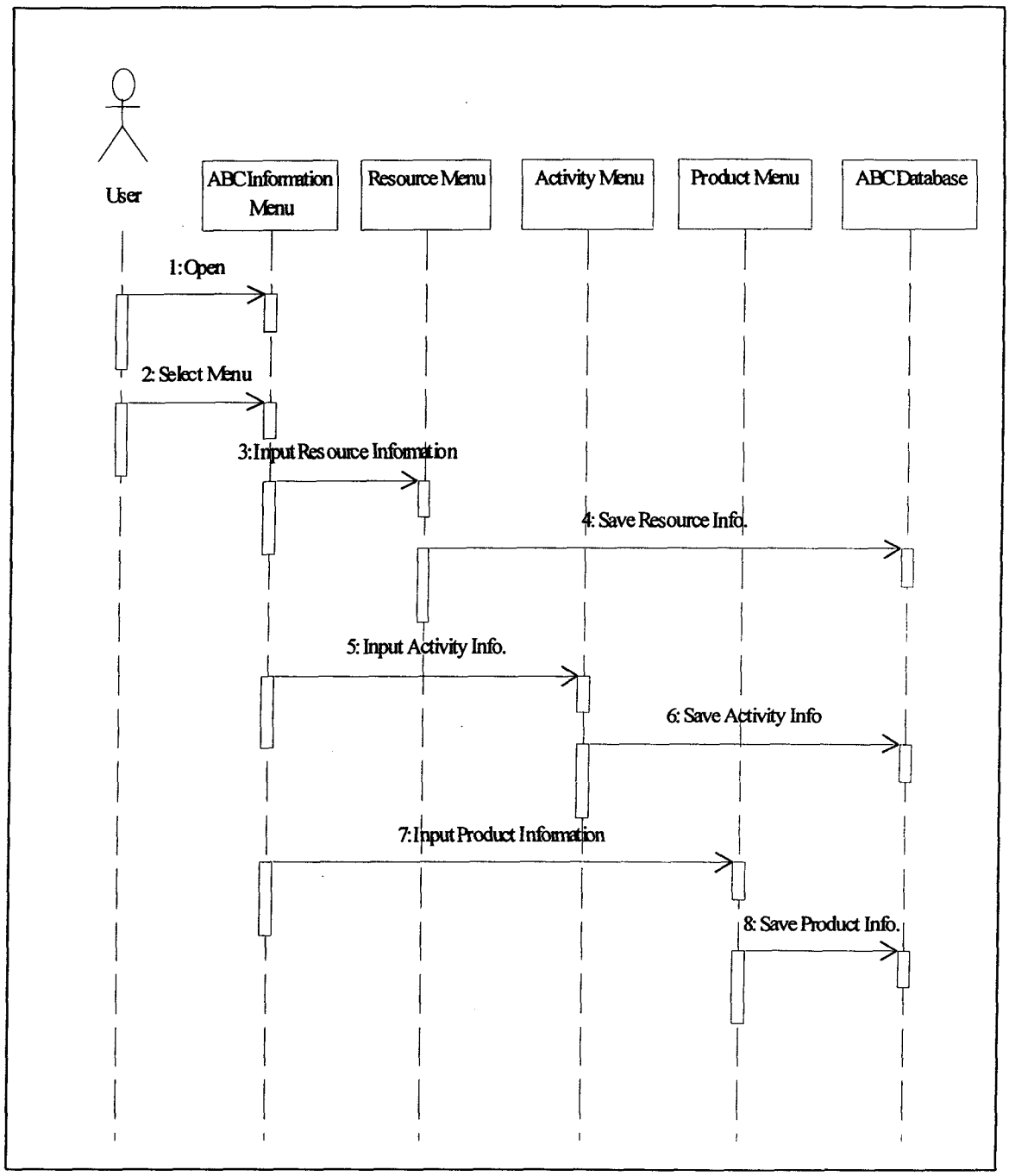


Figure 5.8: Sequence diagram for input ABC information

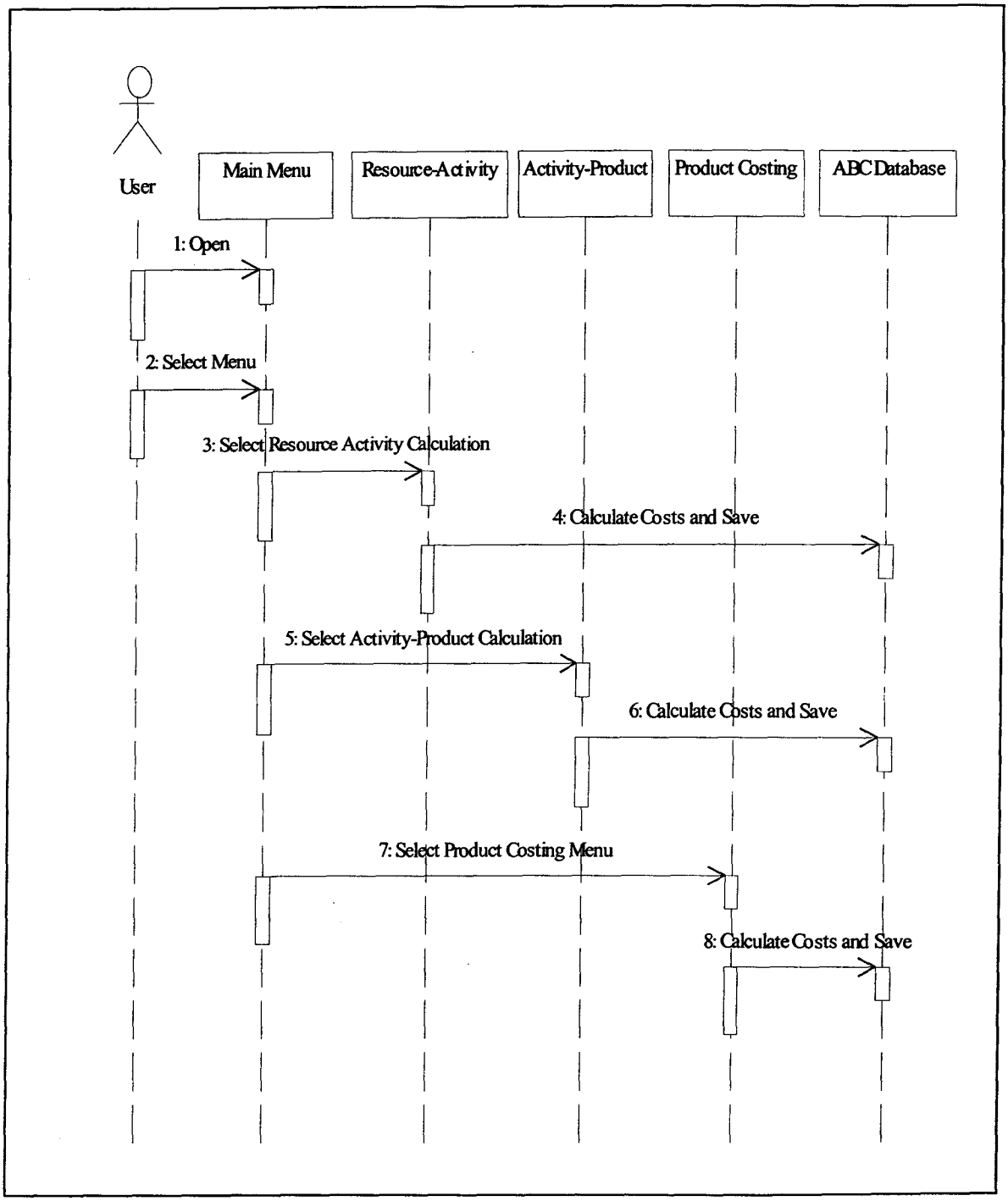


Figure 5.9: Sequence diagram for ABC calculation process

5.4.4 Collaboration Diagrams

Unlike a sequence diagram, a collaboration diagram shows the relationships among the objects playing the different roles. On the other hand, a collaboration diagram does not shows the time as a separate dimension, so the sequence of interactions and the concurrent threads must be determined using sequence numbers. Figure 5.10 and Figure 5.11 show the collaboration diagrams for ABC system.

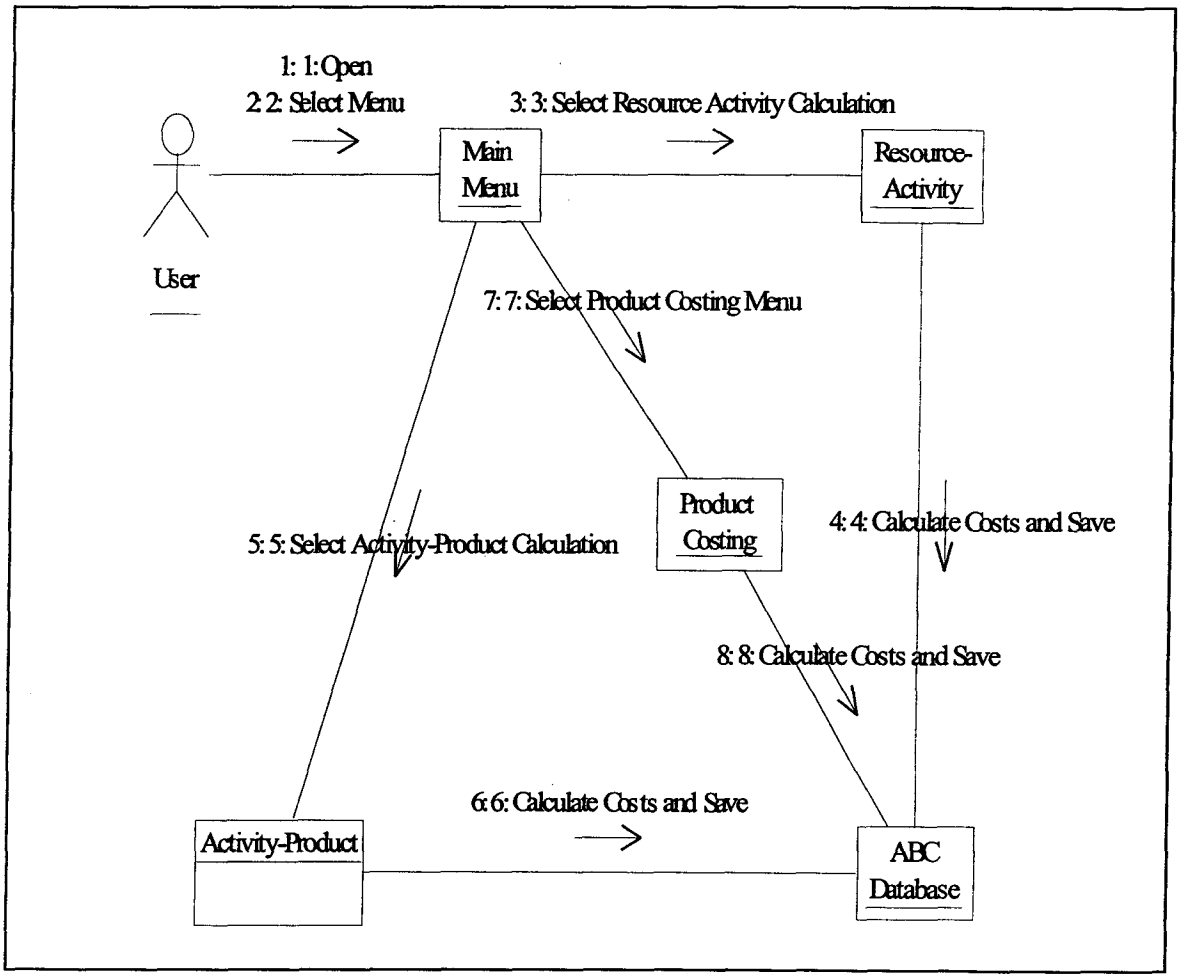


Figure 5.10: Collaboration diagram for calculation process

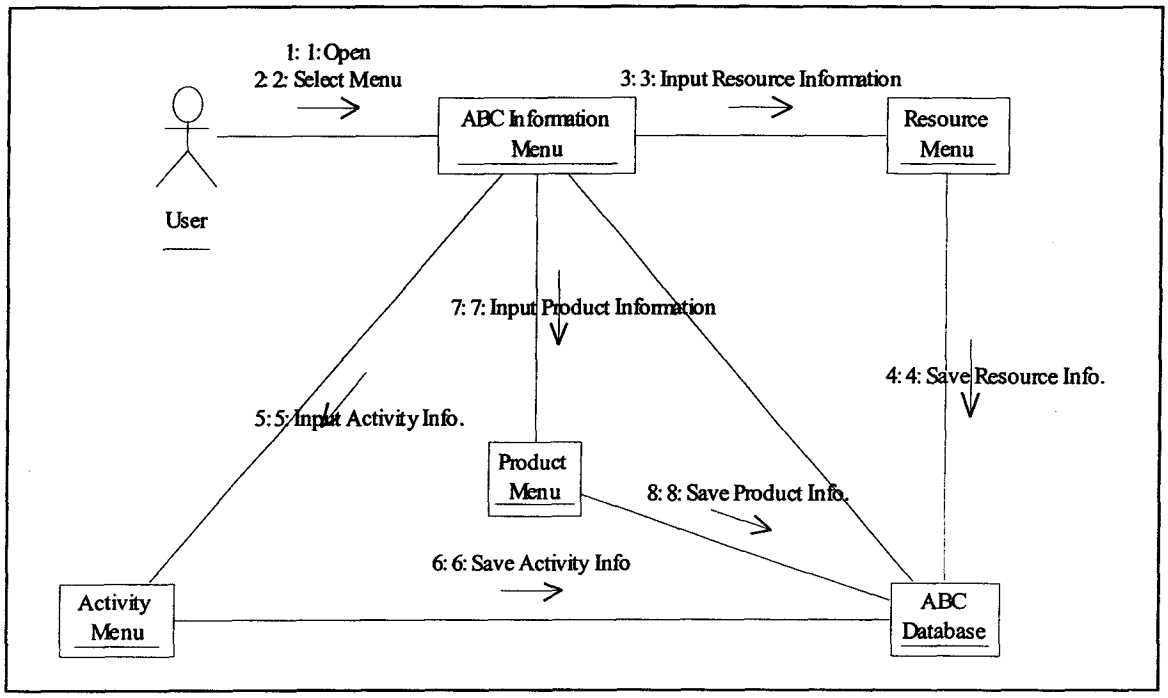


Figure 5.11: Collaboration diagram for save information

5.5 Database Design

The main purpose of database design is to ensure the persistent data is stored consistently and the behavior is well defined in the database. Database is very important for ABC system because the data that we need in calculation using ABC method is taken from the database. Database is referred to a collection of mutually related data for the computer to store and manipulate it.

The organization of the data in a database has to represent the underlying meaning or semantics of the data correctly and efficiently. Normally, structure of data is

arranged for the convenience of the program. A database contains data to be used by many and diverse programs.

For this ABC project, Microsoft Access 2000 is choosing as a database system. Microsoft Access is a powerful program to create and manage databases. It has many built in features to assist user in constructing and viewing information. Figure 5.12 shows the hierarchy that Microsoft Access uses in breaking down a database.

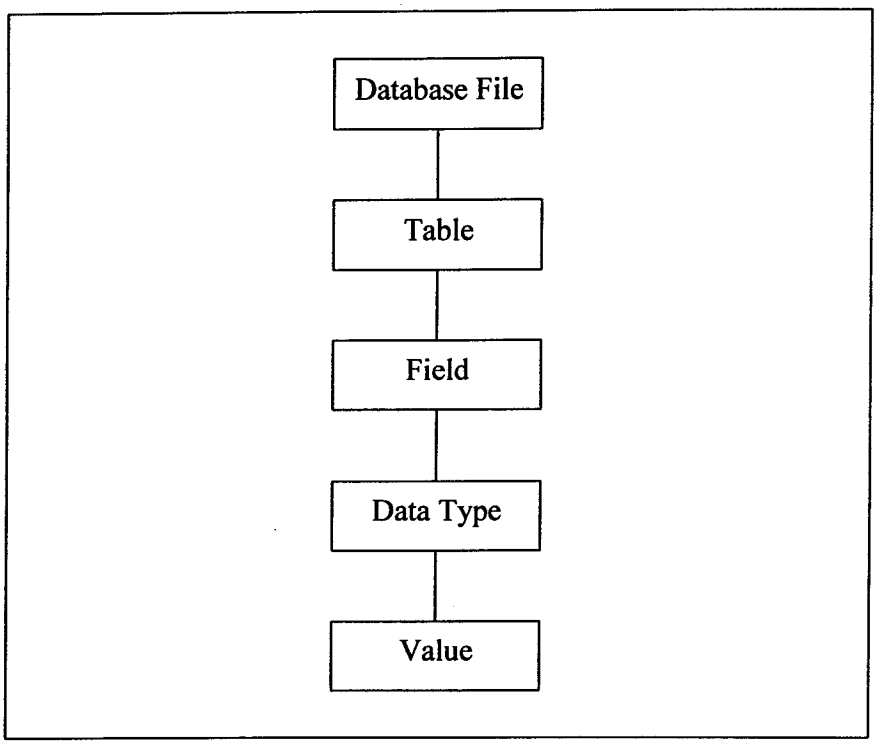


Figure 5.12: Microsoft Access 2000 hierarchy

i. Database file - This is main file that encompasses the entire ABC database and that is saved in the hard-drive. For example, ABCdbase.mdb.

ii. Table - Table is a collection of data related to a specific topic. There can be multiple tables in a database. For examples, Table Resource and Table Activity in Figure 5.13.

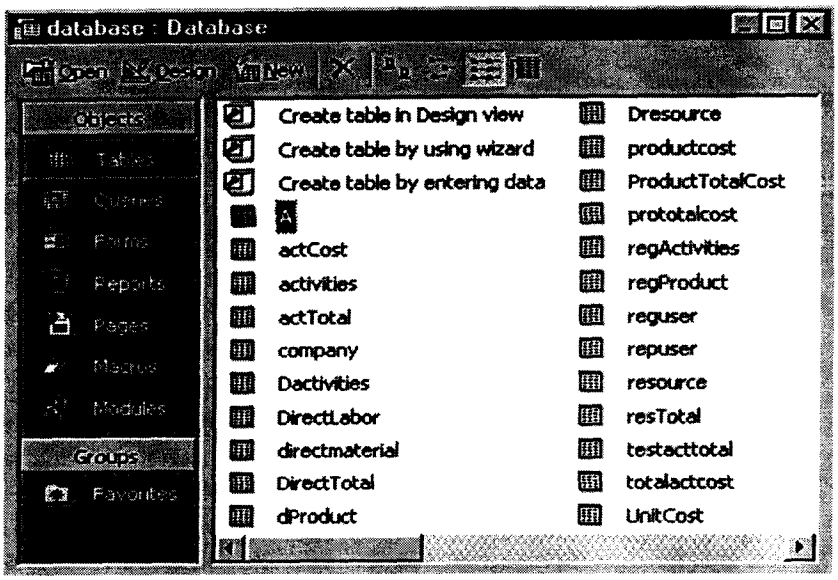


Figure 5.13: Tables in ABC database

iii. Field - Fields are the detailed categories within a Table. Tables usually contain multiple fields. For example, see Figure 5.14.

IDact	nameAct	actDriver	Capacity
ACT-001	SMT	No of panel	780000
ACT-002	Inspect Cured Component	No of inspection	1834515
ACT-003	Radial Component	No of component	9760387
ACT-004	Wave Soldering	No of Panel	663000
ACT-005	Cleaning	No of panel	612000
ACT-006	PCB Separation	no of tabs	7621714

Figure 5.14: Fields for table RegActivities

iv. Datatypes - Datatypes are the properties of each field. A field only has 1 datatype (see Figure 5.15).

Field Name	Data Type	
IDact	Text	ID Number
nameAct	Text	Activity Name
actDriver	Text	Activity Driver
Capacity	Text	Capacity per Month

Figure 5.15: Datatypes of each fields in table RegActivities

For the details of ABC system database design, see Appendix D.

5.6 Implementation

The purposes of implementation are:

i. To define the organization of the code, in terms of implementation subsystems organized in layers.

ii. To implement classes and objects in terms of components (source files, binaries, executables and others).

iii. To test the developed components as units.

5.6.1 Implementation Model

An implementation model is a collection of components, and the subsystems that contain them. Components include both deliverable components, such as executables and components from which the deliverables are produced, such as source code files. Figure 5.16 shows the implementation model for ABC system.

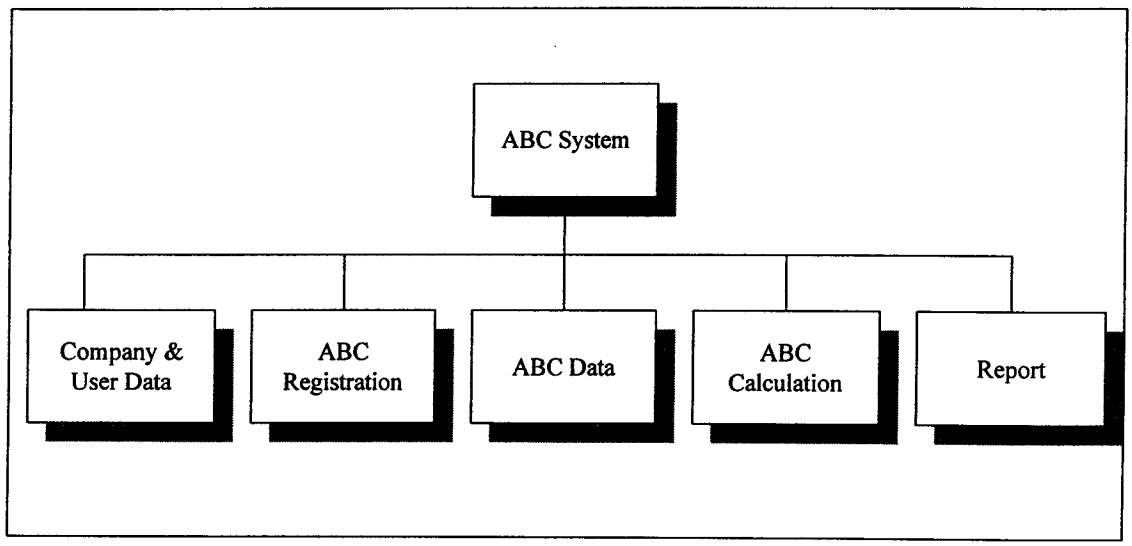


Figure 5.16: Structure of ABC System

Figure 5.16 shows the ABC system that comprises of five main modules. The modules are:

i. Company and User Data – Provides company and user information. Figure 5.17 shows the detail of this module.

ii. ABC Registration – Input the ABC information (Resource, Activity, and Product information). See Figure 5.18 for detail of this module.

iii. ABC Data – Input the resource, activity and product value/cost (see Figure 5.19).

iv. ABC Calculation – Calculation stage (see Figure 5.20 for detail).

v. Report – Output stage (see Figure 5.21 for detail)

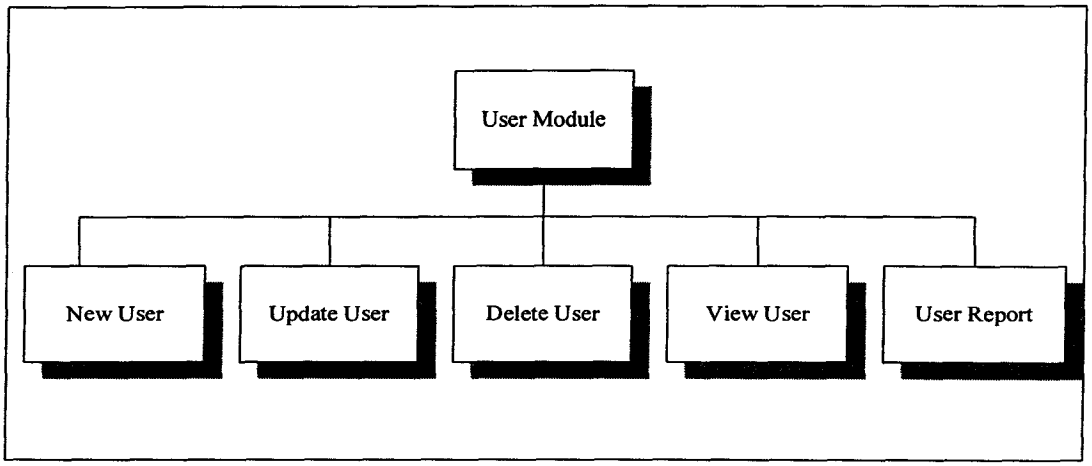


Figure 5.17: User module section

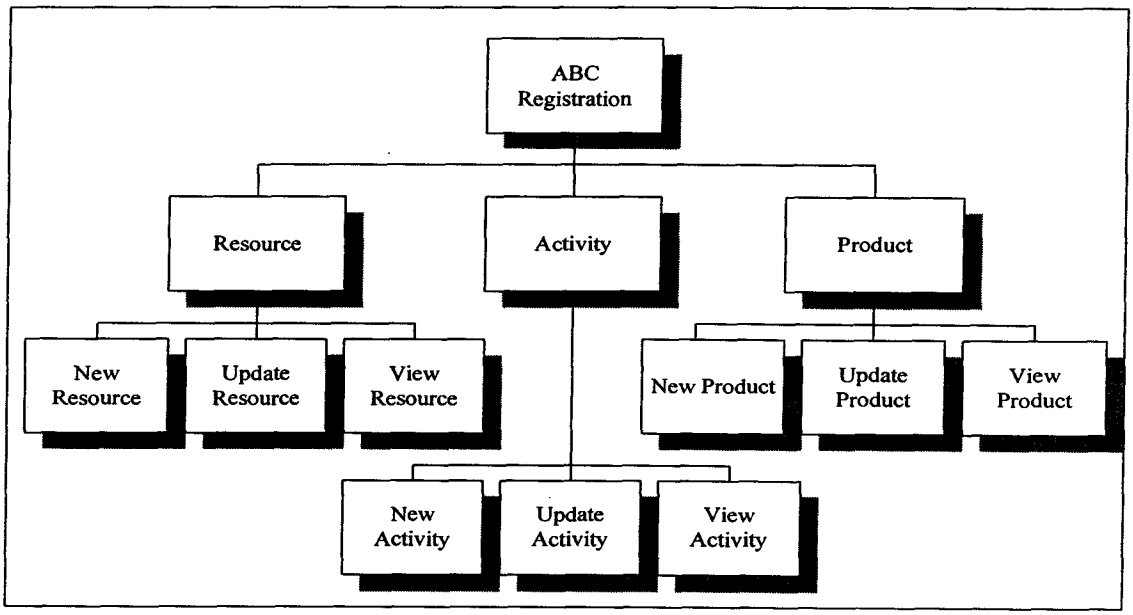


Figure 5.18: ABC registration module

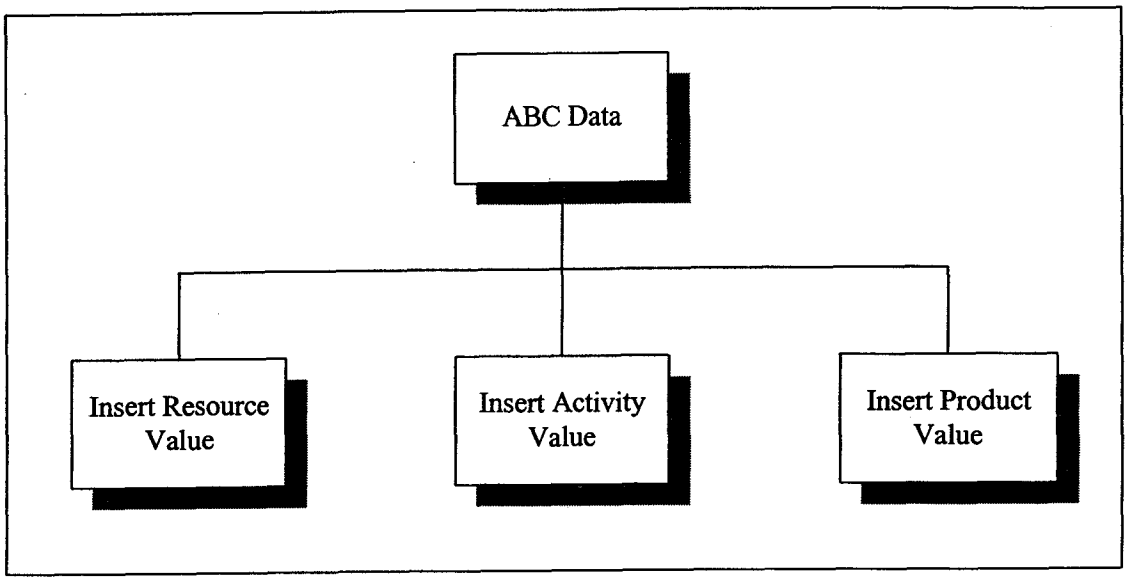


Figure 5.19: ABC data module

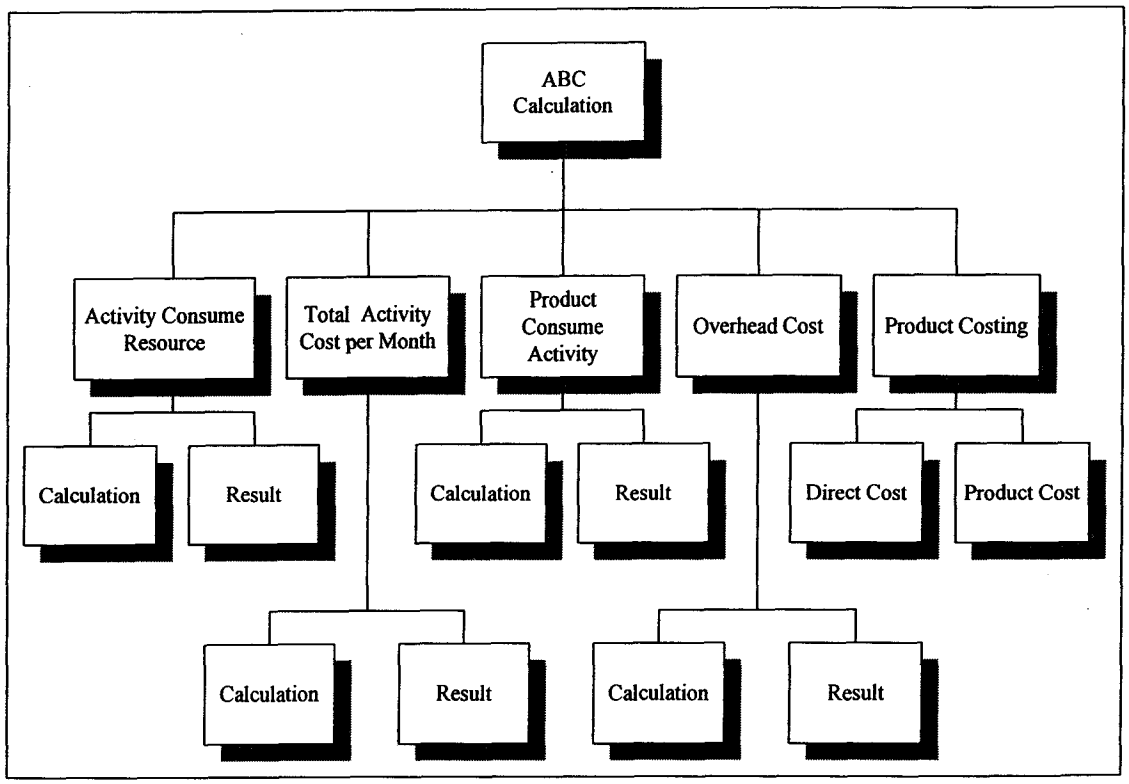


Figure 5.20: ABC calculation module

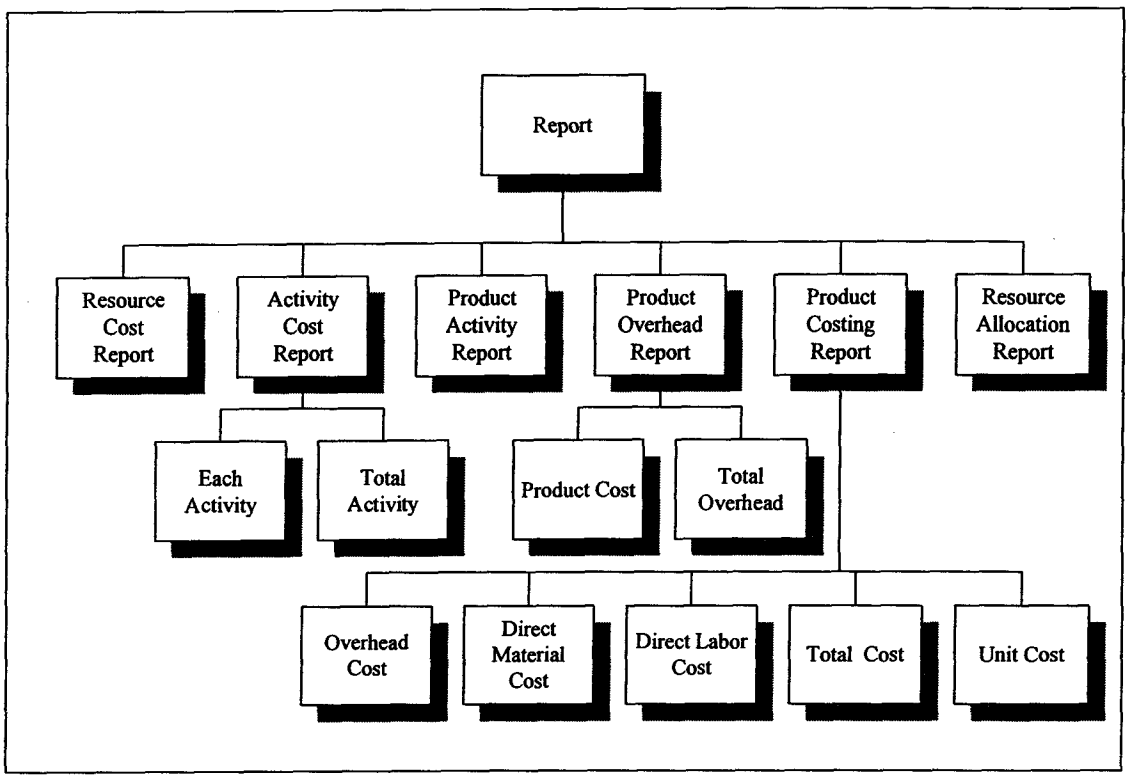


Figure 5.21: Report module

5.6.2 User Interface

A user interface is an interface that enables information to be passed between a user and a computer system. This section gives an overview of the structure of ABC system interfaces. This overview is necessary to understand the software.

A user interface is divided into separate windows. Windows can be moved around the screen, stacked on top of each other. ABC system has one primary window

(main interface) and a number of secondary windows (sub-interface). The primary window handles the major interaction with the user. Secondary windows are used to support the interactions with primary windows by providing details about their objects and operations on those objects. Figure 5.22 shows the primary windows for ABC system.

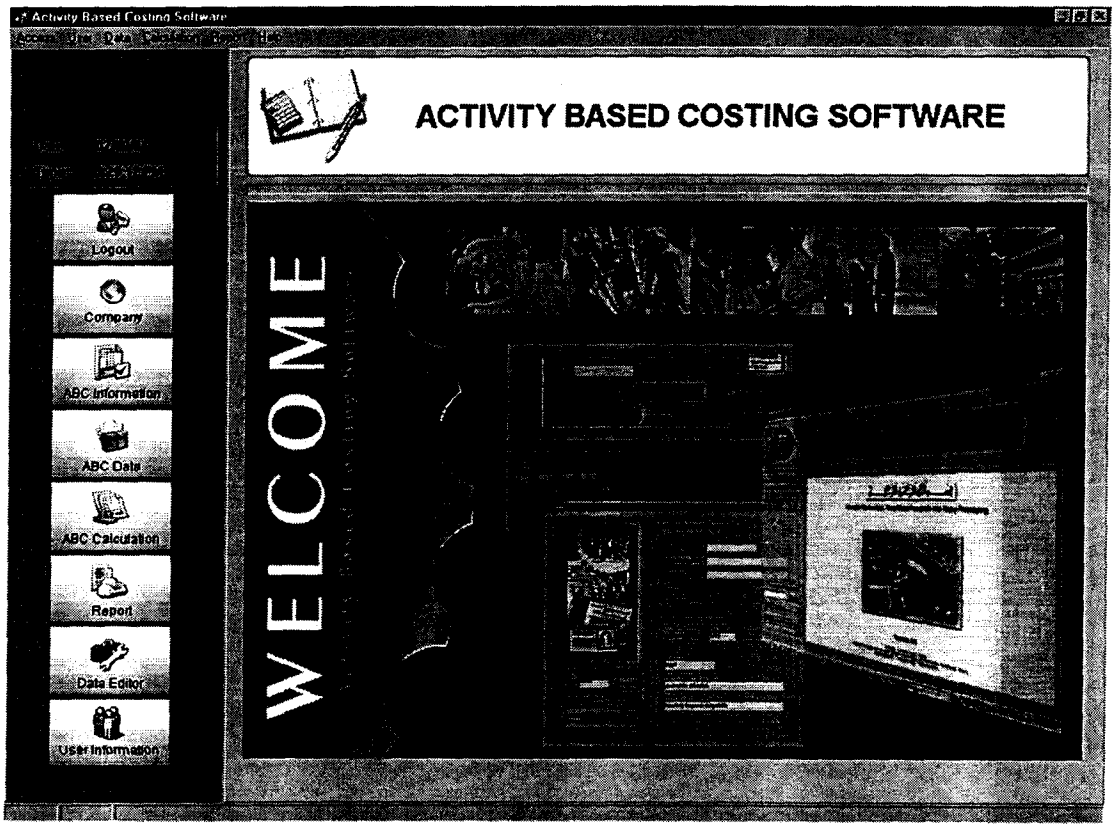


Figure 5.22: ABC System main menu

ABC system has eight submenus. The submenus are:

i. Login/Logout menu
ii. Company menu
iii. ABC Information menu
iv. ABC Data menu
v. ABC Calculation menu
vi. Report Menu

vii. Data Editor menu

viii. User Information menu

Before user login into the system, the correct user name and password have to be input for security purposes. Figure 5.23 shows the login/logout interface.

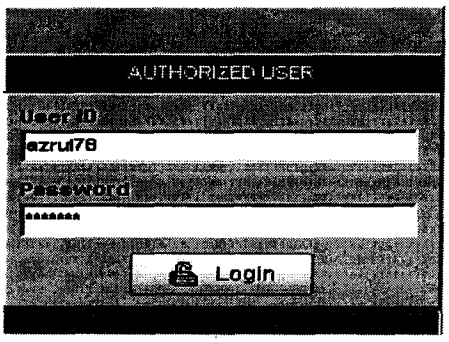


Figure 5.23: Login/logout interface

To register companies' information, user must use company interface. All the company data will key in using this interface (see Figure 5.24).

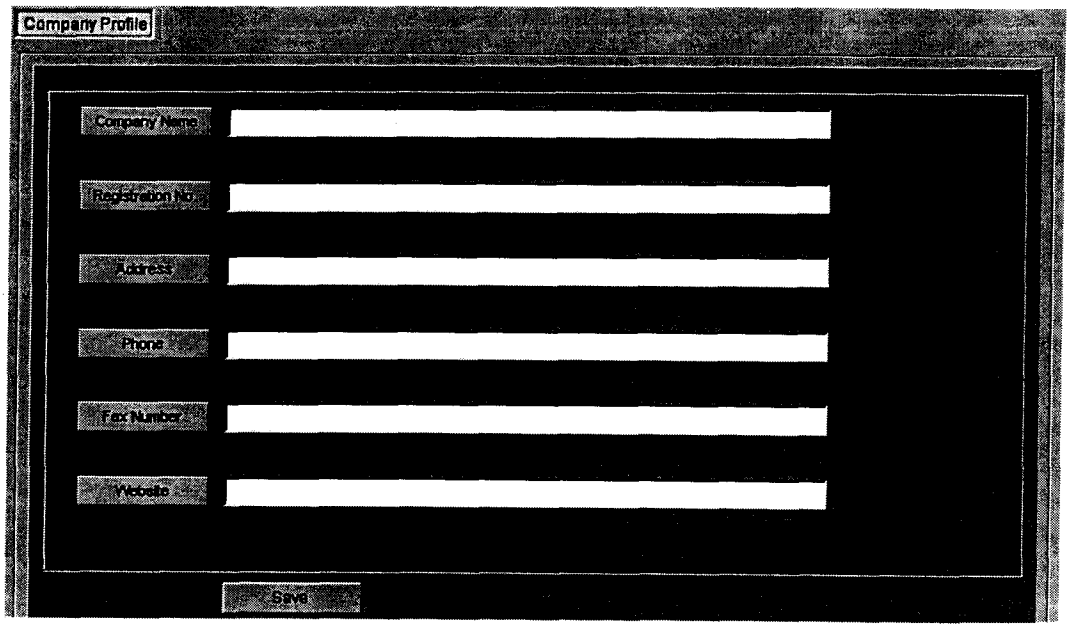


Figure 5.24: Company registration interface

To input the information of resource, activity and product, ABC system provides the ABC information interface. This interface has three submenus, which are resource field, activity field and product field. Figure 5.25 shows the interface for ABC information.

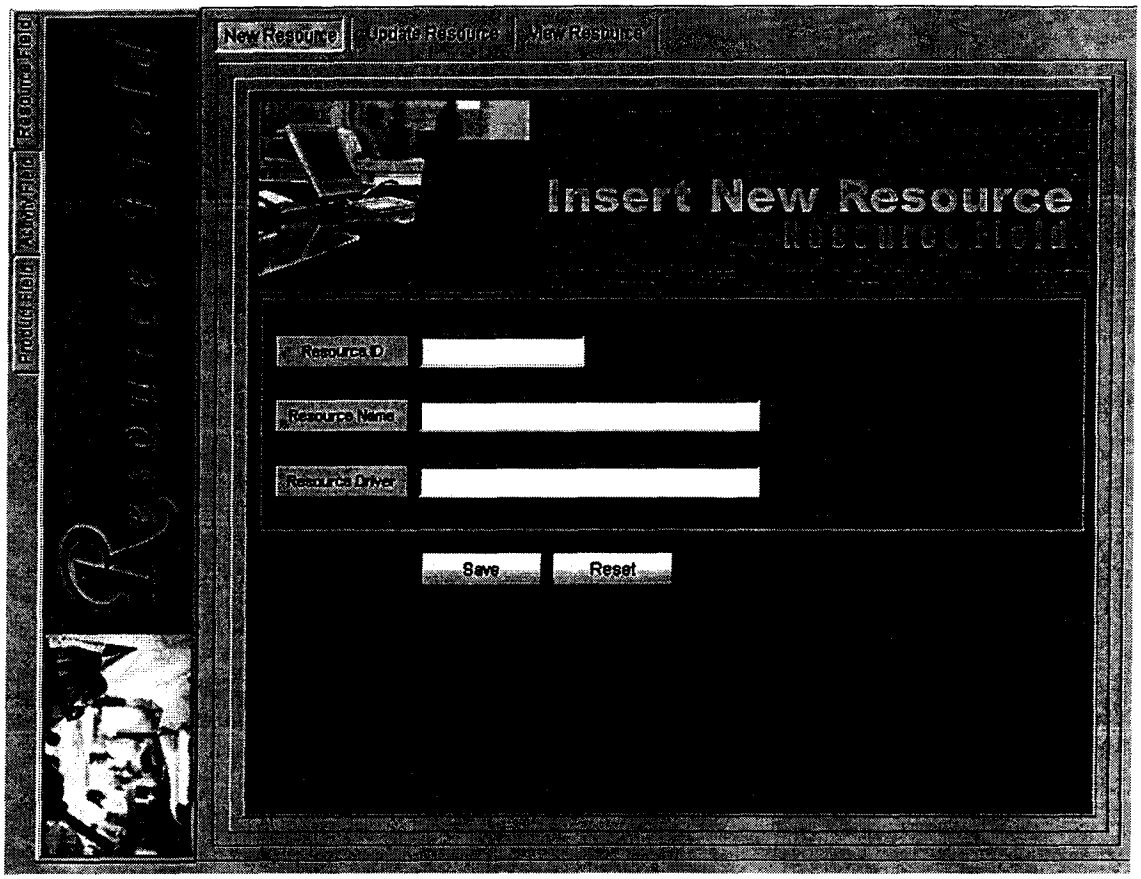


Figure 5.25: ABC Information interface

To key in the data for resource, activity and product, user must use ABC data interface. The data comprise of the number of cost, the driver value or the capacity. Figure 5.26 shows the ABC data interface. This interface also has three submenus, which are:

i. Insert resource data (resource name, category, cost).
ii. Insert activities data (resource name, driver value, activity name).
iii. Insert product data (activity name, product name, capacity).

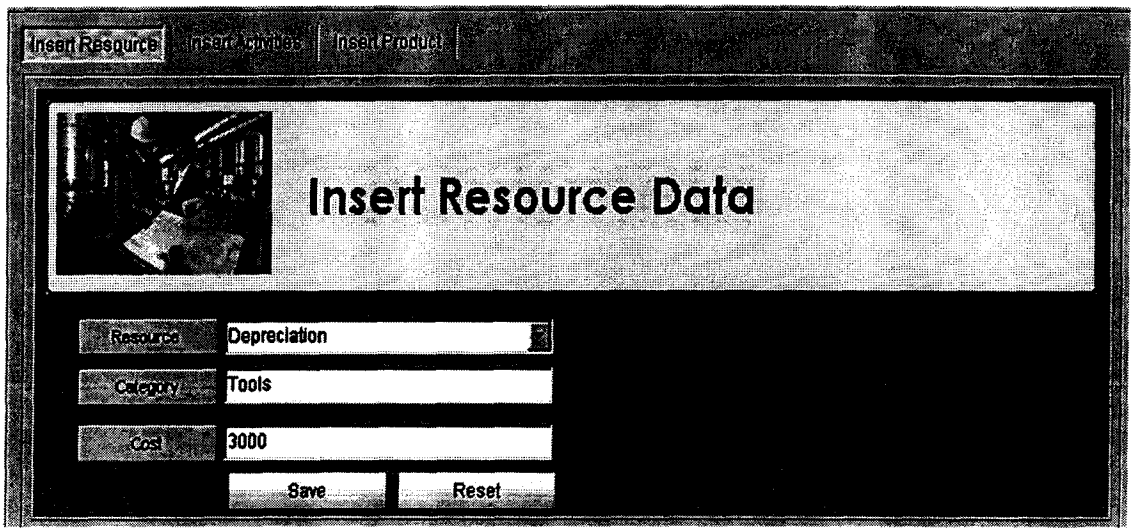


Figure 5.26: ABC Data interface (Insert Resource Data)

After data entry, the ABC system computes the costs using the ABC procedures (see Figure 5.27). It is followed by the presentation of the results. ABC calculation interface has five submenus, which are:

i. Resource Activities
ii. Total Activity Cost
iii. Activities Product
iv. Product Total Overhead Cost
v. Product Costing

After calculation, the ABC system will generate the report and graph. User can print the report to analyze the results of ABC (see Figure 5.28).

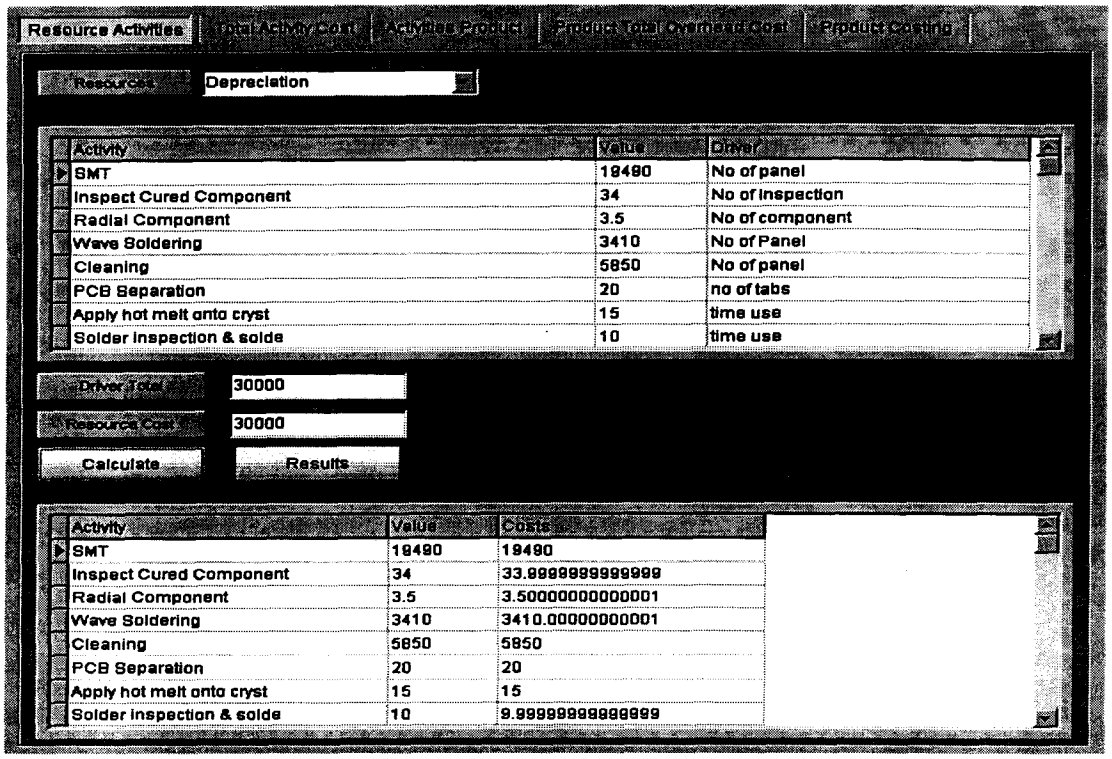


Figure 5.27: ABC Calculation interface

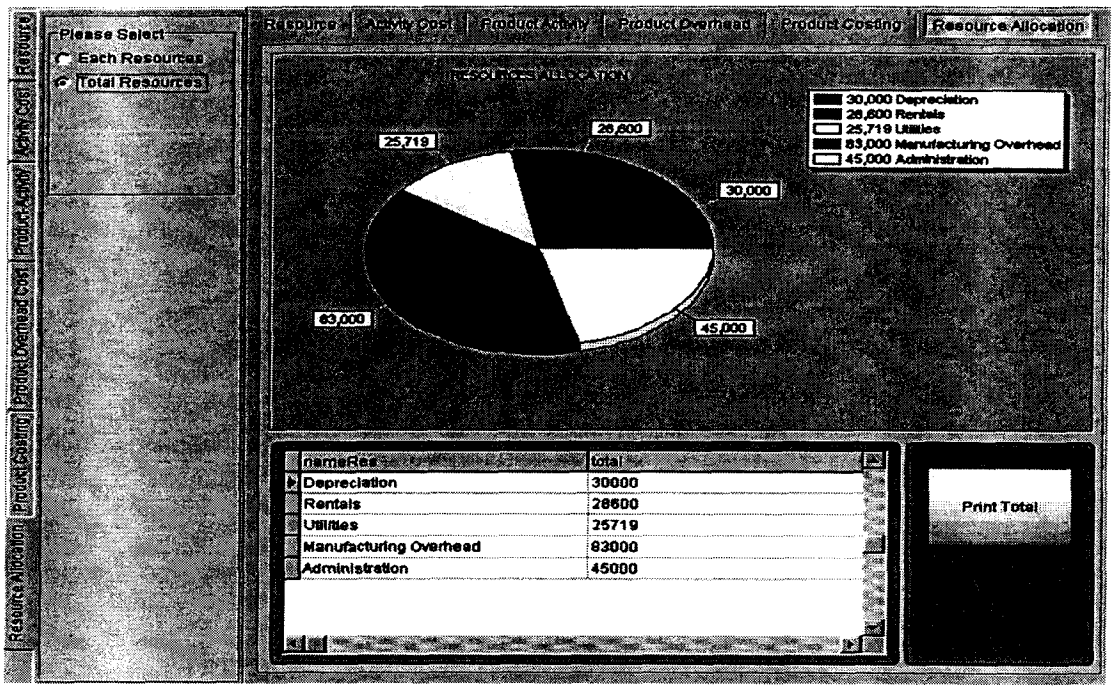


Figure 5.28: ABC Report interface

5.7 Summary

ABC is more complex but more accurate than traditional costing system. To develop the ABC system, Rational Unified Process (RUP) is used as a software development methodology. RUP provides a disciplined approach to assign tasks and responsibilities within the development organization and its goal to ensure the production of high-quality software that meets the needs of its end users. The results of ABC system and software validation will be discussed in the next chapter.

CHAPTER 6

RESULTS ANALYSIS AND DISCUSSION

6.1 Introduction

This chapter will discuss about the differences or comparison between traditional costing system and ABC system. This chapter also compares between ABC results using Excel programming and Delphi programming. It also discovers about the advantages of using ABC system over traditional system and how ABC can be used for qualify, process and productivity improvement.

6.2 Resources Allocation

Discussion on resources allocation will be stated first because it was the primary input of this software. There are five resources have been identified in this case study:

i. Depreciation
ii. Rentals
iii. Utilities
iv. Manufacturing Overhead
v. Administration

Every resource has divided into several categories to make calculation become easier. Three categories have been considered for depreciation. There are machines, equipments and tools. It's included jig tester, solder iron, screwdriver, hand tools, and furniture. There is also one rental machine i.e. AMP pin. The company also hired gardening decoration from other company (sub-con) and paying monthly to the respective company.

Electricity, water, and Internet connections were categories in utilities. Engineer salary, manager salary, supervision/technician salary and others are categorized as manufacturing overhead while other categories for administration are manager salary (personal, finance accounting and other manager), clerical staff and others. Appendix E shows the keyed-in data.

After the data entry, report retrieves from the software, which involves resources, is shown in Table 6.1. Meanwhile Figure 6.1 shows the cost of resources in the form of pie chart.

Table 6.1: Total resources cost for all products (from table resTotal)

resTotal		
IDres	ResourceName	Total
RES-001	Depreciation	30000
RES-002	Rentals	28600
RES-003	Utilities	25719
RES-004	Manufacturing Overhead	83000
RES-005	Administration	45000

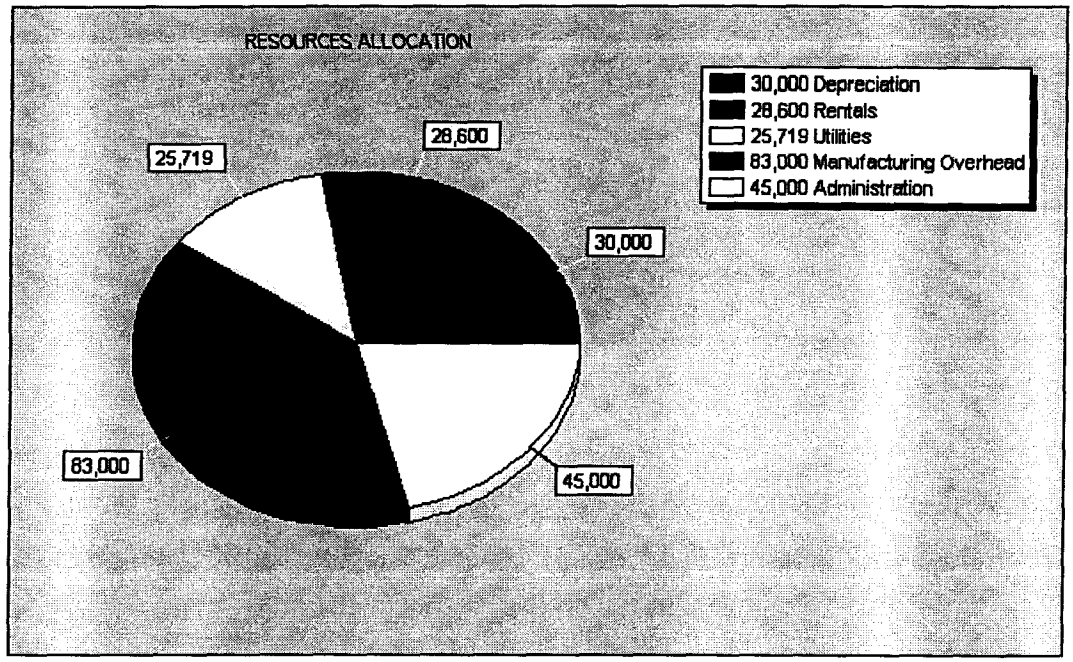


Figure 6.1: Pie chart for resources allocation (RM)

From the pie chart, it is clear that manufacturing overhead is considered as the highest cost.

6.3 Overhead Cost

To calculate overhead for SMT, the method is described as follows:

i. Depreciation

Resource driver for depreciation is named as equipment cost. Every equipment for all activity will be considered in the calculation. Appendix F shows the total cost equipment for every activity. SMT overhead cost for depreciation is based on this formula:

$$\text{SMT Overhead} = \frac{\text{equipment cost}}{\text{total of equipment cost}} \text{ x depreciation cost}$$

$$= \frac{19{,}490}{30{,}000} \text{x } 30{,}000$$

$$= \text{RM } 19{,}490$$

ii. Rental

To determine overhead for rental, floor area is picked as resource driver. Appendix G shows the keyed-in data. Overhead for SMT is calculated as:

$$\text{SMT Overhead} = \frac{\text{SMT floor area}}{\text{total of floor area}} \text{ x rental cost}$$

$$= \frac{270}{4{,}599} \text{ x } 28{,}600$$

$$= \text{RM } 1679.06$$

iii. Utilities

Utilities also used the same resource driver as rental namely floor area which is shown in Appendix H.

$$\text{SMT Overhead} = \frac{\text{SMT floor area}}{\text{total of floor area}} \text{ x total cost of utilities}$$

$$= \frac{270}{4,599} \times 25,719$$

$$= \text{RM } 1509.92$$

iv. Manufacturing

Resource driver used for manufacturing overhead is valued in supervision man-hour. The below calculation determine the overhead for SMT activity and Appendix I shows the keyed-in data.

$$\text{SMT Overhead} = \frac{2.073}{107.784} \times 83,000$$

$$= \text{RM } 1596.33$$

v. Administration

Appendix J shows the keyed-in data for administration resource.

$$\text{SMT Overhead} = \frac{2.073}{107.784} \times 45,000$$

$$= \text{RM } 865.48$$

All overheads are summed up to gain cost activity per month. Cost for SMT activity is:

$$\text{SMT cost} = 19490 + 1679.06 + 1509.92 + 1596.33 + 865.48$$

$$= \text{RM } 25,140.79$$

The same method is used for all other activity. Total cost for every activity is shown by Table 6.2 (table totalcost from database). Table 6.3 shows the total cost of activity calculates using Excel programming.

Table 6.2: Cost of activity in RM/month (from ABC database)

ActID	ActivityName	TotalCost
ACT-001	SMT	25140.7949013922
ACT-002	Inspect Cured Component	1363.7057305159
ACT-003	Radial Component	6405.05659394457
ACT-004	Wave Soldering	9814.34021206144
ACT-005	Cleaning	12495.4149541382
ACT-006	PCB Separation	3256.12736439031
ACT-007	Apply hot melt onto cryst	2799.8799792816
ACT-008	Solder inspection & solde	7130.249781581
ACT-009	Trimmer	7605.27390389971
ACT-010	Segment Check	8672.6408600342
ACT-011	Immediate Testing	9638.12738864697
ACT-012	Wires to lucars	16424.7339578775
ACT-013	Final Assembly	16169.7845776354
ACT-014	Final Testing	9626.00106191944
ACT-015	Code Stemping	9520.55891837309
ACT-016	Inspect/Packing	8888.65195630081
ACT-017	Sealing	4672.41499509856
ACT-018	Palletization	6468.20560175218
ACT-019	Material Handling	6226.26663009284
ACT-020	Maintenance	502.225956152357
ACT-021	Production Management	3359.17272117621
ACT-022	Inventory/Purchasing	3537.80435481386
ACT-023	Sales/Marketing	29031.2651765807
ACT-024	Administration Personnel	3570.30242234125

Table 6.3: Cost of activity in RM/month (using Excel)

Name of Activity	Cost of Activity (RM)
SMT	25,140.79
Inspect cured component	1,363.71
Radial component	6,405.06
Wave soldering	9,814.34
Cleaning	12,495.41
PCB Separation	3,256.13
Apply hot melt onto crystal	2,799.88
Solder inspection & solder S3	7,130.25
Solder Trimmer, S1, S2 To PCB Soldering	7,605.27
Segment Check	8,672.64
Immediate Testing	9,638.13
Solder 4 wires To Lucars & Short Circuit Test	16,424.73
Final Assembly	16,169.78
Final Testing	9,626.00
Date Code stamping & 100% Funtional	9,520.56
Inspect & Packing	8,888.65
Sealing	4,672.41
Palletization	6,468.21
Material handling	6,226.27
Maintenance/engineering	502.23
Production management	3,359.17
Inventory/purchasing	3,537.80
Sales/Marketing	29,031.27
Administration Personnel	3,570.30

From these two tables, we can see the results using this two software are similar. Table 6.4 shows the comparisons of the results. Slight differences in the calculation are only in a decimal point.

Table 6.4: Cost of activity calculates using Excel and ABC software

Activity	Cost of Activity (RM) Using Excel	Cost of Activity (RM) Using New Software
SMT	25,140.79	25140.7949013922
Inspect cured component	1,363.71	1363.7057305159
Radial component	6,405.06	6405.05659394457
Wave soldering	9,814.34	9814.34021206144
Cleaning	12,495.41	12495.4149541382
PCB Separation	3,256.13	3256.12736439031
Apply hot melt onto crystal	2,799.88	2799.8799792816
Solder inspection & solder S3	7,130.25	7130.249781581
Solder Trimmer, S1, S2 To PCB Soldering	7,605.27	7605.27390389971
Segment Check	8,672.64	8672.6408600342
Immediate Testing	9,638.13	9638.12738864697
Solder 4 wires To Lucars & Short Circuit Test	16,424.73	16424.7339578775
Final Assembly	16,169.78	16169.7845776354
Final Testing	9,626.00	9626.00106191944
Date Code stamping & 100% Funtional	9,520.56	9520.55891837309
Inspect & Packing	8,888.65	8888.65195630081
Sealing	4,672.41	4672.41499509856
Palletization	6,468.21	6468.20560175218
Material handling	6,226.27	6226.26663009284
Maintenance/engineering	502.23	502.225956152357
Production management	3,359.17	3359.17272117621
Inventory/purchasing	3,537.80	3537.80435481386
Sales/Marketing	29,031.27	29031.2651765807
Administration Personnel	3,570.30	3570.30242234125

This software also generates a bar chart for user. From the bar chart (see Figure 6.2), it is easily for users to identify the highest cost and the lower cost for that month.

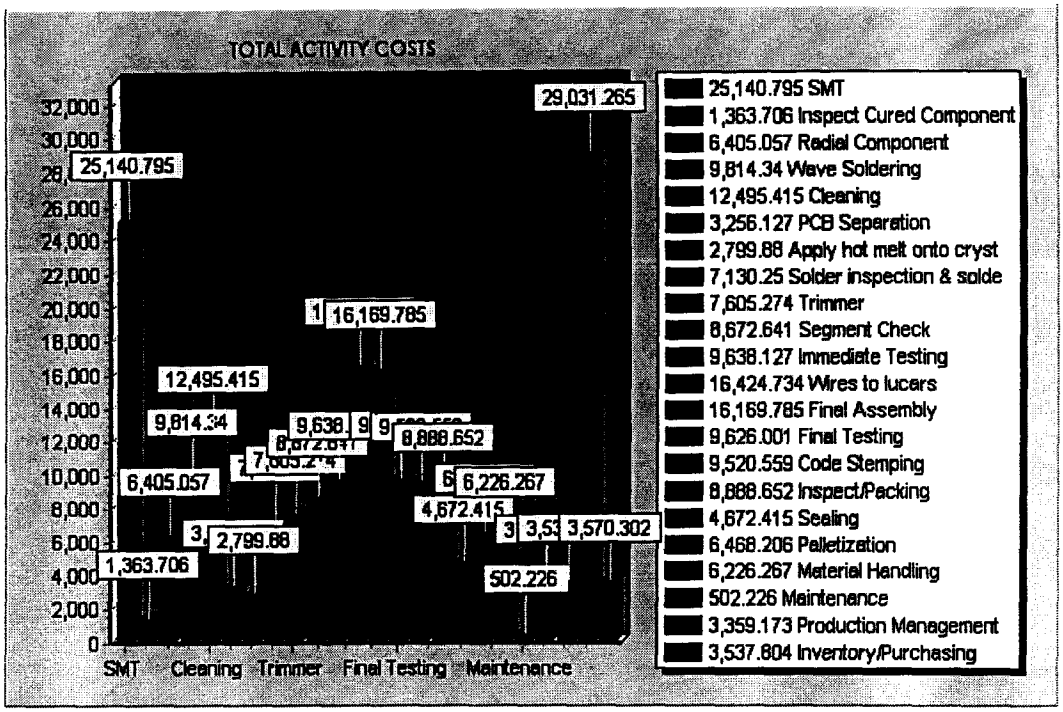


Figure 6.2: Cost of activity in bar chart

6.4 Cost for Each Product

After all of cost information has been insert into the ABC database, cost for every activity will attain from the report of activity of each product. The total product cost (PC Clock) using the ABC software is RM 31,291.29. Table 6.5 shows the detail cost for PC Clock calculates using ABC software.

Table 6.5: Cost of activities for specific product (table from database)

IDact	NameAct	NameProduct	Cost
ACT-001	SMT	PC Clock	198.032107530966
ACT-002	Inspect Cured Component	PC Clock	4.56720605080345
ACT-003	Radial Component	PC Clock	129.020024187796
ACT-004	Wave Soldering	PC Clock	90.9491798837187
ACT-005	Cleaning	PC Clock	125.444165814093
ACT-006	PCB Separation	PC Clock	31.4978702063301
ACT-007	Apply hot melt onto cryst	PC Clock	84.5765126392183
ACT-008	Solder inspection & solde	PC Clock	623.909591509524
ACT-009	Trimmer	PC Clock	711.702509839412
ACT-010	Segment Check	PC Clock	930.590919227545
ACT-011	Immediate Testing	PC Clock	1153.27538733598
ACT-012	Wires to lucars	PC Clock	3327.19188010731
ACT-013	Final Assembly	PC Clock	3227.18633742009
ACT-014	Final Testing	PC Clock	1148.6947762787
ACT-015	Code Stemping	PC Clock	1124.96817558551
ACT-016	Inspect/Packing	PC Clock	978.624178399009
ACT-017	Sealing	PC Clock	771.440332121137
ACT-018	Palletization	PC Clock	2042.59124265859
ACT-019	Material Handling	PC Clock	1966.18946213458
ACT-020	Maintenance	PC Clock	158.430900994434
ACT-021	Production Management	PC Clock	1060.79138563459
ACT-022	Inventory/Purchasing	PC Clock	1116.02661035137
ACT-023	Sales/Marketing	PC Clock	9158.12781595605
ACT-024	Administration Personnel	PC Clock	1127.46392284461

The cost of activities for specific product is calculated based on determined cost driver allocation. For example, calculation for specific product (PC Clock) using SMT activity is:

$$\text{SMT cost} = \frac{\text{capacity per month}}{\text{total available capacity}} \text{ x total cost of SMT}$$

$$= \frac{6144}{780000} \text{ x } 25{,}140.79$$

$$= \text{RM } 198.032$$

The reclaimed values were based on the information which has been insert into ABC database namely total available capacity and capacity per month. Table 6.6 shows cost product calculates using Excel programming and the comparison of both results is shown in Table 6.7.

Table 6.6: Cost of activities for specific product (table from database)

Name of Product	Name of Activity	Cost (RM)
PC Clock	SMT	198.03
	Inspect cured component	4.57
	Radial component	129.02
	Wave soldering	90.95
	Cleaning	125.44
	PCB Separation	31.50
	Apply hot melt onto crystal	84.58
	Solder inspection & solder S3	623.91
	Solder Trimmer, S1, S2 To PCB Soldering	711.70
	Segment Check	930.59
	Immediate Testing	1,153.28
	Solder 4 wires To Lucars & Short Circuit Test	3,327.19
	Final Assembly	3,227.19
	Final Testing	1,148.69
	Date Code stamping & 100% Funtional	1,124.97
	Inspect & Packing	978.62
	Sealing	771.44
	Palletization	2,042.59
	Material handling	1,966.19
	Maintenance/engineering	158.43
	Production management	1,060.79
	Inventory/purchasing	1,116.03
	Sales Marketing	9,158.13
	Administration Personnel	1,127.46

Table 6.7: Cost of product calculates using Excel and ABC software

Name of Product	Name of Activity	Cost (RM) Using Excel	Cost (RM) Using ABC Software
PC Clock	SMT	198.03	198.032107530966
	Inspect cured component	4.57	4.56720605080345
	Radial component	129.02	129.020024187796
	Wave soldering	90.95	90.9491798837187
	Cleaning	125.44	125.444165814093
	PCB Separation	31.50	31.4978702063301
	Apply hot melt onto crystal	84.58	84.5765126392183
	Solder inspection & solder S3	623.91	623.909591509524
	Solder Trimmer, S1, S2 To PCB Soldering	711.70	711.702509839412
	Segment Check	930.59	930.590919227545
	Immediate Testing	1,153.28	1153.27538733598
	Solder 4 wires To Lucars & Short Circuit Test	3,327.19	3327.19188010731
	Final Assembly	3,227.19	3227.18633742009
	Final Testing	1,148.69	1148.6947762787
	Date Code stamping & 100% Funtional	1,124.97	1124.96817558551
	Inspect & Packing	978.62	978.624178399009
	Sealing	771.44	771.440332121137
	Palletization	2,042.59	2042.59124265859
	Material handling	1,966.19	1966.18946213458
	Maintenance/engineering	158.43	158.430900994434
	Production management	1,060.79	1060.79138563459
	Inventory/purchasing	1,116.03	1116.02661035137
	Sales Marketing	9,158.13	9158.12781595605
	Administration Personnel	1,127.46	1127.46392284461

From Table 6.7, we can see the product's cost calculate using Excel programming and ABC software are similar. However using new ABC software, the process for key in data is more easier and faster.

The bar chart (Figure 6.3) can be created from this report to find out which activity contributes the highest cost. From this chart, it is found that sales marketing is the most costly activity at the price of RM 9158.13. This is followed by final assembly and solder 4 wires to lucars activity with both of them using RM 3,327.19. The total cost for these three activities is close to half of the total cost. It is clear that these activities are considered as a critical activity.

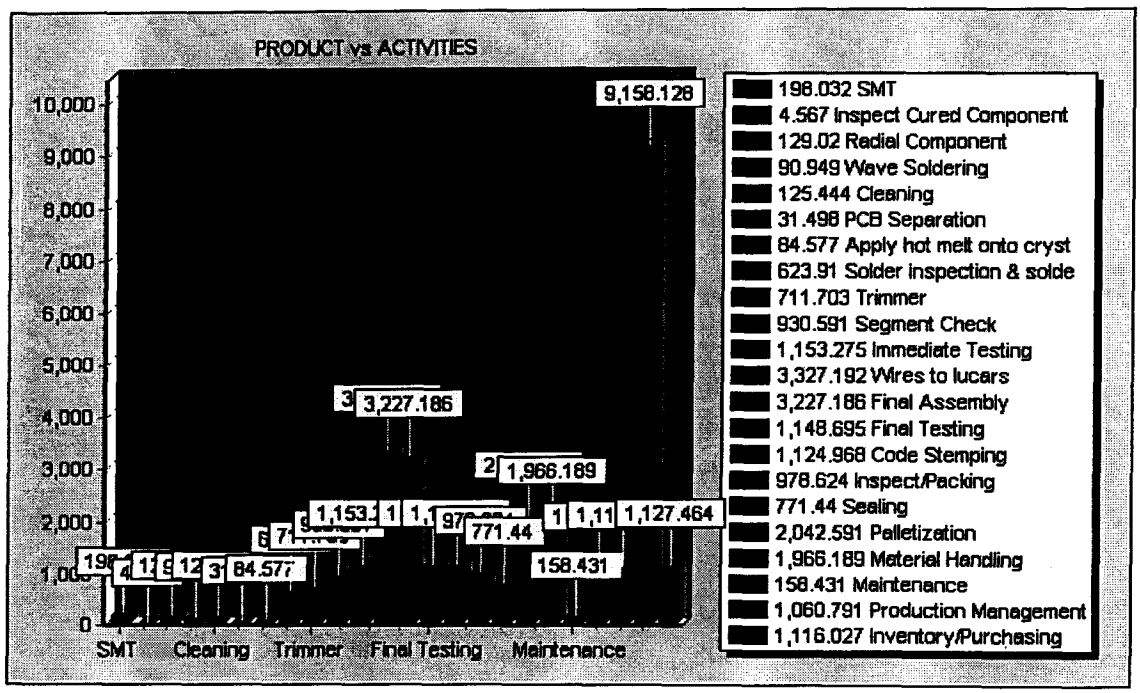


Figure 6.3: Cost for specific product (bar chart)

Total cost of this product will dramatically reduce if the cost of these three activities decreases. Others minor activities such as sealing, inspect cured component,

radial component, inventory/ purchasing, PCB separation, palletization and material handling contribute less than 10% and yet it is lower than 1%.

6.5 Total Product Cost

From the total cost of this specific product, actual cost associated with production could be calculated based on three main costs namely direct labor, direct material, and overhead cost. Differentiation of cost calculation per unit product between ABC and traditional costing system is shown in Table 6.8.

Table 6.8: Cost per unit product

Cost Type	Activity Based Costing	Traditional Costing
Direct Labor	$= \text{standard time} \times \frac{\text{labor rate}}{3600}$ $= 537.56 \times \frac{6.34}{3600}$ = RM 0.947	$= \text{standard time} \times \frac{\text{labor rate}}{3600}$ $= 537.56 \times \frac{6.34}{3600}$ = RM 0.947
Direct Material	Resistor Mini Melf = RM 0.0367 Capacitor Electric = RM 0.0746 Capacitor 1206 = RM 0.1039 Lucar Blade = RM 0.3088 Rear Case = RM 2.0607 Front Case = RM 6.952 IC = RM 10.332 Display =RM 10.333 **Total = RM 30.21**	Resistor Mini Melf = RM 0.0367 Capacitor Electric = RM 0.0746 Capacitor 1206 = RM 0.1039 Lucar Blade = RM 0.3088 Rear Case = RM 2.0607 Front Case = RM 6.952 IC = RM 10.332 Display =RM 10.333 **Total = RM 30.21**
	SMT = RM 198.03	

Overhead	Inspect Cured Component = RM 4.57 Radial Component = RM 129.02 Wave Soldering =RM 90.95 Cleaning = RM 125.44 PCB Separation = RM 31.50 Apply Hot Melt Onto Crystal = RM 84.58 Solder Inspection & Solder S3 = RM 623.91 Solder Trimmer, S1, S2 to PCB =RM 711.70 Segment Check = RM 930.59 Immediate Testing = RM 1,153.28 Final Assembly = RM 3,227.19 Solder 4 wires to Lucar = RM 3,227.19 Final Testing = RM 1,148.69 Date Code Stamping & 100% Functional = RM1,124.97 Inspect & Packing =RM 978.62 Sealing = RM 771.44 Palletization = RM 2,042.59 Material Handling = RM 1,966.19 Maintenance/Engineering = RM 158.43 Production Management = RM 1,060.79 Inventory/Purchasing = RM 1,116.03 Sales/Marketing = RM 9,158.13 Administration Personnel = RM 1,127.46 Total Overhead Cost = RM 31291.29 = RM 1.27 per unit	Total available time per month = 82 x 8.5 x 19 = 13243 hours Overhead absorption rate $(OAR) = \frac{RM\ 212319}{13243}$ = RM 16.03 per labor hour Total hour used $= \frac{537.56 \times 24576}{3600}$ = 3669.7 hours Total overhead cost = RM 16.03 x 3669.7 hours = RM 58825.97 per month = RM 2.39 per unit
Total Cost (Per unit)	**RM 32.43**	**RM 33.53**

For traditional costing system:

i. Total available time per month = number of direct labor that involved in case product line x total hour per day x total day per month

ii. $$\text{OAR} = \frac{\text{Total Resources Cost}}{\text{Total available time per month}}$$

iii. $$\text{Total hour used} = \frac{\text{standard time x no. of unit per month}}{3600}$$

To compare the results of product unit cost, refer to Figure 6.4 and Figure 6.5. Figure 6.4 is the bar chart generated using Microsoft Excel 2000 and Figure 6.5 is the bar chart generated by new ABC software that has been developed. We can see from these two figures, the unit cost for PC clock is similar.

Name of Product	Cost per unit
pc clock	$32.43

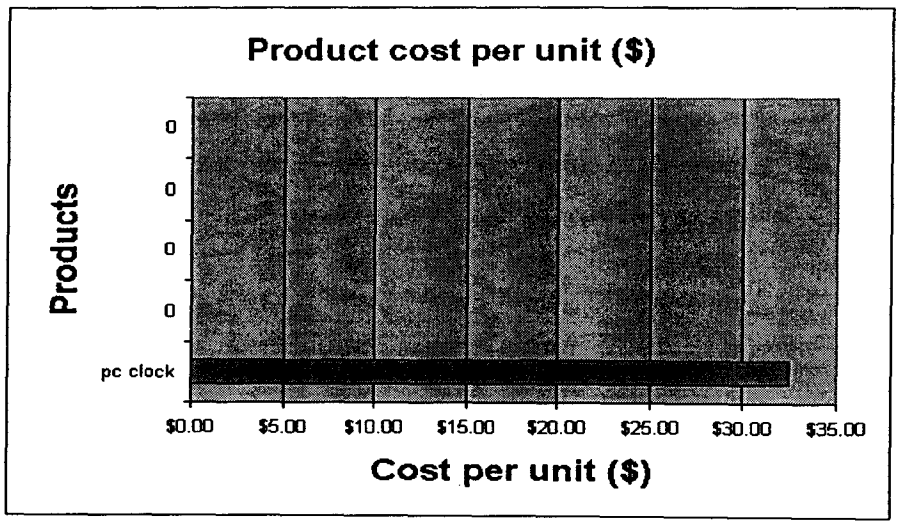


Figure 6.4: Bar chart generated by Microsoft Excel 2000

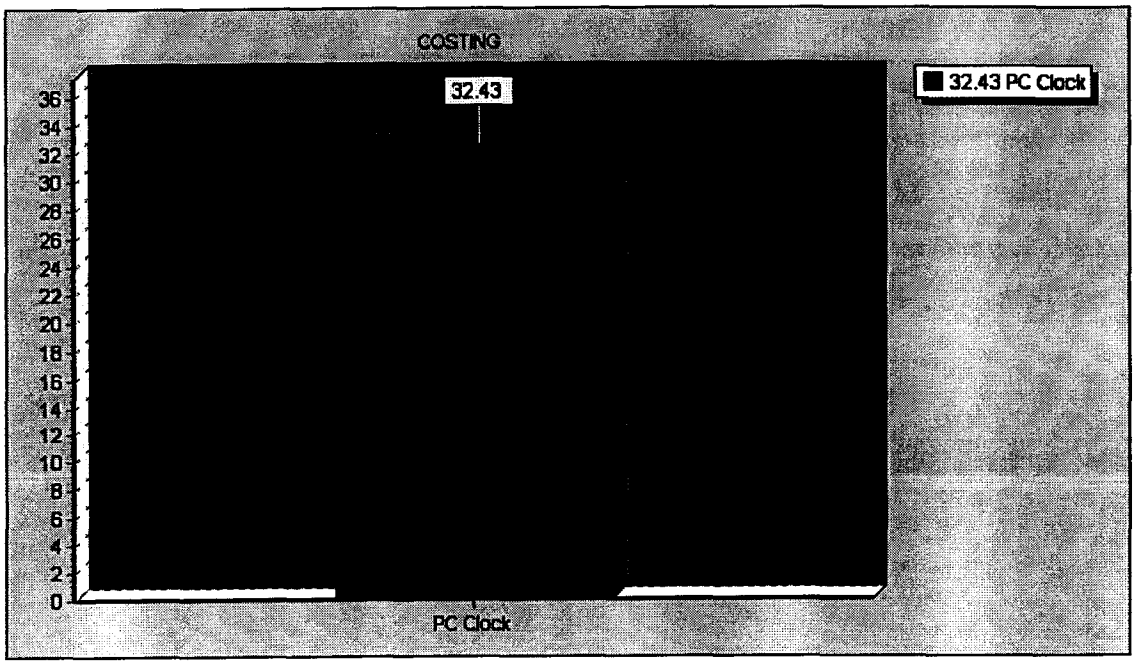


Figure 6.5: Bar chart generated by ABC software

6.6 Discussion

The total product unit cost generated by the ABC system is RM 32.43. The cost of the product using the traditional costing system is RM 33.53. Therefore, the traditional costing system will costs more the product by:

$$= \frac{33.53 - 32.43}{33.53} \times 100\,\%$$

$$= 3.28\,\%$$

It is observe that, the difference of cost as small as 3.28 % is caused by total cost involved although dissimilarity between ABC and Traditional costing system is calculated on overhead cost. For direct labor and direct material cost improvement is unable to be executed because it depends on factor outside production line. For example, direct material will be decreased if company changes their supplier. Therefore more attention should be paid to overhead cost difference for improvement.

From Table 6.8, the percentage of overhead cost for traditional costing over ABC method by:

$$= \frac{2.39 - 1.27}{2.39} \times 100\ \%$$

$$= 46.86\ \%$$

Sales/Marketing activity is the most critical activity because it contributes the highest cost. Cost driver is the factor that determines cost for an activity; so that its value should be decreased. Cost driver for sales/marketing is referred as the number of order. Therefore, to decrease this cost activity, number of order should be reduced considering to factor resources.

For other activities, in order to make them appropriate, every resource for respective activity should be reconsidered and studied. ABC method has shown clearly what factors contribute to cost activity and which activity results in the highest cost.

6.7 Software Testing and Validation: Another Case Study

The primary purpose of the testing and validation is to test the accuracy of ABC software. Data from literature and companies is used to validate the ABC software. The software must be validated to ensure that it does what the users needs. Table 6.9, Table 6.10, Table 6.11 and Table 6.12 show the testing results using data from company A.

Table 6.9: Activity cost per month

ID	Activity	Cost
ACT-001	ordering	2246.84
ACT-002	store/packing	3555.45
ACT-003	material handling	3470.90
ACT-004	quality control	5781.58
ACT-005	product scheduling	1308.61
ACT-006	cutting AL	2865.20
ACT-007	bending AL	3934.34
ACT-008	cut/spotweld/paint	4551.41
ACT-009	cut-M	4028.83
ACT-010	assemble	2996.11
ACT-011	prepare glue	4778.09
ACT-012	grinding	3934.34
ACT-013	clipping	3839.86
ACT-014	ass. bottom	4778.09
ACT-015	M-Prepare	3090.59
ACT-016	sewing	3472.21
ACT-017	assemble pocket	3090.59
ACT-018	cut-F	5662.43
ACT-019	bend frame header	7538.90
ACT-020	stemping header	4366.36
ACT-021	hammering	3090.59
ACT-022	cutting	7538.90
ACT-023	spotweld endpost	3880.44
ACT-024	sales followup	3185.08
ACT-025	admin/finance	14814.27

Table 6.10: Overhead cost for Product A

Name of Product	Name of Activity	Cost
A	Ordering	385.17
	Store/packing	444.43
	Mat. Handling	809.88
	Quality Control	722.70
	Prod. Scheduling	261.72
	Cutting-AL	1,910.13
	Bending -Al	2,622.89
	Cut/spotweld/paint	3,034.27
	Cut-M	503.60
	Assemble	-
	Prepare glue	-
	Grinding	491.79
	Clipping	-
	Ass bottom S	-
	Prepare M	-
	Sewing	-
	Assble pocket	-
	Cut - F	4,044.59
	Bend frame header/ep/strut	1,370.71
	Stemping header/ep/strut	793.88
	Hammering	2,060.39
	Cutting strut/endpost	-
	Spot weld endpost	-
	Sales Folowup	796.27
	Admin/Finance	5,184.99

Table 6.11: Total overhead cost

ID	Product Name	Total Cost
PRO-001	PRODUCT A	25437.44
PRO-002	PRODUCT B	11725.98
PRO-003	PRODUCT C	12061.28
PRO-004	PRODUCT D	31319.42

Table 6.12: Cost per unit

ID	Product Name	Cost per unit
PRO-001	PRODUCT A	249.11
PRO-002	PRODUCT B	139.18
PRO-003	PRODUCT C	43.72
PRO-004	PRODUCT D	272.75

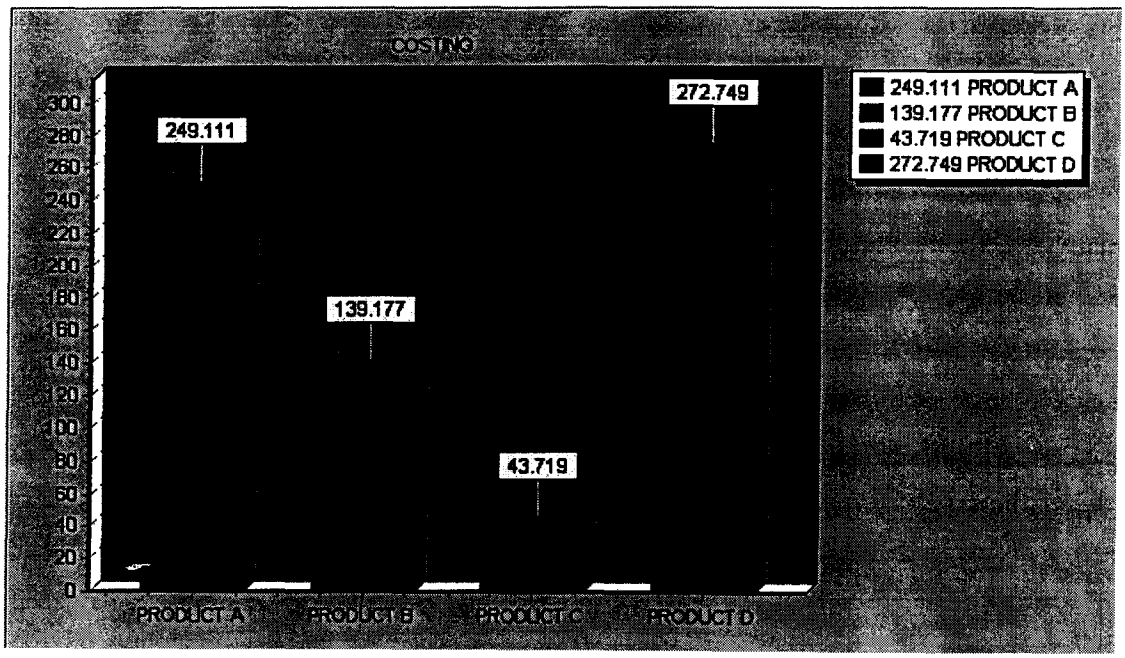


Figure 6.6: Bar chart for product unit cost

From the tables, it is clear the ABC software has been developed, tested and validated in the selected SMEs to ensure that it does what the users needs.

CHAPTER 7

CONCLUSION AND FUTURE STUDY

7.1 Conclusion

This thesis has described the adoption of Activity Based Costing System in manufacturing company. It is clear from the literature reviewed and the case study presented in Chapter 6 that ABC offers substantial benefits over conventional accounting systems. However, it has a relatively low up-take amongst organizations (Sohal and Chung, 1998). Many of the problems and difficulties associated with introducing ABC are related to managerial aspects rather than the technical aspects. Based on the case study presented, the following are identified as a key ingredient for successful implementation of ABC:

i. Total commitment from top management. They must realize the benefits and the objectives of ABC offers the organisation and must get involved in setting up the approach. The objectives must be clear and simple so that everyone in the organisation can understand them. The objectives must be regularly

reviewed and revised as changes take place within the organisation and in the marketplace.

ii. The establishment of a multi-disciplinary project team to introduce and implement the ABC system in the organisation. The team members must be co-operative and share similar values and attitudes. A knowledgeable project leader or champion have to be identified for the overall success of the project. This person must have adequate experience in project implementation. The project team has the responsibility for clearly defining time frames, actions and responsibilities. It continuously monitors the progress of the project and makes the necessary changes so that targets can be achieved.

iii. Adequate resource allocation to the ABC project. Sufficient time must be allowed for data gathering and analysis during working hours. Time allocated to gain confidence with the new system is absolutely necessary (Sohal and Chung, 1998).

iv. Access to outside expertise, particularly when new concepts and software are being developed.

v. Keeping the implementation as simple as possible, perhaps introducing it as a pilot project.

vi. Using appropriate software is an important key for ABC success.

The integrated system was develop to help manager and cost engineers to identify the critical process or activities that need to be further analyzed for improvements and cost saving. The reports provide guideline to managers and engineers to make correct or better decision on the next action that to be taken.

From the analysis of the results, the differences between Activity Based Costing and traditional costing system have been discovered such as advantages and weaknesses. Calculation for a unit cost of product using both methods has been shown. From this calculation, a small percentage of difference is valued 3.28 % and for overhead cost 46.86% is retrieved.

The analysis of activities to identify value-added and non-value added activities and benchmarking at each activity level direct improvement efforts in the right direction. The maximum benefits of ABC can only be achieved if it is implemented for the whole organization. Therefore, the company should use ABC for all of their products to calculate the cost of products and product profitability accurately.

The spreadsheet alternative, for example Microsoft Excel 2000 offered an economical option that appeared attractive initially, but lacks in the formatting flexibility and textual capabilities of a database option. Further, while the linking and macro capabilities of spreadsheets were impressive, the ability of spreadsheets to handle paragraphs of text without disrupting the visual content of other cells in a row or column was a potential problem. Finally, the spreadsheet tends to be one dimensional in its appearance when compared with a multi-view capability of a database.

7.2 Future Study

There are several disadvantages in this ABC software. User may experience confusion while using this software. Amongst the disadvantages are:

i. Limited database size.

ii. Not web-based application.

Therefore, future study using Active Server Pages (ASP), PHP or suitable web pages programming language is expected to overcome all these disadvantages. Microsoft SQL Server can overcome the limited database size problem.

This costing system is not only for manufacturing company but it is also applicable to service sector. Further research should be done to service sector, for example education, banking and medical services.

REFERENCES

Abrahams, M. D. and Reavily, M. N. (1998). Activity Based Costing: Illustrations from the State of Iowa. *Reprint, Goverment Finance Review*. 1(1): 1-10.

Azrulhizam Shapi'i (2002). *Solving Shortest Path Problem Using Floyd-Warshall Algorithm*. Universiti Teknologi Malaysia: Bachelor Degree Thesis.

Bukovinsky, D., Sprolige, H. And Talbott, J. (2000). Activity Based Costing for Sales and Administrative Costs. *The CPA Journal*. 70(4): 70-72.

Cagwin, D. and Bouwman, M. J. (2000). The Association Between Activity Based Costing And Improvement In Financial Performance. *Accounting Colloquium (University of Arkansas)*. 5(2): 65-68.

Campi, J.P. (1992). It's Not as Easy as ABC. *Journal of Cost Management for the Manufacturing*. 6(3): 5-11.

Chan, M.F.S., Keung, K.F. and Chung, W.W.C. (2000). A Design of an ABC Template for Easy Assimilation in SME. *Logistics Information Management*. 13(3): 126-137.

Chongkruksut, W. (2002). *The Adoption of Activity Based Costing In Thailand*. Faculty of Business and Law, Victoria University: Ph.D. Thesis.

Cooper, R. (1987). Does Your Company Need A New System?. *Journal of Cost Management*. 6(3): 45-49.

Cooper, R. (1990). Implementing an Activity-Based Costing System. *Journal of Costing Management*. Spring: 33-42.

Cooper, R. (1991). A Structured Approach to Implementing ABC. *Accountancy*. 78-80.

Cooper, R. and Kaplan, R.S. (1991). Profit Priorities from Activity-Based Costing. *Harvard Business Review*. 5(6): 130-135.

Cooper, R. and Turney, P.B.B. (1989). Internally Focused Activity-Based Costing Systems. *Harvard Business School Press*. 2(4): 65-78.

Dikolli, S. and Smith, M. (1996). Prototyping for Effective Data Management. *Managerial Auditing Journal*. 11(1): 19-22.

Doost, R.K. (1997). Viewpoint: Mysons and Me and ABC Costing. *Managerial Auditing Journal*. 12(7): 354-357.

Emblemsvag, J. (2001). Activity Based Life-cycle Costing. *Managerial Auditing Journal*. 16(1): 17-27.

Esculier, G.G. (1997). Techniques: Using Improper Costing Methods May Lead to Losses. *The TQM Magazine*. 9(3): 228-230.

Foote, P. S. (1994). Refining Activity Based Costing. *American Institute of Certified Public Accounts*. 11(2): 112-125.

Gosselin, M. (1997). The Effect of Strategy and Organisational Structure on The Adoption and Implementation of Activity Based Costing. *Accounting, Organisations, and Society*. 22(2): 105-122.

Gunasekaran, A. (1999). A Framework for The Design and Audit of an Activity Based Costing System. *Managerial Auditing Journal*. 14(3): 118-126.

Gunasekaran. A., Marri, H.B. and Grieve, R.J. (1999). Justification and Implementation of Activity Based Costing in Small and Medium-Sized Enterprises. *Logistics Information Management*. 12(5): 386-394.

Gurses, A.P.(1999). *An Activity-Based Costing and Theory of Constraints Model for Product-Mix Decisions*. Virginia Polytechnic Institute and State University: Masters Thesis.

Heizer, J., and Render, B. (1999). *Operations Management*. Fifth Edition. New Jersey: Prentice Hall.

Helberg, C., Galletly, J.E. and Bicheno, J.R. (1994). Simulating Activity-based Costing. *Industrial Management and Data System*. 94(9): 3-8.

Hongren, C.T., Foster, G. and Datar, S.M. (2000). *Cost Accounting: A Managerial Emphasis*. Tenth Edition. New Jersey: Prentice Hall.

Innes, J. and Mitchell, F. (1991). ABC: A Survey of CIMA members. *Management Accounting (UK)*. 69(2): 28-30.

Innes, J., Mitchell, F. and Yoshikawa, T. (1994). *Activity Costing For Engineers*. United Kingdom: John Wiley and Sons Ltd.

Kaplan, R. S. (1984). Yesterday's Accounting Undermines Production. *Harvard Business Review.* 2(4): 95-101.

Kaplan, R. S. (1990). The Four-Stage Model of Cost Systems Design. *Management Accounting.* 12(6): 22-26.

Kaplan, R. S. (1992). In Defence of Activity-Based Cost Management. *Management Accounting.* 58-63.

Krumwiede, K.P. and Roth, H.P. (1997). Implementing Information Technology Innovations: The Activity-Based Costing Example. *Advanced Management Journal,* 62(4): 4-13.

Krumwiede, K.P. (1998). Why It is Tried and How It Succeeds. *Management Accounting Journal.* 14(3): 32-38.

Maher, M. (1997). *Cost Accounting: Creating Value for Management.* Fifth Edition. USA: McGrawth Hill.

Morrow, M. (1992). *Activity Based Management.* Hertfordshire: BPCC Wheatons Ltd.

Miller, A. J. (1992). Designing and Implementing a New Cost Management System. *Cost Management.*12(2): 41-53.

Mohamed Faizal Bin Che Omar (2003). *Application Of Activity Based Costing System In A Manufacturing Company: A Case Study.* Universiti Teknologi Malaysia: Bachelor Degree Thesis.

Morakul, S. and Wu, F.H. (2001). Cultural Influences on The ABC Implementation in Thailand's Environment. *Journal of Managerial Psychology.* 16(2): 142-158.

Norkiewicz, A. (1994). Nine step to implementing ABC. *Management Accounting.*

Lea, B. R. (1998). *The Impact of Management Accounting Alternatives in Different Manufacturing Environment.* Clemson University: Ph.D. Thesis.

Lere, J.C. (2000). Activity based costing: a powerful tool for pricing. *Journal of Business and Industrial Marketing.* 15(1): 23-33.

Londe, B.J.L. and Ginter, J.L. (1999). A Summary of Activity Based Costing Best Practices. *Ohio State University's Supply Chain Management Research Group.* 2(3): 15-22.

O'Guin, M. C. (1991). *The Complete Guide to Activity Based Costing.* New Jersey: Prentice Hall.

Ooi, G., Soh, C. and Lee, P.M. (1999). An Activity Based Costing Approach to Systems Development and Implementation. *Journal of Cost Management.* 10-14.

Page, J. and Hooper, P. (1987). *Accounting and Information Systems.* Third Edition. Englewood Cliff: Prentice Hall.

Raffish, N., and Turney, P. (1991). The CAM-I Glossary of Activity Based Management. *CAM-I.* 2(4): 33-40.

Roberts, M.W. and Silvester, K.J. (1996). Why ABC failed and How It May Yet Succeed?. *Journal of Cost Management.* 9(1): 23-35.

Roztocki, N., Valenzuela, J.F., Porter, J.D., Monk, R.M. and Needy, K.L. (1999) A Procedure for Smooth Implementation of Activity Based Costing in Small Companies. *Journal of Cost Management.* 32(3): 26-42.

Roztocki, N. (1998). *The Integrated Activity Based Costing And Economic Value Added Information System.* School of Business, State University of New York: Nw Paltz.

Sharman, P. (1996). Activity/Process Budgets: A Tool for Change Management. *Cost Management.* 70(2): 21.

Sekaran, U. (2000). *Research Methods for Business: A Skill-Building Approach.* New York: John Wiley & Sons.

Shields, M.D. (1995). An Empirical Analysis of Firms: Implementation Experiences with Activity-Based Costing. *Journal of Management Accounting Research.* 7(2): 148-164.

Shields, M.D., McEwen, M.A. (1996). Implementing Activity-Based Costing Systems Successfully. *Journal of Cost Management.* 9(1): 15-22.

Sohal, A.S. and Chung, W.W.C. (1998). Activity Based Costing in Manufacturing : Two Case Studies on Implementation. *Integrated Manufacturing System.* 9(3): 137-147.

Sullivan, W.G. (1992). A New Paradigm for Engineering Economy. *The Engineering Economist.* 36(3): 187-200.

Turney, B.B.P. (1996). *Activity Based Costing The Performance Breakthrough.* London: CLA.

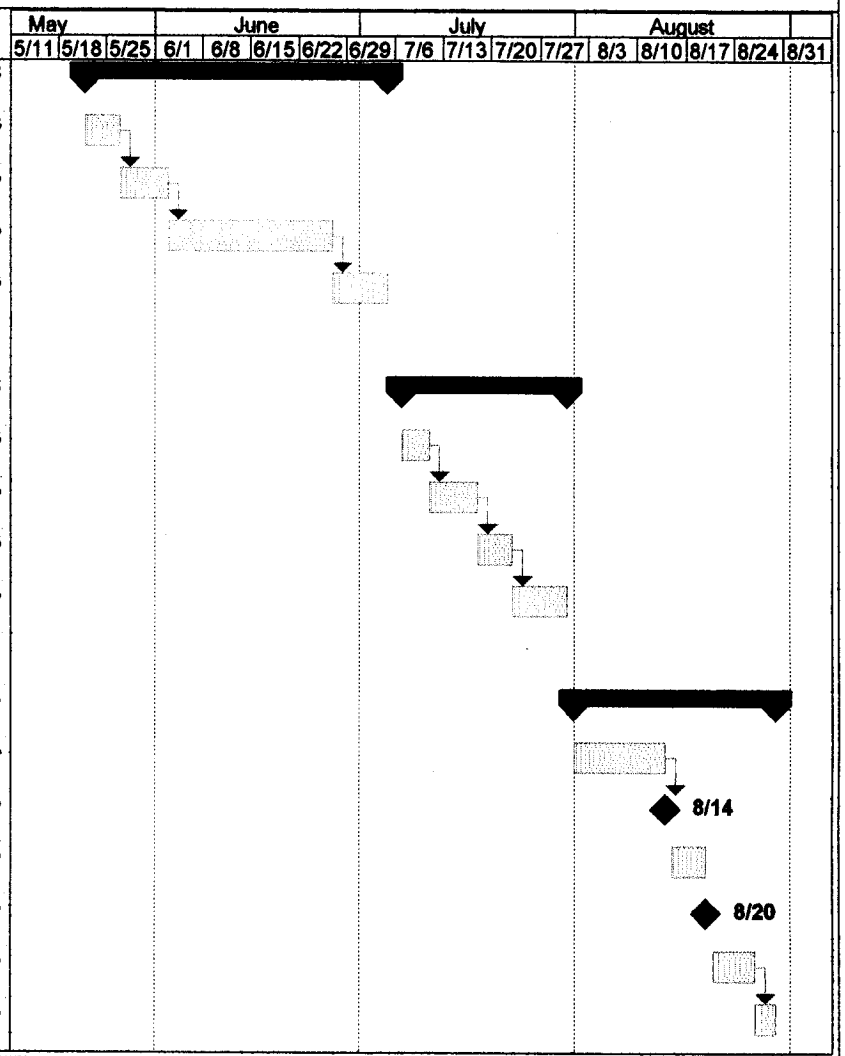
Wan Harun Wan Hamid, Jafri Mohd Rohani and Zailis Abu Bakar (2003). Simulating and Integrated ABC and Six Sigma: A Tutorial. *Jabatan Kejuruteraan Pengeluaran dan Industri, Fakulti Kejuruteraan Mekanikal, Universiti Teknologi Malaysia.*

APPENDIX A

PROJECT GANTT CHART

PROJECT 1 GANTT CHART SEMESTER I 2003/2004

ID	Task Name	Start	Finish
1	**Feasibility Study**	**Thu 5/22/03**	**Fri 7/4/03**
2	Tittle identification	Thu 5/22/03	Mon 5/26/03
3	Scope and Objectives Identification	Tue 5/27/03	Mon 6/2/03
4	Literature Review	Tue 6/3/03	Thu 6/26/03
5	Background Review	Fri 6/27/03	Fri 7/4/03
6			
7	**Analysis Phase**	**Mon 7/7/03**	**Wed 7/30/03**
8	Problem Analysis	Mon 7/7/03	Thu 7/10/03
9	Methodologies/Technique Determination	Fri 7/11/03	Thu 7/17/03
10	Insruments (Software and Hardware) Determination	Fri 7/18/03	Tue 7/22/03
11	Data Collection	Wed 7/23/03	Wed 7/30/03
12			
13	**Report Writing**	**Fri 8/1/03**	**Fri 8/29/03**
14	Report Preparation	Fri 8/1/03	Wed 8/13/03
15	Report Submission	Thu 8/14/03	Thu 8/14/03
16	Report Correction	Fri 8/15/03	Tue 8/19/03
17	Project 1 Submission	Wed 8/20/03	Wed 8/20/03
18	Presentation Preparation	Thu 8/21/03	Tue 8/26/03
19	Presentation	Wed 8/27/03	Fri 8/29/03

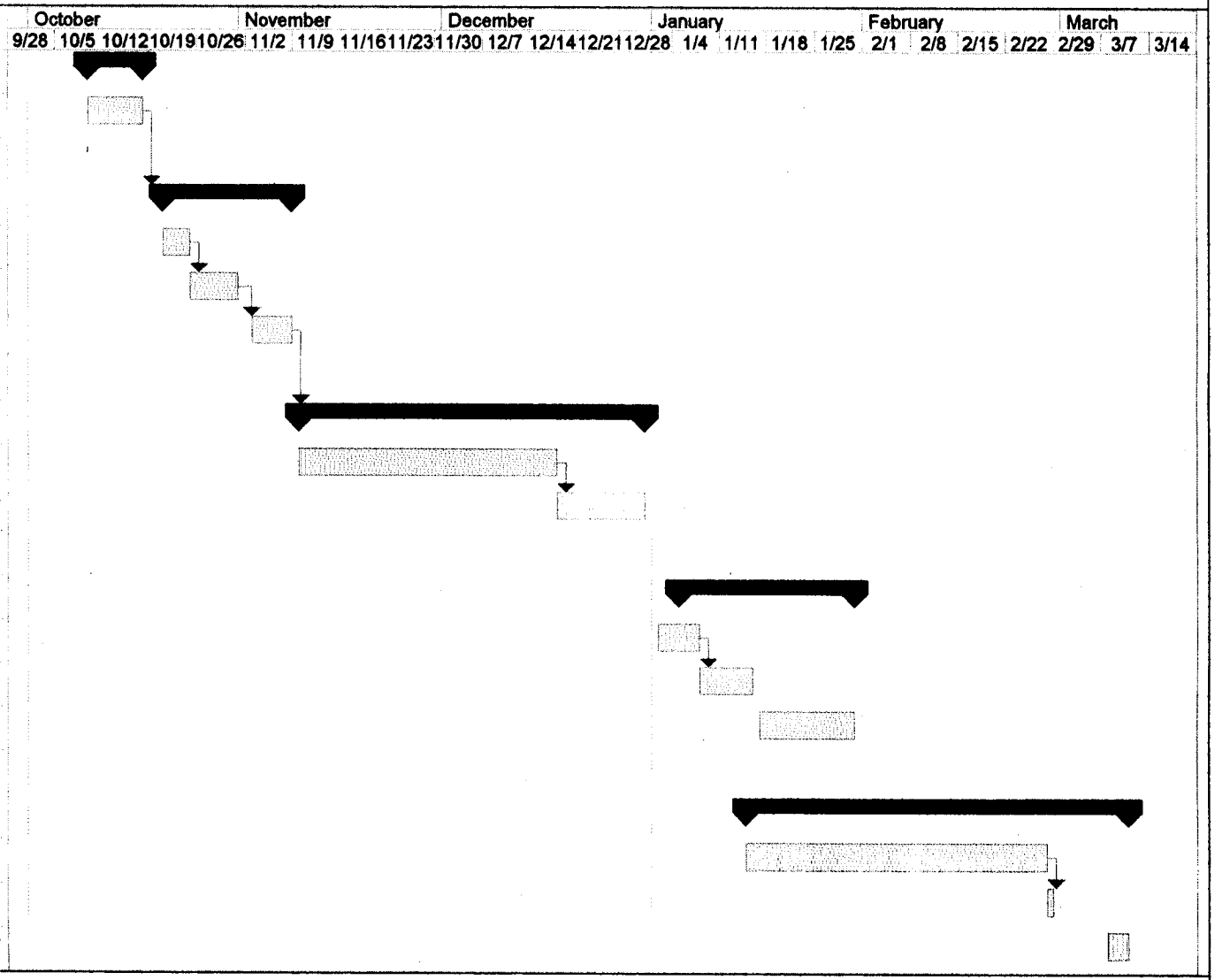


Azrulhizam Bin Shapi'i
Msc IT In Manufacturing

Task
Split
Progress
Milestone
Summary
Rolled Up Task
Rolled Up Split
Rolled Up Milestone
Rolled Up Progress
External Tasks
Project Summary
External Milestone
Deadline

PROJECT 2 GANTT CHART SEMESTER II 2003/2004

ID	Task Name	Start
1	**Requirements**	Fri 10/10/03
2	Design Use-Case Model	Fri 10/10/03
3		
4	**Analysis & Design**	Tue 10/21/03
5	Design Architecture	Tue 10/21/03
6	Design Input Format	Sat 10/25/03
7	Design Output Format	Mon 11/3/03
8		
9	**Implementation**	Mon 11/10/03
10	Coding	Mon 11/10/03
11	Coding Checking	Thu 12/18/03
12		
13	**Testing & Validation**	Mon 1/5/04
14	Testing - Literature Data	Fri 1/2/04
15	Testing - Case Study Data	Thu 1/8/04
16	Correction	Sat 1/17/04
17		
18	**Transition**	Thu 1/15/04
19	Report Writing	Thu 1/15/04
20	Submit Report	Sat 2/28/04
21	Presentation	Mon 3/8/04



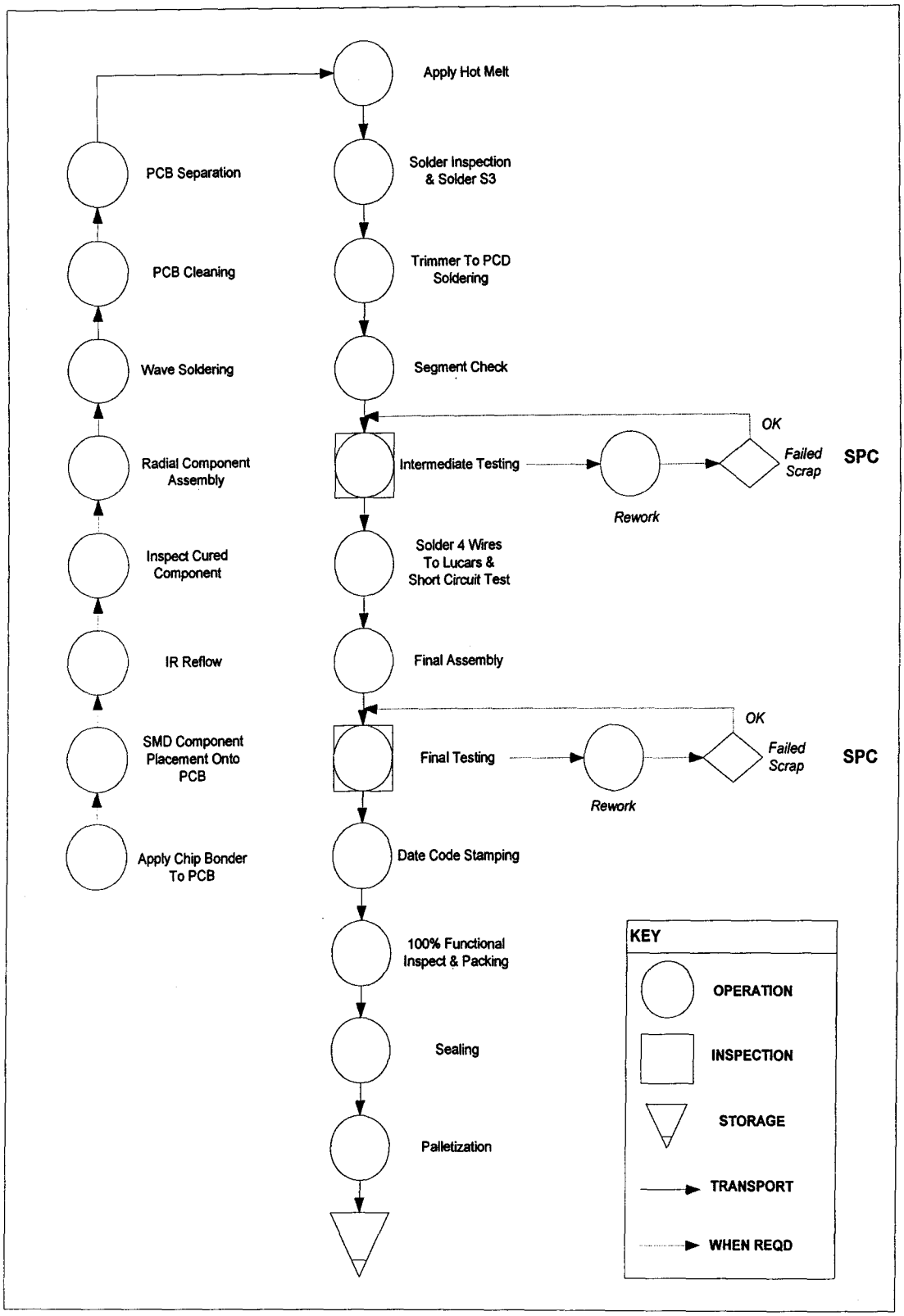
Azrulhizam Shapi'i
Msc IT In Manufacturing

Task
Split
Progress
Milestone
Summary
Project Summary
External Tasks
External Milestone
Deadline

Page 1

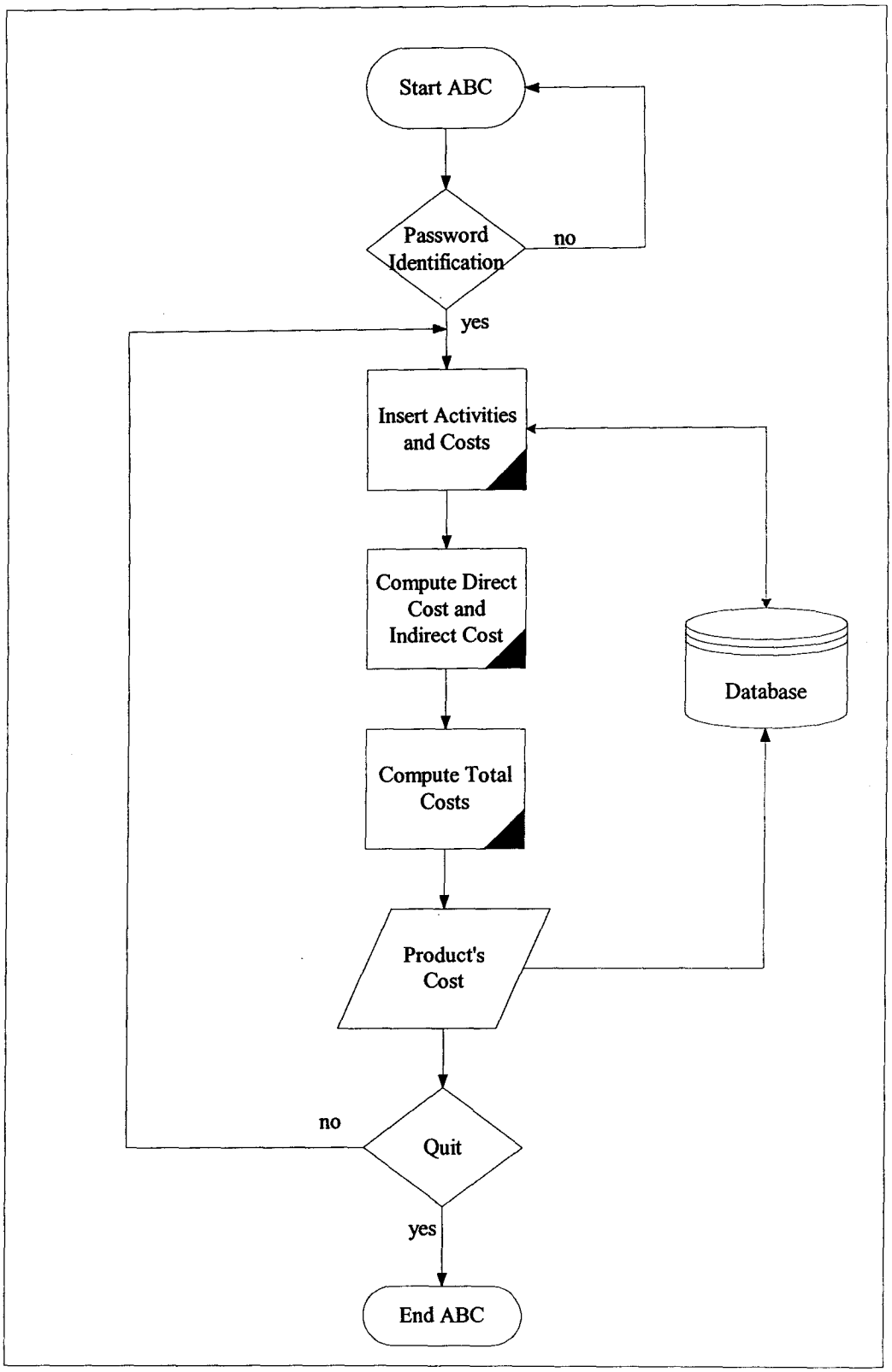
APPENDIX B

PRODUCTION LINE FLOW CHART


Apply Hot Melt
Solder Inspection & Solder S3
Trimmer To PCD Soldering
Segment Check
OK
Intermediate Testing
Failed Scrap
SPC
Rework
Solder 4 Wires To Lucars & Short Circuit Test
Final Assembly
OK
Final Testing
Failed Scrap
SPC
Rework
Date Code Stamping
100% Functional Inspect & Packing
Sealing
Palletization
PCB Separation
PCB Cleaning
Wave Soldering
Radial Component Assembly
Inspect Cured Component
IR Reflow
SMD Component Placement Onto PCB
Apply Chip Bonder To PCB
KEY
OPERATION
INSPECTION
STORAGE
TRANSPORT
WHEN REQD

APPENDIX C

ABC SOFTWARE FLOW DIAGRAM


Start ABC
Password Identification
no
yes
Insert Activities and Costs
Compute Direct Cost and Indirect Cost
Compute Total Costs
Product's Cost
Database
no
Quit
yes
End ABC

APPENDIX D

DATABASE DESIGN

Table Activities_Resource

IDres	nameres	IDact	nameAct	value	resDriver	rate	cost	IDResAct
RES-001	Depreciation	ACT-024	Administration Personnel	146	head count	0.0048666	146	DepAdministr
RES-001	Depreciation	ACT-001	SMT	19490	No of panel	0.6496666	19490	DepSMT
RES-001	Depreciation	ACT-002	Inspect Cured Component	34	No of inspection	0.0011333	33.9999999	DepInspect
RES-001	Depreciation	ACT-003	Radial Component	3.5	No of component	0.0001166	3.5000000	DepRadial
RES-001	Depreciation	ACT-004	Wave Soldering	3410	No of Panel	0.1136666	3410.00000	DepWave
RES-001	Depreciation	ACT-005	Cleaning	5850	No of panel	0.195	5850	DepCleaning
RES-001	Depreciation	ACT-006	PCB Separation	20	no of tabs	0.0006666	20	DepPCB
RES-001	Depreciation	ACT-007	Apply hot melt onto cryst	15	time use	0.0005	15	DepApply hot

Table Activities

IDres	NameRes	IDact	nameAct	value	resDriver	IDResAct
RES-001	Depreciation	ACT-001	SMT	19490	No of panel	DepSMT
RES-001	Depreciation	ACT-002	Inspect Cured Component	34	No of inspection	DepInspect Cu
RES-001	Depreciation	ACT-003	Radial Component	3.5	No of component	DepRadial Com
RES-001	Depreciation	ACT-004	Wave Soldering	3410	No of Panel	DepWave Solde
RES-001	Depreciation	ACT-005	Cleaning	5850	No of panel	DepCleaning
RES-001	Depreciation	ACT-006	PCB Separation	20	no of tabs	DepPCB Separa
RES-001	Depreciation	ACT-007	Apply hot melt onto cryst	15	time use	DepApply hot

Table ActTotal

IDres	total
RES-001	30000
RES-002	4599
RES-003	4599
RES-004	107.784
RES-005	107.784

Table Company

name	registery	address	tel	fax	web
Nistel Automotive	UTMPPI2213	NO 17, Jalan Kabong 5, Taman Teratai	06-9523493	06-9888011	http://www.mscit2003.my/~

Table Direct_Labor

ProductID	ProductName	DirectLaborCost
PRO-001	PC Clock	23273.472

Table Direct_Material

ProductID	ProductName	IDProMate	Material	Costs
PRO-001	PC Clock	PC ClockDirect	Direct	855490.56

Table Direct_Total

ProductID	DirectTotalCost
PRO-001	855490.56

Table Dproduct

IDact	IDpro	IDActPro	namePro	value
ACT-001	PRO-001	SMTPC Clock	PC Clock	6144
ACT-002	PRO-001	Inspect CPC Clock	PC Clock	6144
ACT-003	PRO-001	Radial CoPC Clock	PC Clock	196608
ACT-004	PRO-001	Wave SoldPC Clock	PC Clock	6144
ACT-005	PRO-001	CleaningPC Clock	PC Clock	6144
ACT-006	PRO-001	PCB SeparPC Clock	PC Clock	73728
ACT-007	PRO-001	Apply hotPC Clock	PC Clock	63.42
ACT-008	PRO-001	Solder inPC Clock	PC Clock	183.71
ACT-009	PRO-001	TrimmerPC Clock	PC Clock	172032

Table Dresource

IDres	nameRes	category	ResCategory	value
RES-001	Depreciation	Machines	DepMachi	20000
RES-001	Depreciation	Equipments	DepEquip	7000
RES-001	Depreciation	Tools	DepTools	3000
RES-002	Rentals	Rental Equavalent	RenRenta	26000
RES-002	Rentals	Others	RenOther	2600
RES-003	Utilities	Electricity	UtiElect	24592
RES-003	Utilities	Water	UtiWater	1077
RES-003	Utilities	Internet	UtiInter	50

Table ProductCost

IDact	NameAct	IDPro	NameProduct	Value	Rate	Cost	IDActPro
ACT-001	SMT	PRO-001	PC Clock	6144	0.00787692	198.03210	SMTPC Clock
ACT-002	Inspect Cured Component	PRO-001	PC Clock	6144	0.00334911	4.5672060	Inspect CPC Clock
ACT-003	Radial Component	PRO-001	PC Clock	196608	0.02014346	129.02002	Radial CoPC Clock
ACT-004	Wave Soldering	PRO-001	PC Clock	6144	0.00926696	90.949179	Wave SoldPC Clock
ACT-005	Cleaning	PRO-001	PC Clock	6144	0.01003921	125.44416	CleaningPC Clock
ACT-006	PCB Separation	PRO-001	PC Clock	73728	0.00967341	31.497870	PCB SeparPC Clock
ACT-007	Apply hot melt onto cryst	PRO-001	PC Clock	63.42	0.03020719	84.576512	Apply hotPC Clock
ACT-008	Solder inspection & solde	PRO-001	PC Clock	183.71	0.08750178	623.90959	Solder inPC Clock
ACT-009	Trimmer	PRO-001	PC Clock	172032	0.09358012	711.70250	TrimmerPC Clock

Table ProductTotalCost

ProductID	ProductName	OverheadCost	DmaterialCost	DLaborCost	TotalCost
PRO-001	PC Clock	31291.2924947114	855490.56	23273.472	910055.324494711

Table RegActivities

IDact	nameAct	actDriver	Capacity
ACT-001	SMT	No of panel	780000
ACT-002	Inspect Cured Component	No of inspection	1834515
ACT-003	Radial Component	No of component	9760387
ACT-004	Wave Soldering	No of Panel	663000
ACT-005	Cleaning	No of panel	612000
ACT-006	PCB Separation	no of tabs	7621714

Table RegProduct

IDProduct	nameProduct
PRO-001	PC Clock
PRO-002	Flashers

Table RegUser

userID	userPassword	name	post	dept	type
admin	admin78	Tester	System Tester	Manufacturing	Admin
b	b	b	b	b	b

Table Resource

IDres	nameRes	ResDriver
RES-001	Depreciation	Equipment Cost
RES-002	Rentals	Floor Area
RES-003	Utilities	Floor Area
RES-004	Manufacturing Overhead	Man Per Hour
RES-005	Administration	Operator-man-hour

Table ResTotal

IDres	NameRes	Total
RES-001	Depreciation	30000
RES-002	Rentals	28600
RES-003	Utilities	25719
RES-004	Manufacturing Overhead	83000
RES-005	Administration	45000

Table TotalActCost

IDact	nameAct	totalcost
ACT-001	SMT	25140.7949013922
ACT-002	Inspect Cured Component	1363.7057305159
ACT-003	Radial Component	6405.05659394457
ACT-004	Wave Soldering	9814.34021206144
ACT-005	Cleaning	12495.4149541382
ACT-006	PCB Separation	3256.12736439031
ACT-007	Apply hot melt onto cryst	2799.8799792816
ACT-008	Solder inspection & solde	7130.249781581

Table UnitCost

ProductID	ProductName	TotalCost	Output	UnitCost
PRO-001	PC Clock	910055.324494711	24576	37.0302459511194

APPENDIX E

RESOURCE INFORMATION

	Resource 1	Depreciation
No	Category	Resources ($)
1	Machines	$ 20,000.00
2	Equipments	$ 7,000.00
3	Tools	$ 3,000.00
4		
5		
		$ 30,000.00

	Resource 2	Rentals
No	Category	Resources ($)
1	Rental equivalent	$ 26,000.00
2	Others	$ 2,600.00
3		
4		
		$ 28,600.00

	Resource 3	Utilities
No	Category	Resources ($)
1	Electricity	$ 24,592.00
2	Water	$ 1,077.00
3	Internet	$ 50.00
4		
5		
		$ 25,719.00

	Resource 4	Manufacturing overhead
No	Category	Resources ($)
1	engineer salary	$ 30,000.00
2	manager salary	$ 24,000.00
3	supervisor/technician	$ 23,500.00
4	others	$ 5,500.00
5		
6		
		$ 83,000.00

	Resource 5	Administration
No	Category	Resources ($)
1	Manager salary	$ 20,000.00
2	Clerical staff	$ 15,000.00
3	Others	$ 10,000.00
4		
5		
		$ 45,000.00

APPENDIX F

DEPRECIATION DATA

Depreciation		
Name of Activities	**Equipment Cost (RM)**	**Driver**
SMT	19490	no of panel
Inspect cured component	34	no of inspection
Radial component	3.5	no of component
Wave soldering	3410	no of panel
Cleaning	5850	no of panel
PCB Separation	20	no of tabs
Apply hot melt onto crystal	15	time use
Solder inspection & solder S3	10	time use
Solder Trimmer, S1, S2 To PCB Soldering	10	no of solder point
Segment Check	5	no of unit
Immediate Testing	5	no of trimmer tested
Solder 4 wires To Lucars & Short Circuit Test	30	time use
Final Assembly	9	no of component
Final Testing	19	no of test sequence
Date Code stamping & 100% Funtional	5	no of test sequence
Inspect & Packing	2.5	no of test sequence
Sealing	2	no of box(15 units)
Palletization	97	no of pallet
Material handling	5	no of move
Maintenance/engineering	5	no of maintenance hour
Production management	97	no of batch
Inventory/purchasing	145	no of order
Sales/marketing	585	no of order
Administration Personnel	146	head count

APPENDIX G

RENTAL DATA

Rentals		
Name of Activities	**Floor area**	**Driver**
SMT	270	no of panel
Inspect cured component	24	no of inspection
Radial component	9	no of component
Wave soldering	297	no of panel
Cleaning	297	no of panel
PCB Separation	18	no of tabs
Apply hot melt onto crystal	36	time use
Solder inspection & solder S3	24	time use
Solder Trimmer, S1, S2 To PCB Soldering	24	no of solder point
Segment Check	24	no of unit
Immediate Testing	24	no of trimmer tested
Solder 4 wires To Lucars & Short Circuit Test	48	time use
Final Assembly	48	no of component
Final Testing	24	no of test sequence
Date Code stamping & 100% Funtional	24	no of test sequence
Inspect & Packing	24	no of test sequence
Sealing	96	no of box(15 units)
Palletization	240	no of pallet
Material handling	24	no of move
Maintenance/engineering	24	no of maintenance hour
Production management	240	no of batch
Inventory/purchasing	240	no of order
Sales/marketing	2400	no of order
Administration Personnel	120	head count

APPENDIX H

UTILITIES DATA

Utilities		
Name of Activities	**Floor area**	**Driver**
SMT	270	no of panel
Inspect cured component	24	no of inspection
Radial component	9	no of component
Wave soldering	297	no of panel
Cleaning	297	no of panel
PCB Separation	18	no of tabs
Apply hot melt onto crystal	36	time use
Solder inspection & solder S3	24	time use
Solder Trimmer, S1, S2 To PCB Soldering	24	no of solder point
Segment Check	24	no of unit
Immediate Testing	24	no of trimmer tested
Solder 4 wires To Lucars & Short Circuit Test	48	time use
Final Assembly	48	no of component
Final Testing	24	no of test sequence
Date Code stamping & 100% Funtional	24	no of test sequence
Inspect & Packing	24	no of test sequence
Sealing	96	no of box(15 units)
Palletization	240	no of pallet
Material handling	24	no of move
Maintenance/engineering	24	no of maintenance hour
Production management	240	no of batch
Inventory/purchasing	240	no of order
Sales/marketing	2400	no of order
Administration Personnel	120	head count

APPENDIX I

MANUFACTURING OVERHEAD DATA

Manufacturing overhead		
Name of Activities	**Supervision man-hour (per day)**	**Driver**
SMT	2.073	no of panel
Inspect cured component	0.881	no of inspection
Radial component	5.301	no of component
Wave soldering	2.439	no of panel
Cleaning	2.642	no of panel
PCB Separation	2.546	no of tabs
Apply hot melt onto crystal	1.987	time use
Solder inspection & solder S3	5.757	time use
Solder Trimmer, S1, S2 To PCB Soldering	6.157	no of solder point
Segment Check	7.060	no of unit
Immediate Testing	7.873	no of trimmer tested
Solder 4 wires To Lucars & Short Circuit Test	13.328	time use
Final Assembly	13.131	no of component
Final Testing	7.851	no of test sequence
Date Code stamping & 100% Funtional	7.774	no of test sequence
Inspect & Packing	7.244	no of test sequence
Sealing	2.978	no of box(15 units)
Palletization	2.978	no of pallet
Material handling	5.000	no of move
Maintenance/engineering	0.180	no of maintenance hour
Production management	0.360	no of batch
Inventory/purchasing	0.470	no of order
Sales/marketing	0.084	no of order
Administration Personnel	1.690	head count

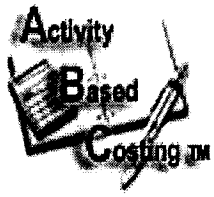
APPENDIX J

ADMINISTRATION DATA

Administration		
Name of Activities	**Operator man-hour**	**Driver**
SMT	2.073	no of panel
Inspect cured component	0.881	no of inspection
Radial component	5.301	no of component
Wave soldering	2.439	no of panel
Cleaning	2.642	no of panel
PCB Separation	2.546	no of tabs
Apply hot melt onto crystal	1.987	time use
Solder inspection & solder S3	5.757	time use
Solder Trimmer, S1, S2 To PCB Soldering	6.157	no of solder point
Segment Check	7.060	no of unit
Immediate Testing	7.873	no of trimmer tested
Solder 4 wires To Lucars & Short Circuit Test	13.328	time use
Final Assembly	13.131	no of component
Final Testing	7.851	no of test sequence
Date Code stamping & 100% Funtional	7.774	no of test sequence
Inspect & Packing	7.244	no of test sequence
Sealing	2.978	no of box(15 units)
Palletization	2.978	no of pallet
Material handling	5.000	no of move
Maintenance/engineering	0.180	no of maintenance hour
Production management	0.360	no of batch
Inventory/purchasing	0.470	no of order
Sales/marketing	0.084	no of order
Administration Personnel	1.690	head count

APPENDIX K

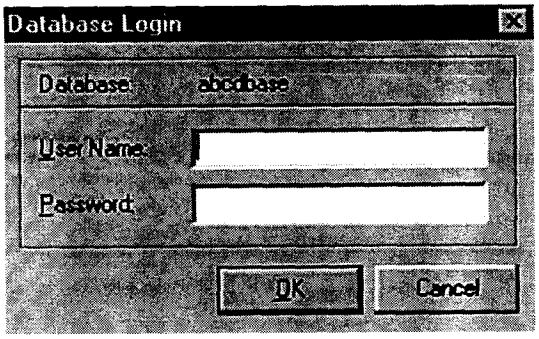
USER MANUAL



ABC SYSTEM USER MANUAL

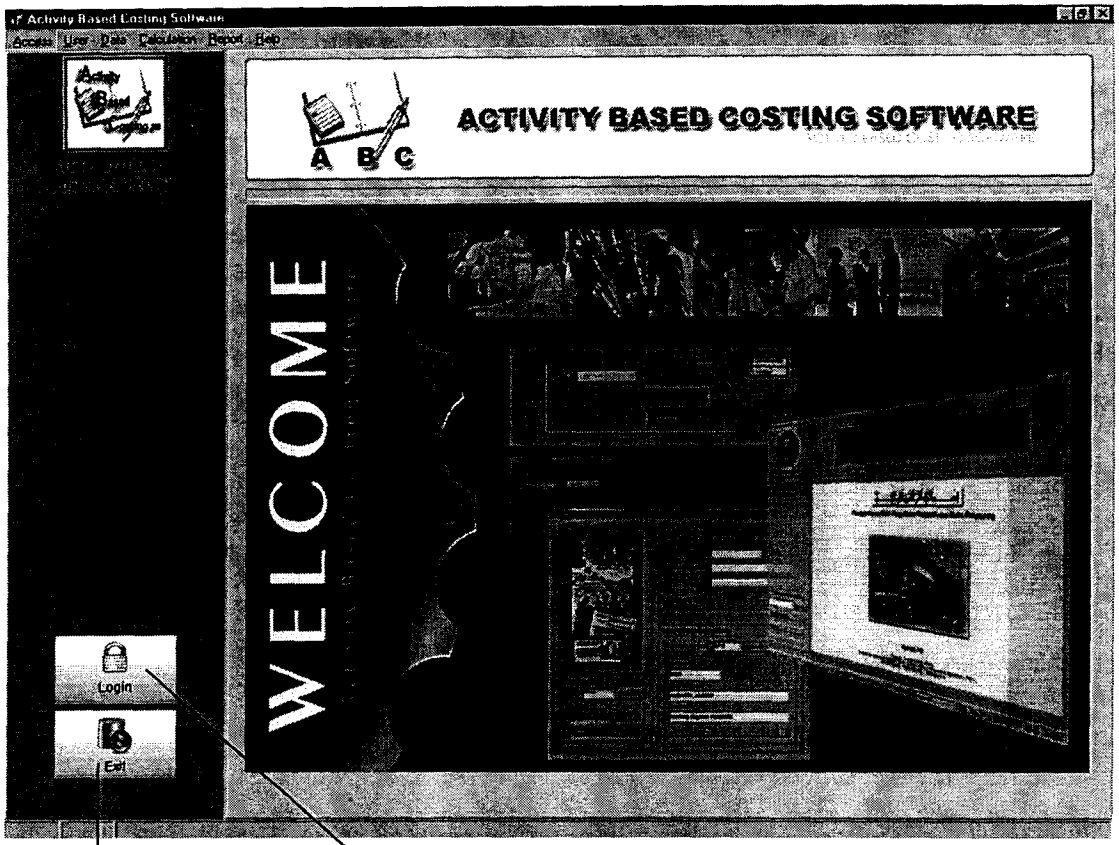
1. Database Login Menu

To login into system, click OK.



2. Main Menu

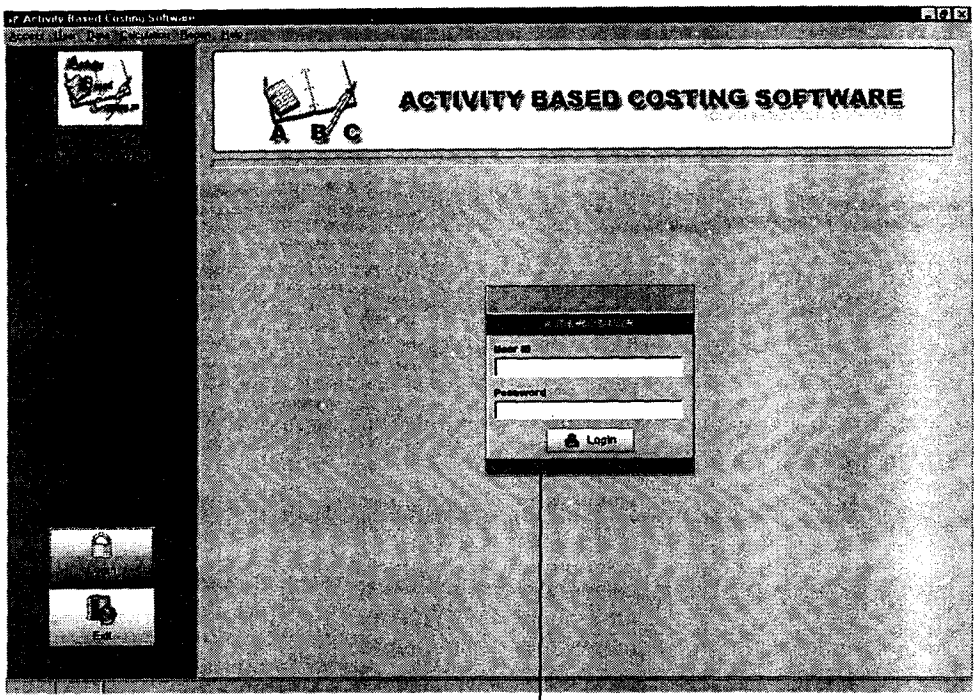
This is the main interface of ABC system.

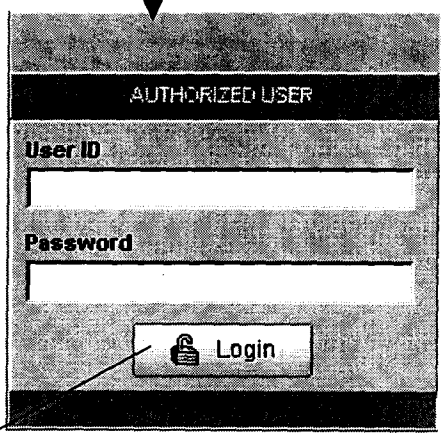


To exit, click this button

To login into system, click Login button

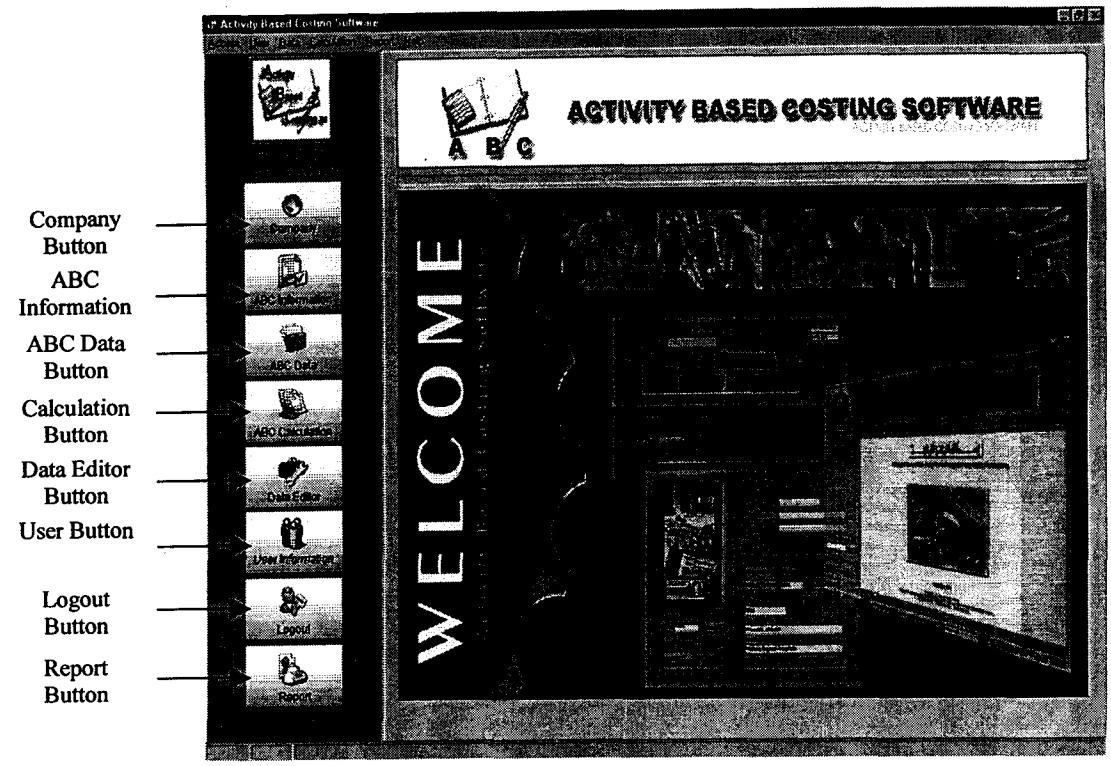
3. Login Interface





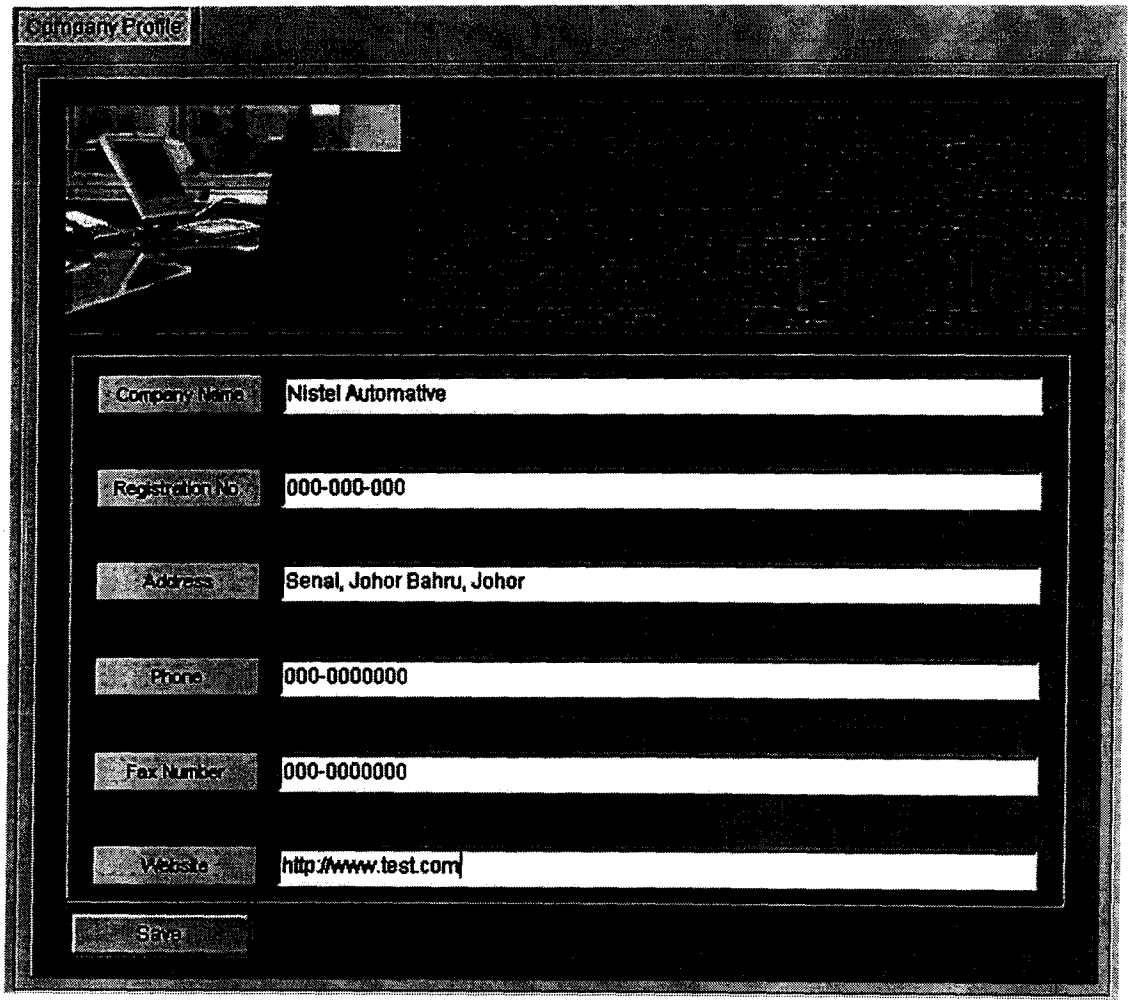
User must input the correct user ID and password for security purposes

4. Menu for Admin

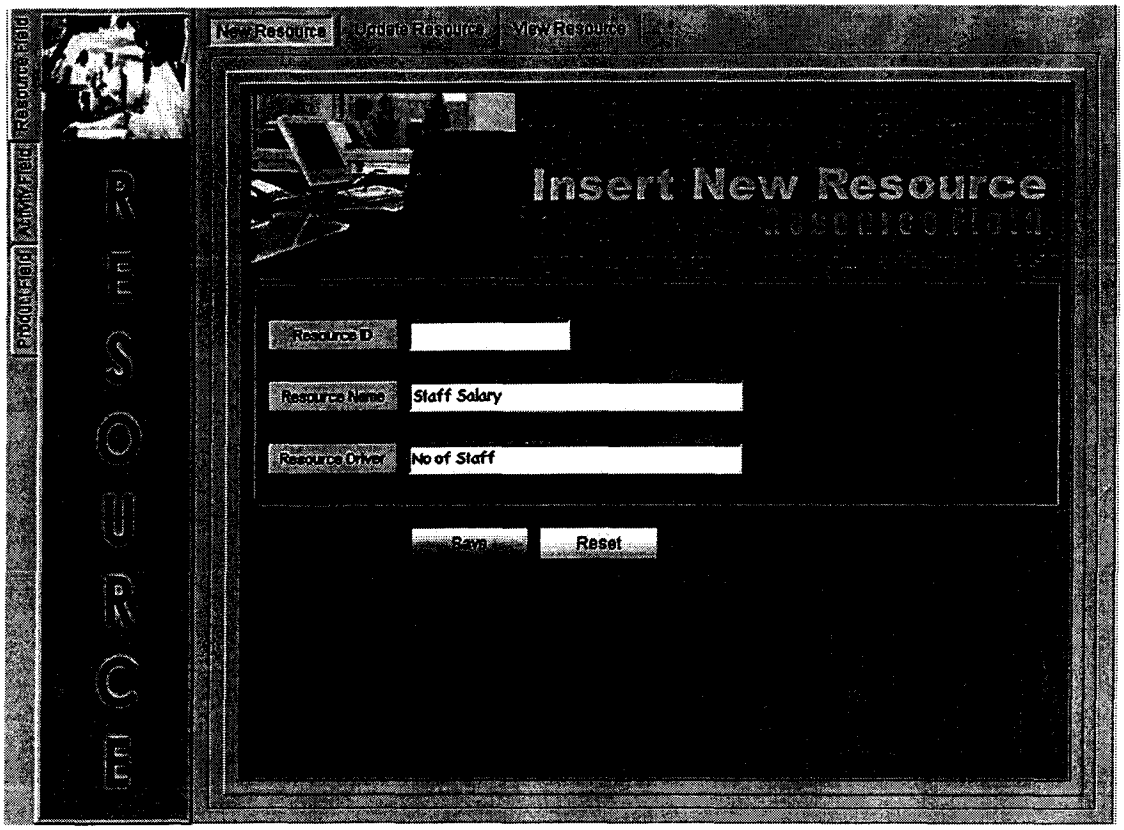


5. Company Profile Interface

Fills all the information about company, and then click SAVE button.

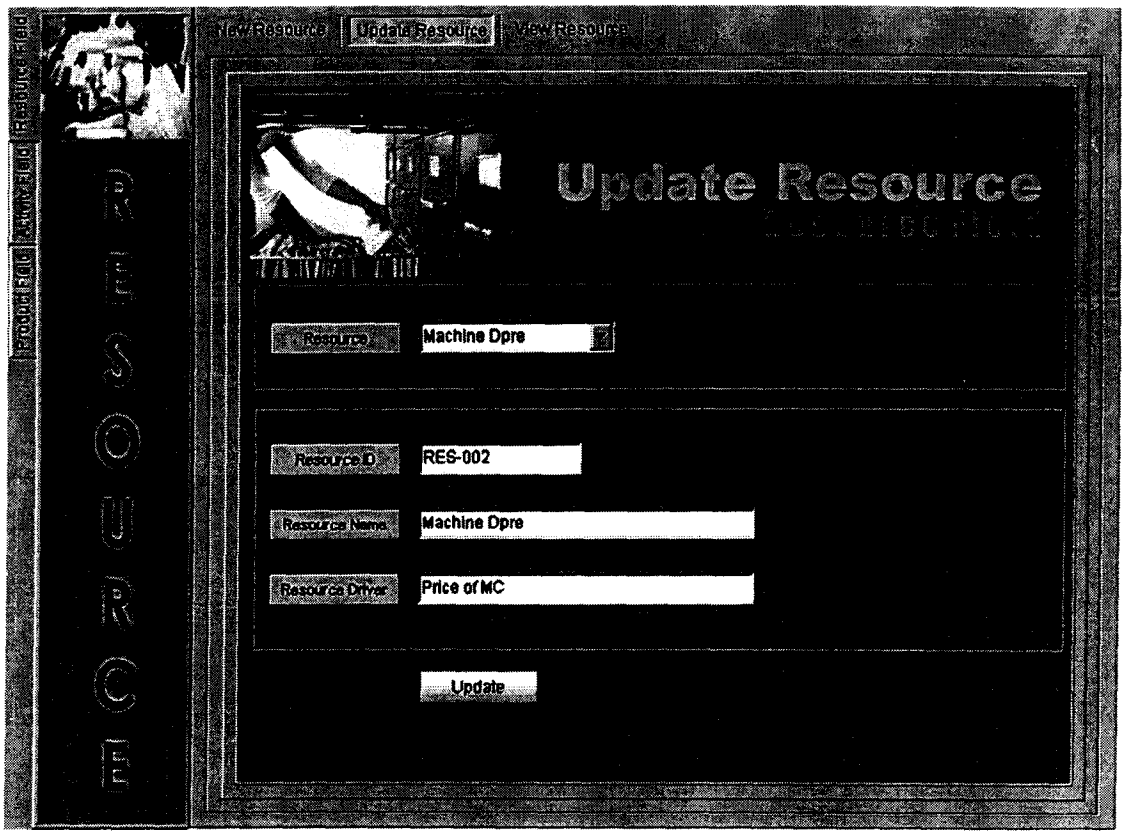


6. ABC Information Interface (Resource Section – New Resource)



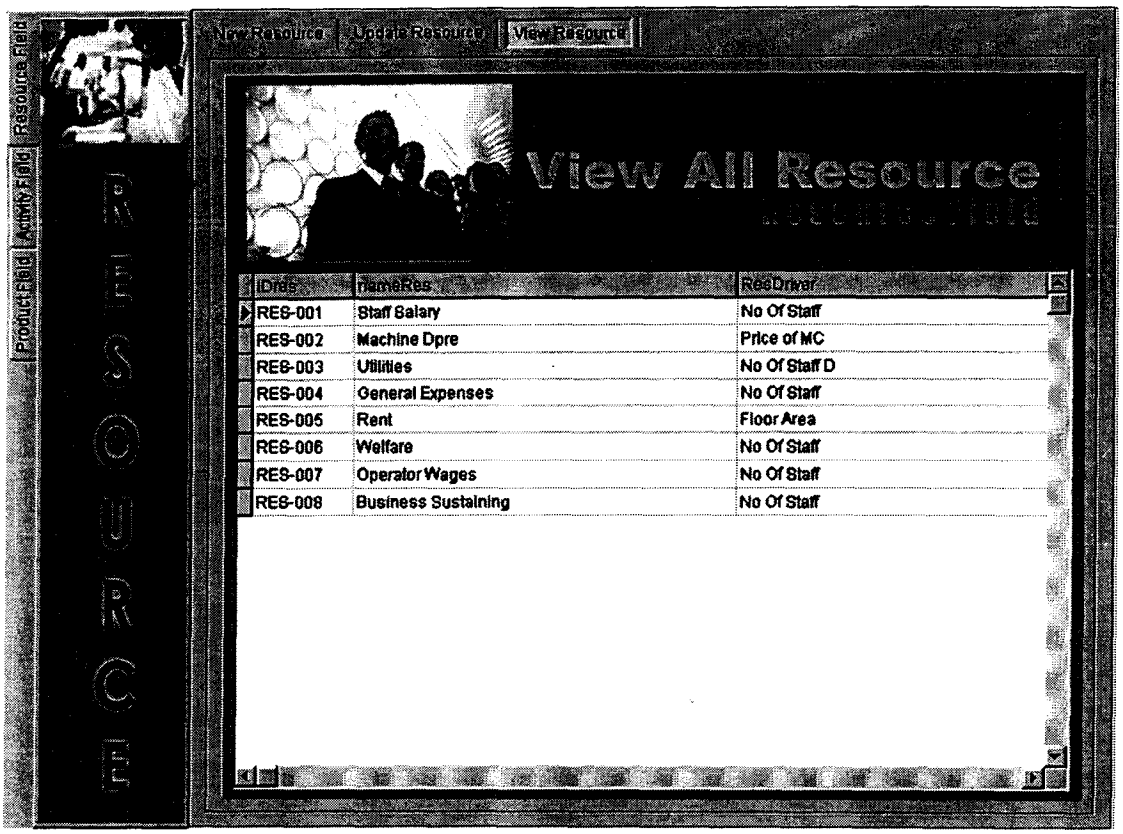
Insert the Resource Name and Resource Driver information, and then click SAVE button.

7. ABC Information Interface (Resource Section – Update Resource)



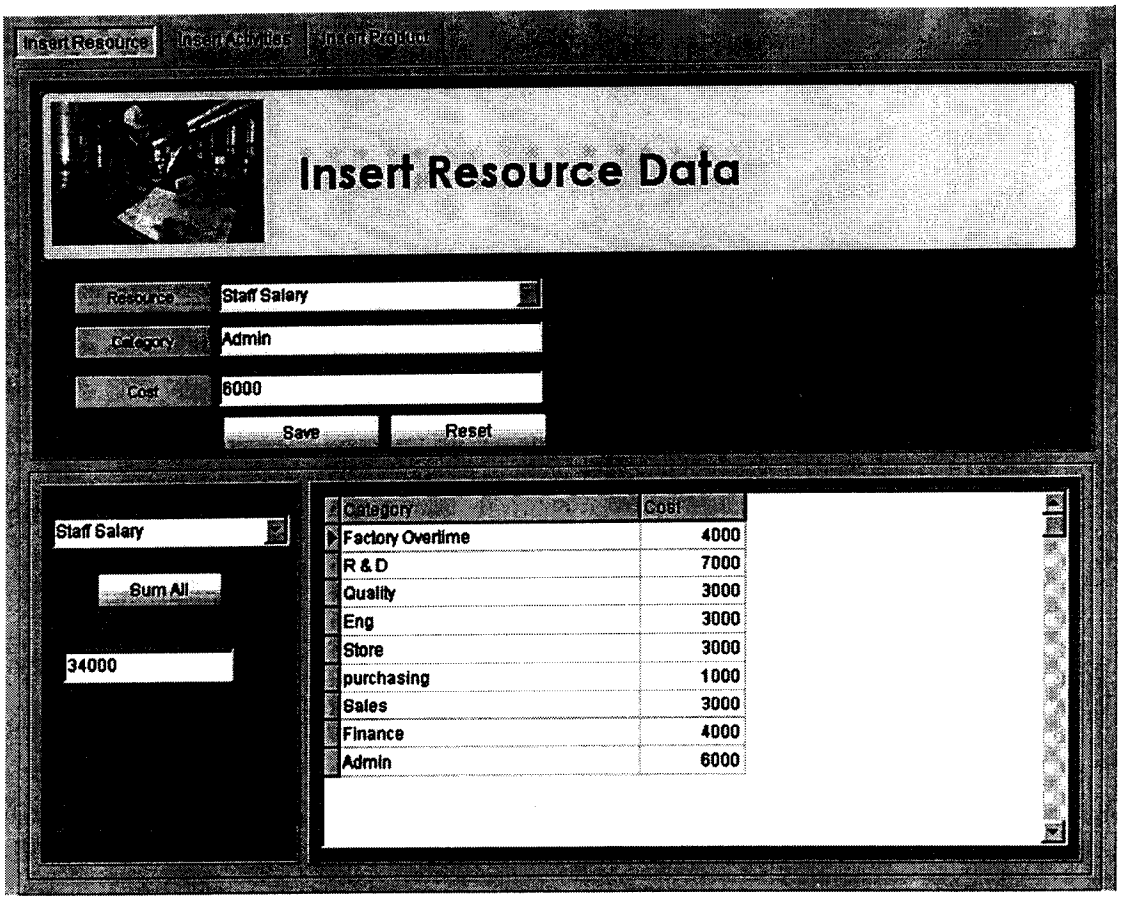
Select resource using combo box. To update resource information, click UPDATE button.

8. ABC Information Interface (Resource Section – View Resource)



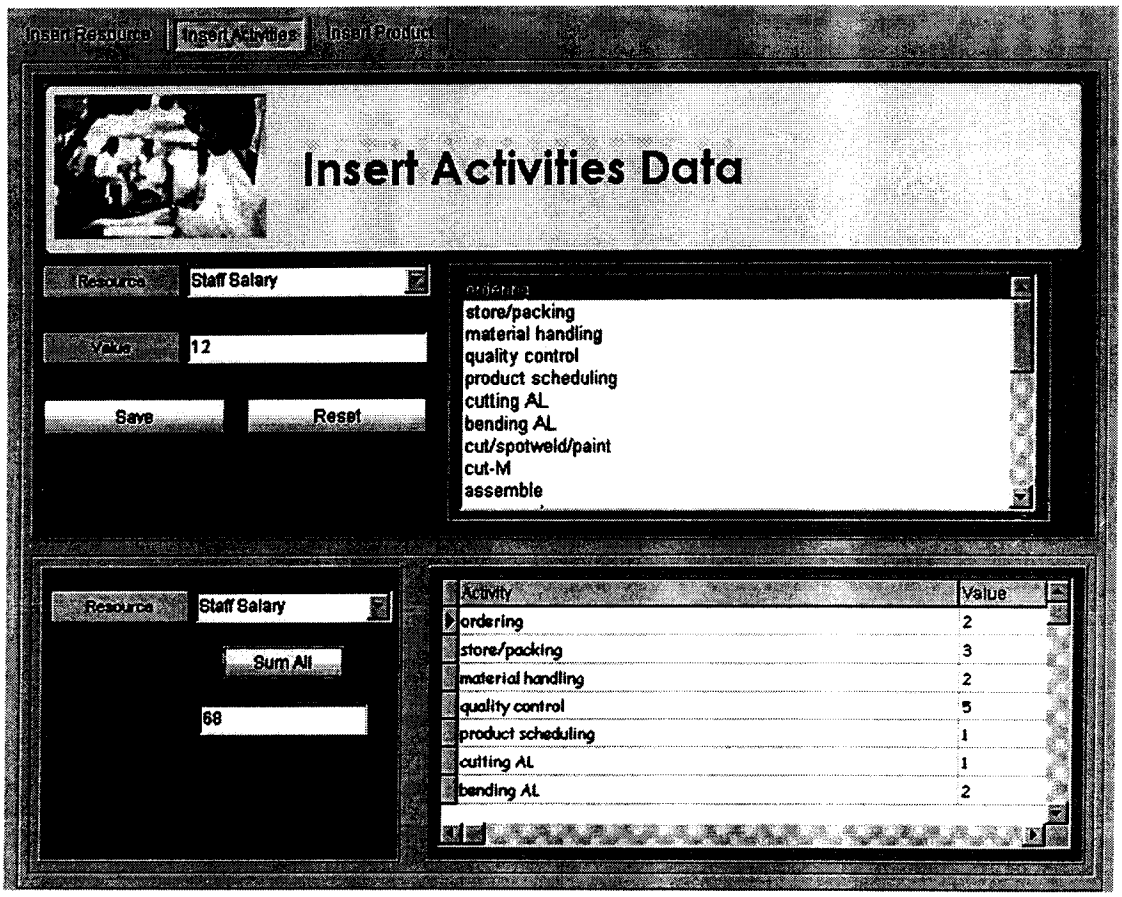
To view all the resources information, select this section.

9. ABC Data Interface (Insert Resource Data)



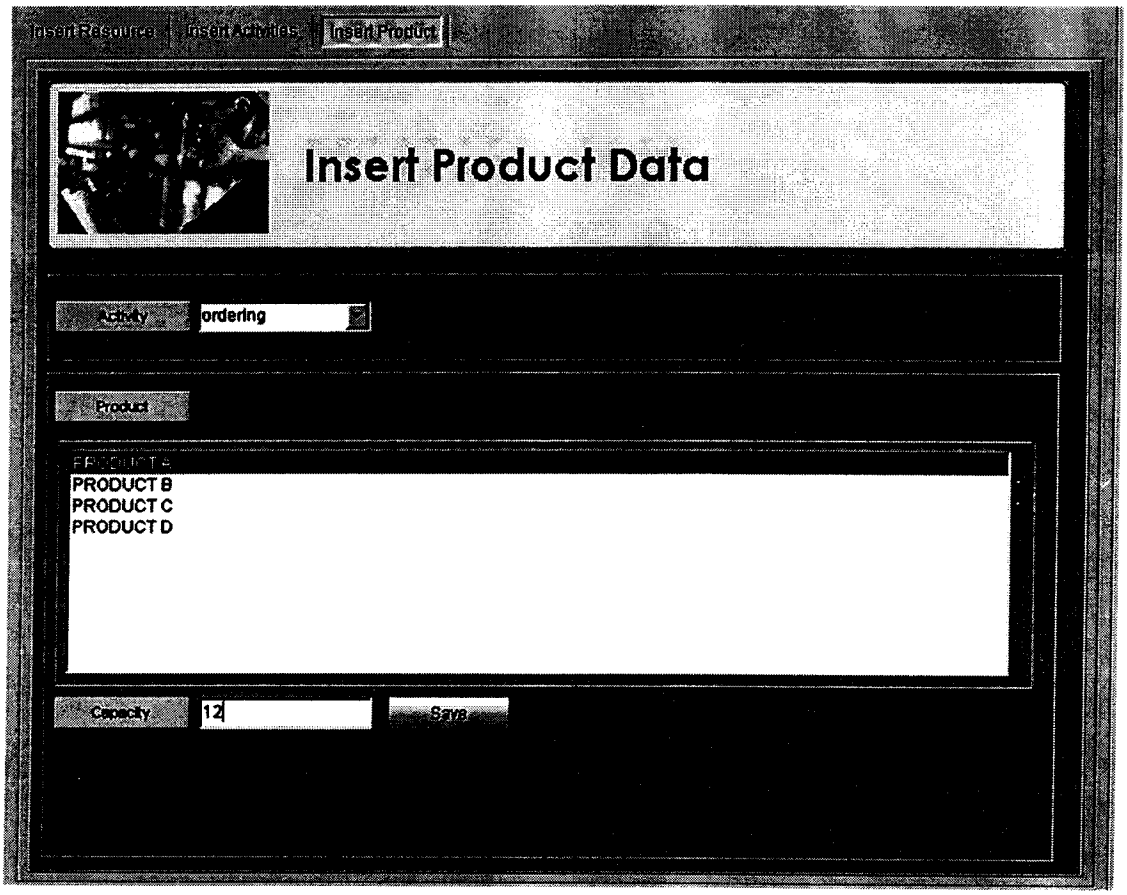
User must select resource, and then input the resource data (Category and Cost). Click SAVE button.

10. ABC Data Interface (Insert Activities Data)



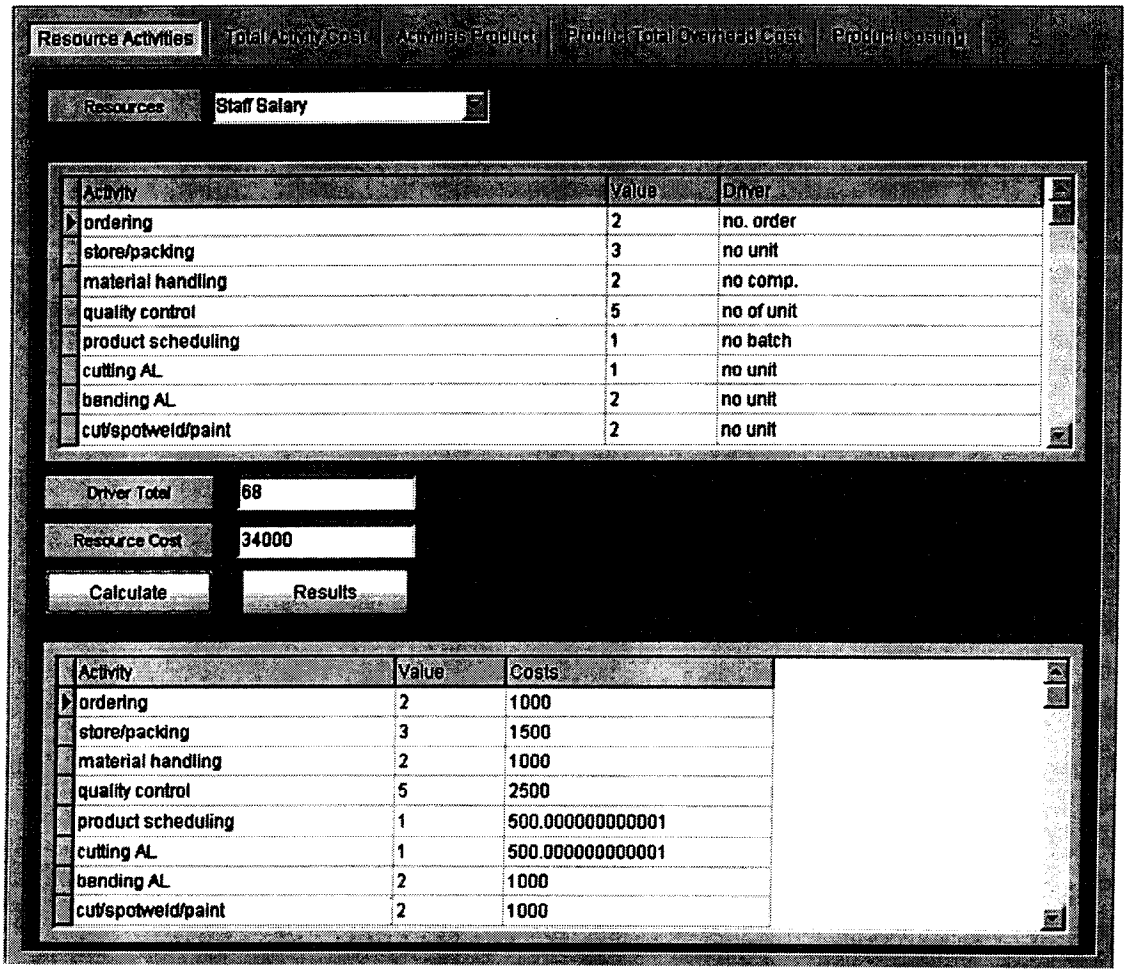
Select resource name and activity, and then input the value. Click SAVE button.

11. ABC Data Interface (Insert Product Data)



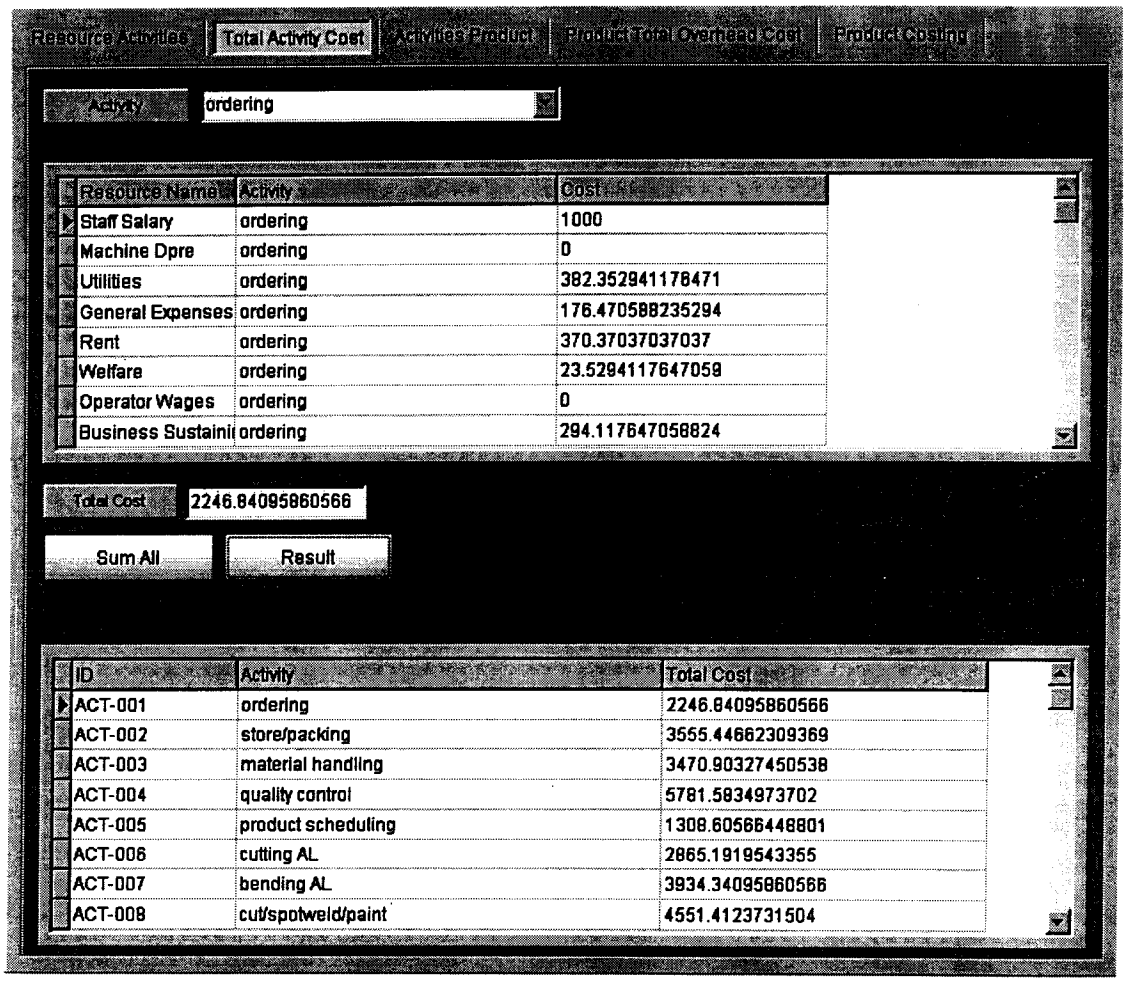
Select activity and product, and the input the capacity of the product. Click SAVE button.

12. ABC Calculation Interface (Resource Activities Section)



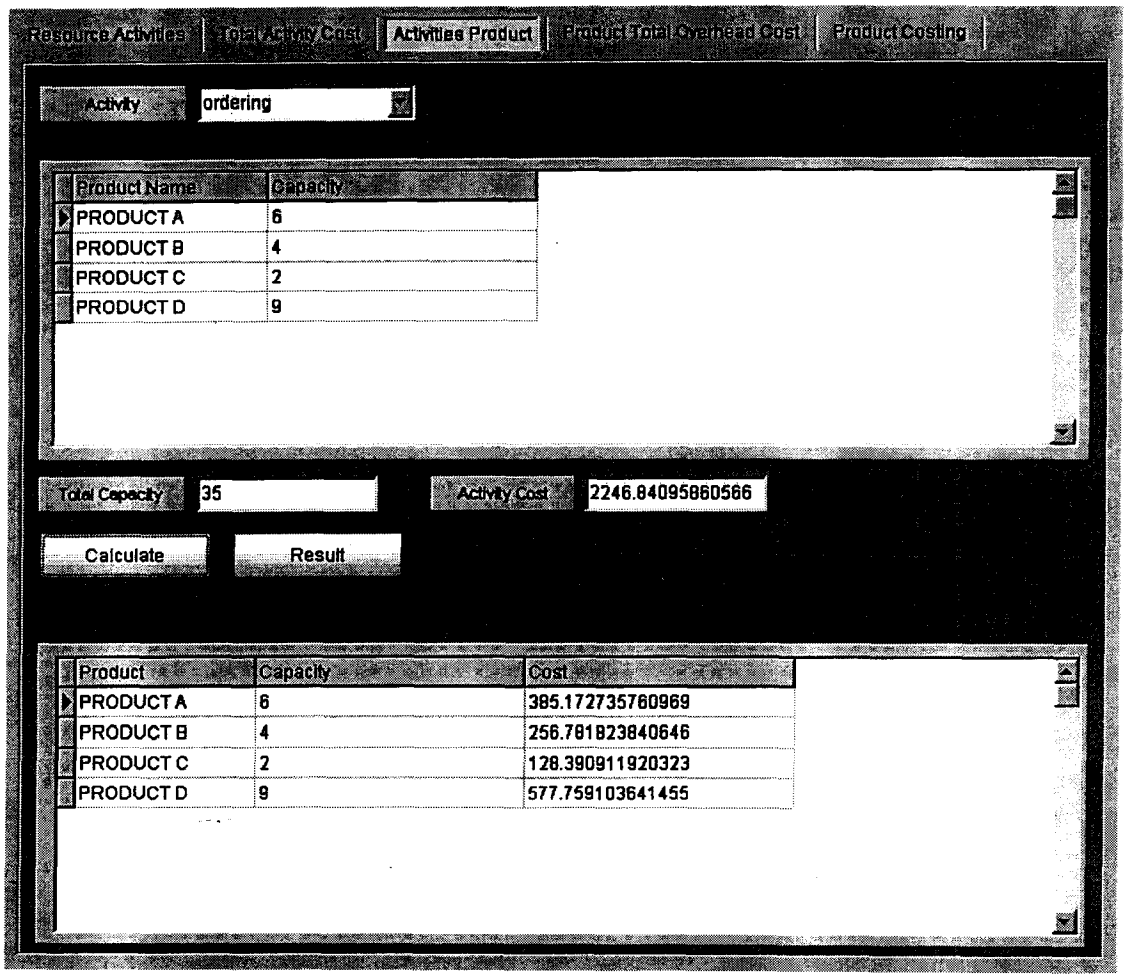
Select resource name, and then click CALCULATE button. To view the results, click RESULTS button.

13. ABC Calculation Interface (Total Activities Cost)



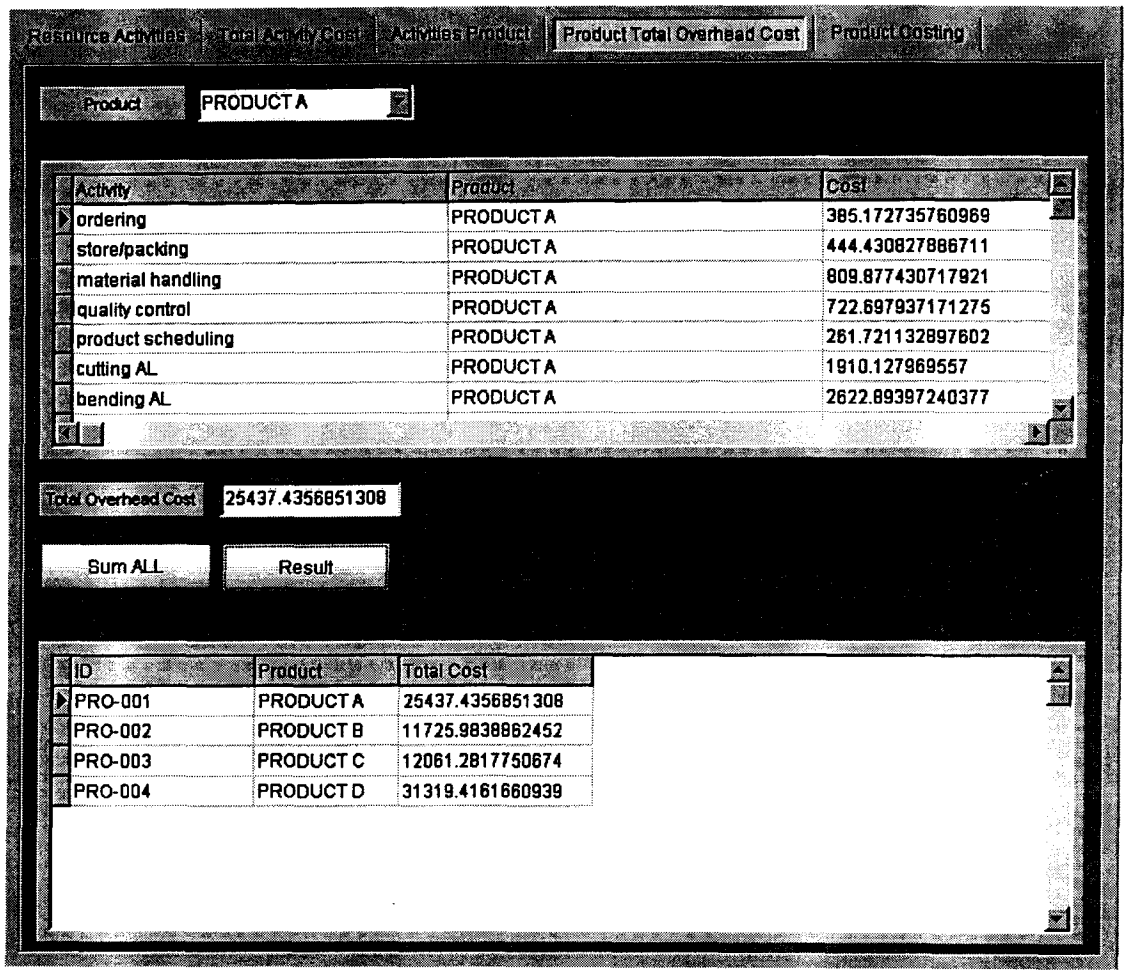
To sum the activity cost, select activity, and then click SUM ALL button. To view, the results, click RESULTS button.

14. ABC Calculation Interface (Activities Product Section)



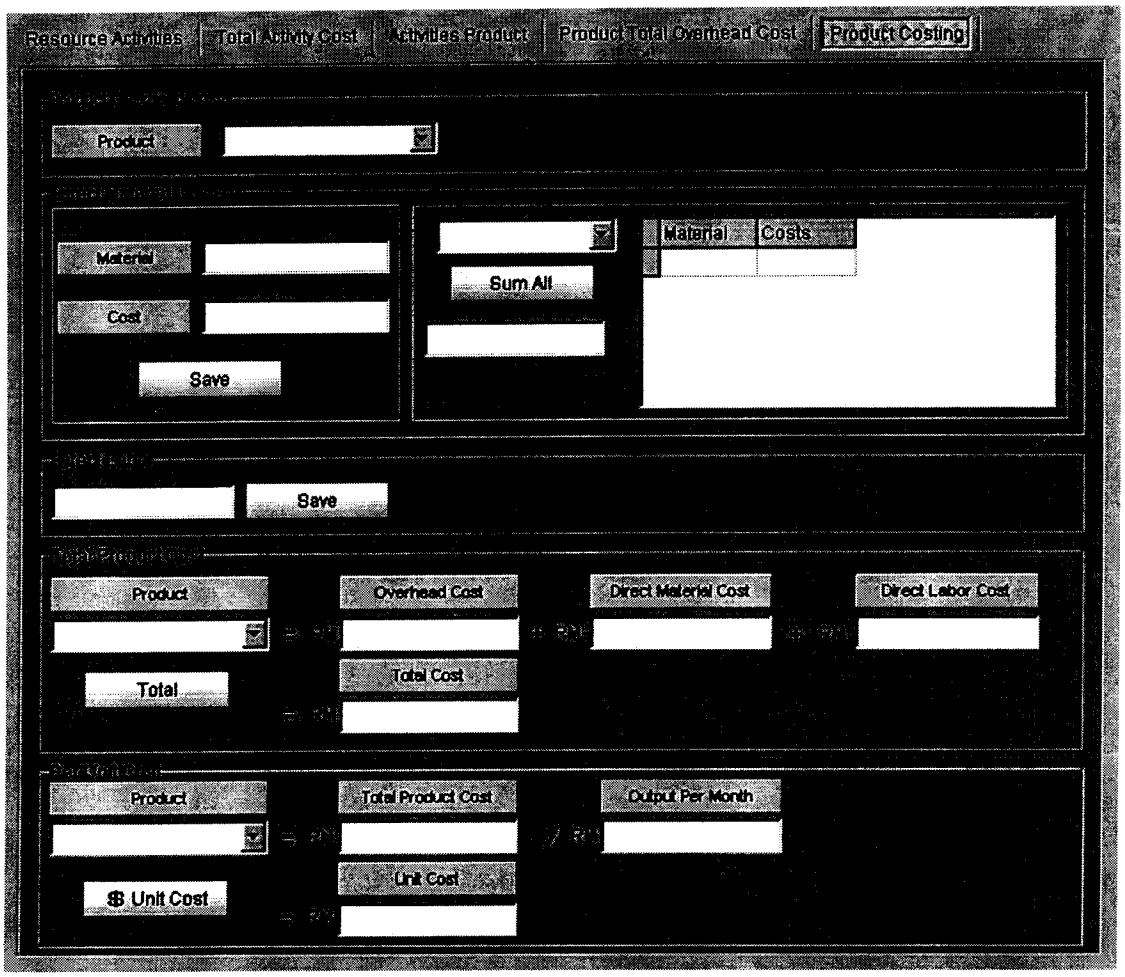
Select activity, and then click CALCULATE button. To view the results, click RESULT button.

15. ABC Calculation Interface (Total Overhead Cost Section)



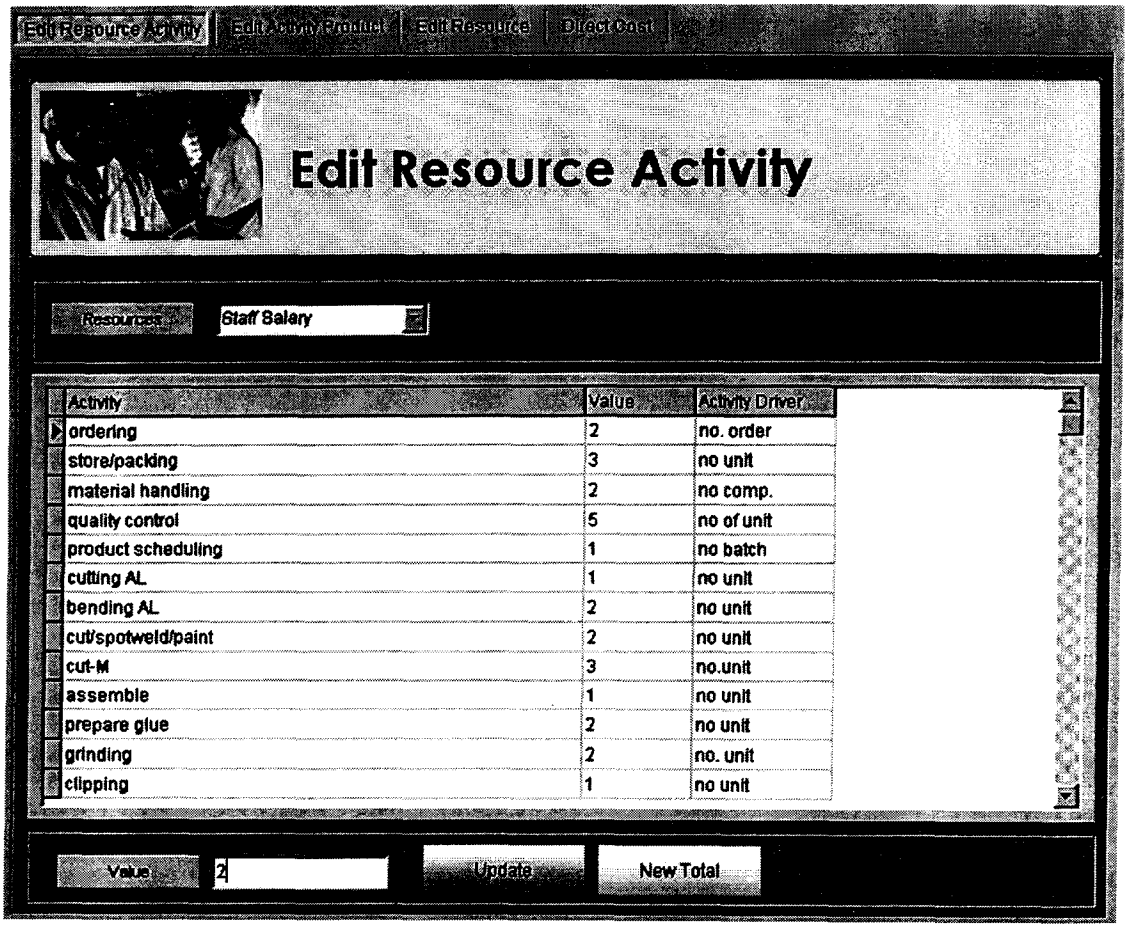
To sum the product overhead cost, select product name, and the click SUM ALL button. To view the results, click RESULT button.

16. ABC Calculation Interface (Product Costing Section)



To calculate product's cost, user must input product's direct material cost and direct labor cost. User can calculate total product cost and per unit cost.

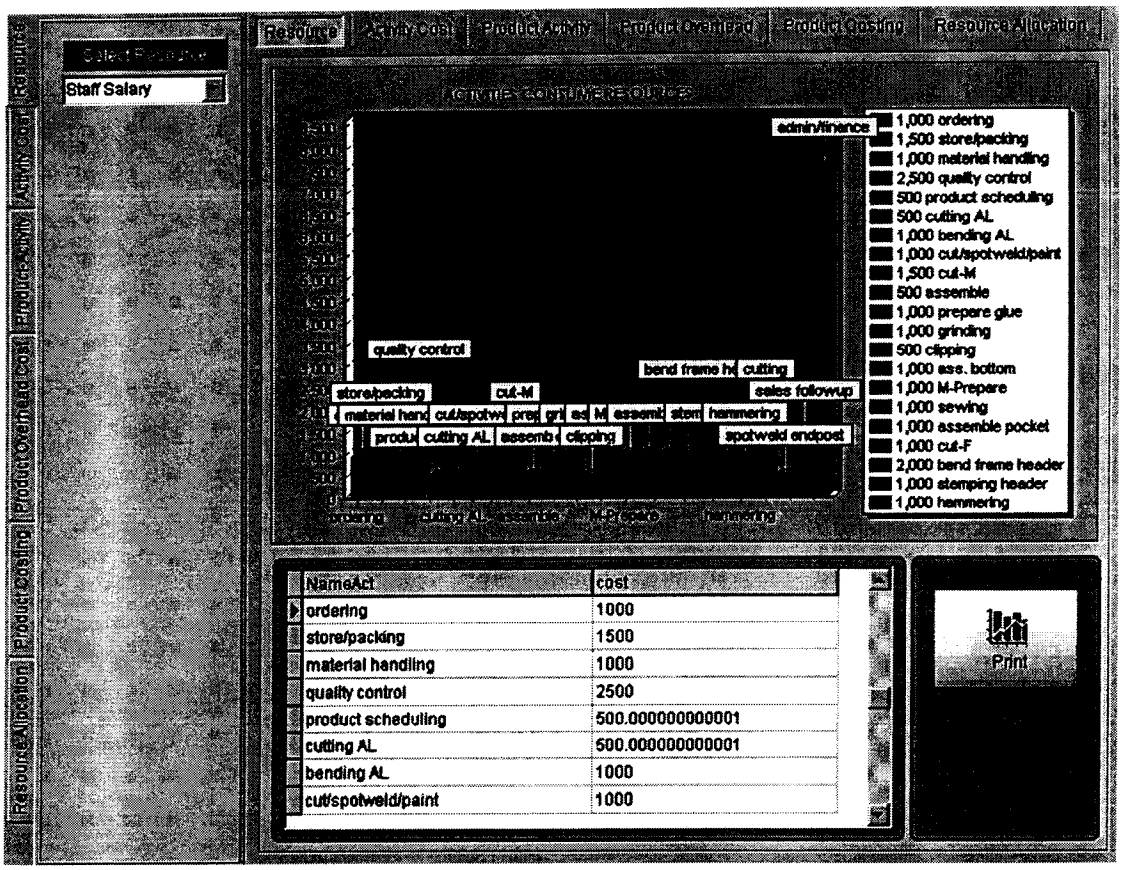
17. Data Editor Interface (Resource Section)



This section allow user (admin) to edit the ABC data for forecasting purposes.

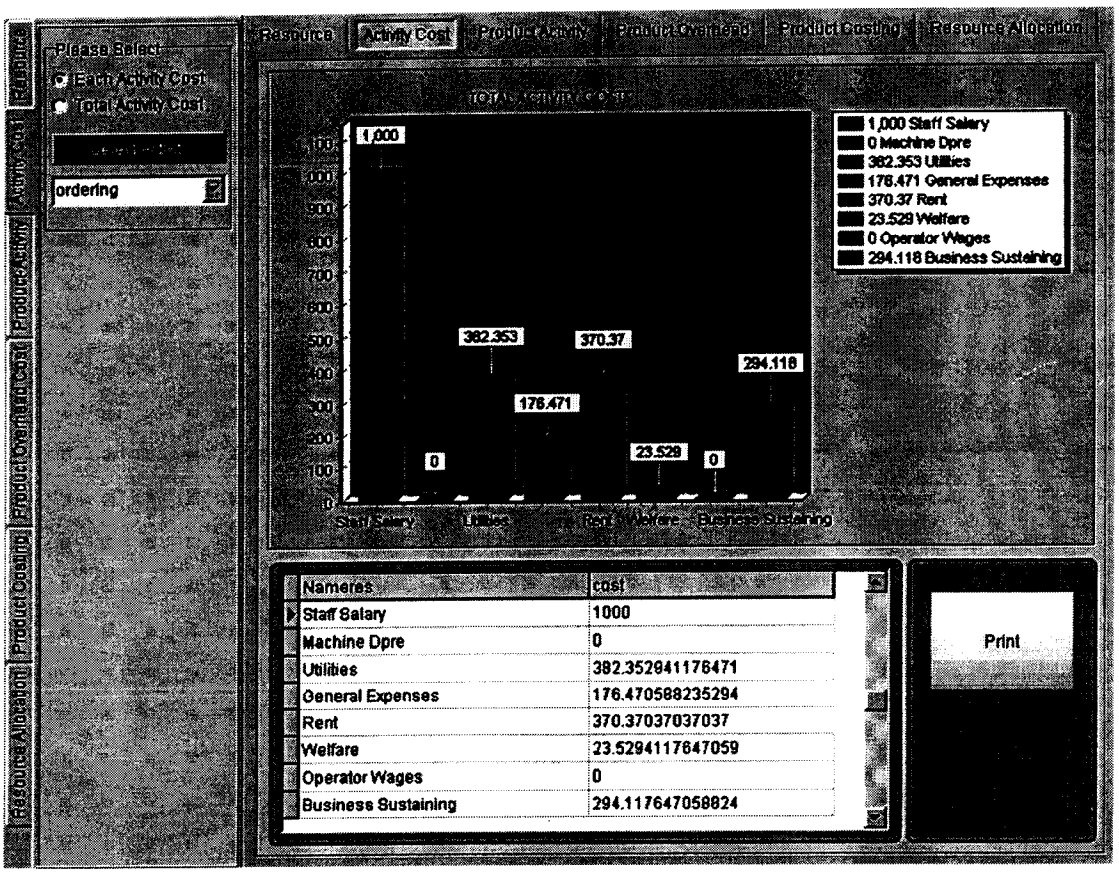
18. Report Interface (Resource Section)

To print the report, click PRINT button.



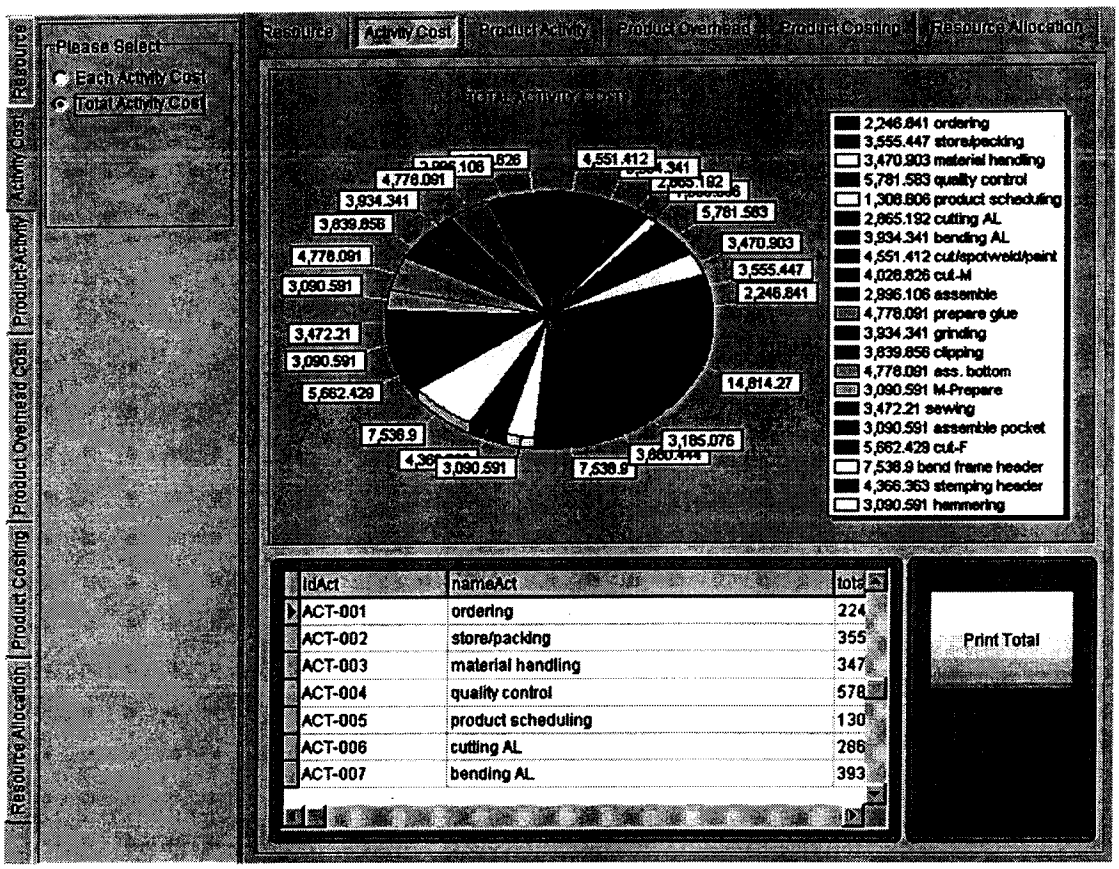
19. Report Interface (Activity Cost Section)

To print the report, click PRINT button.



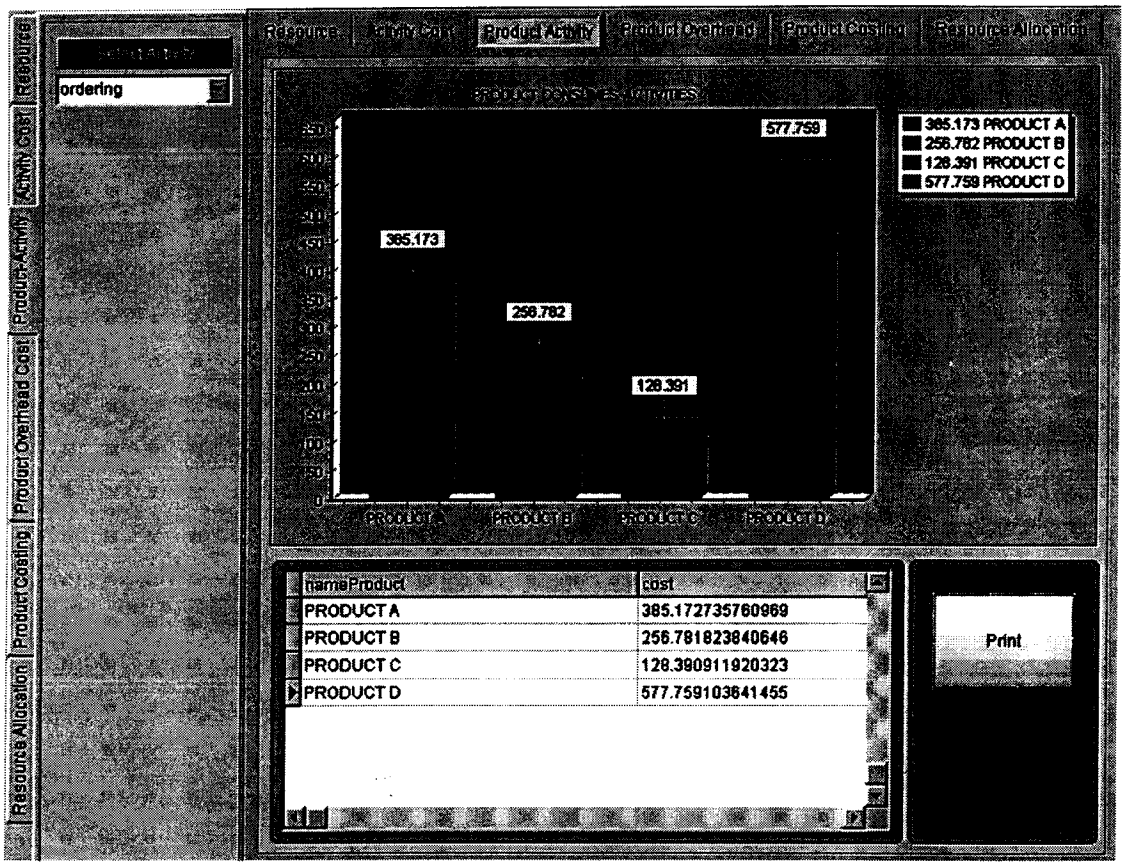
20. Report Interface (Activity Cost – Total Activity Cost)

To print the report, click PRINT button.



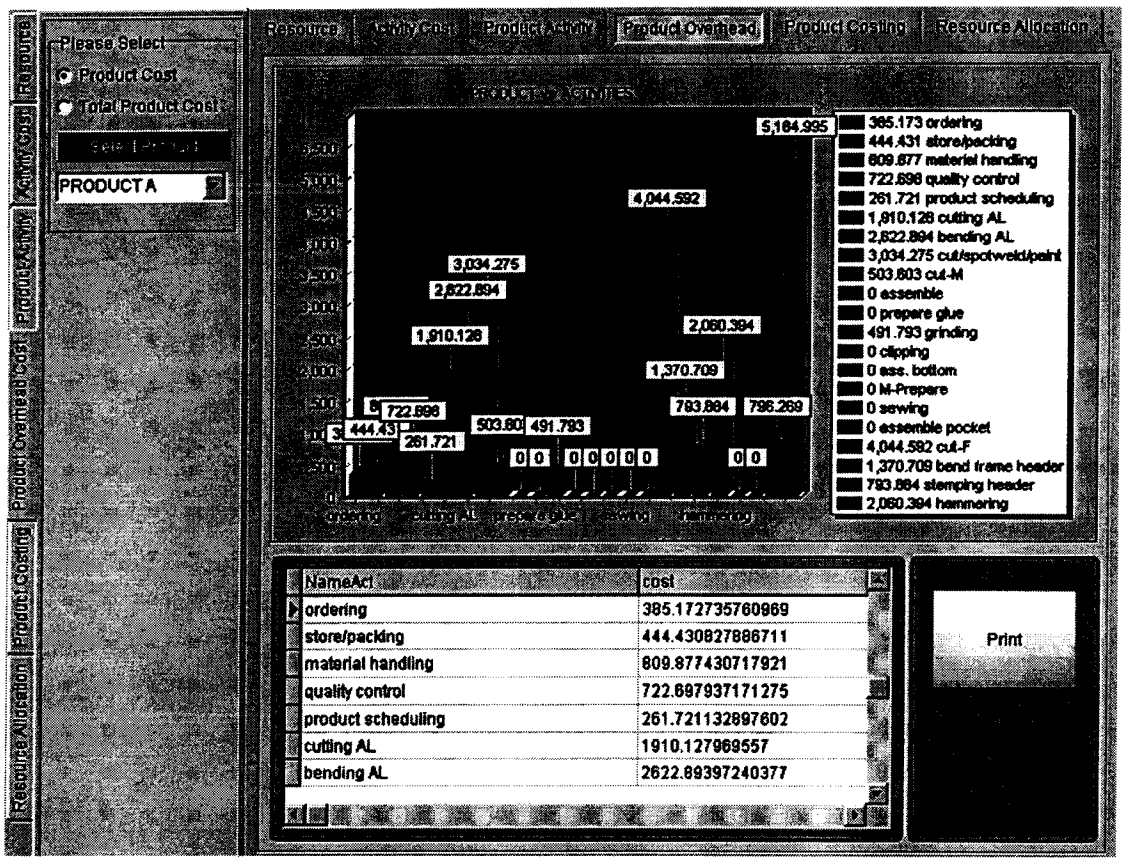
21. Report Interface (Product Activity Section)

To print the report, click PRINT button.



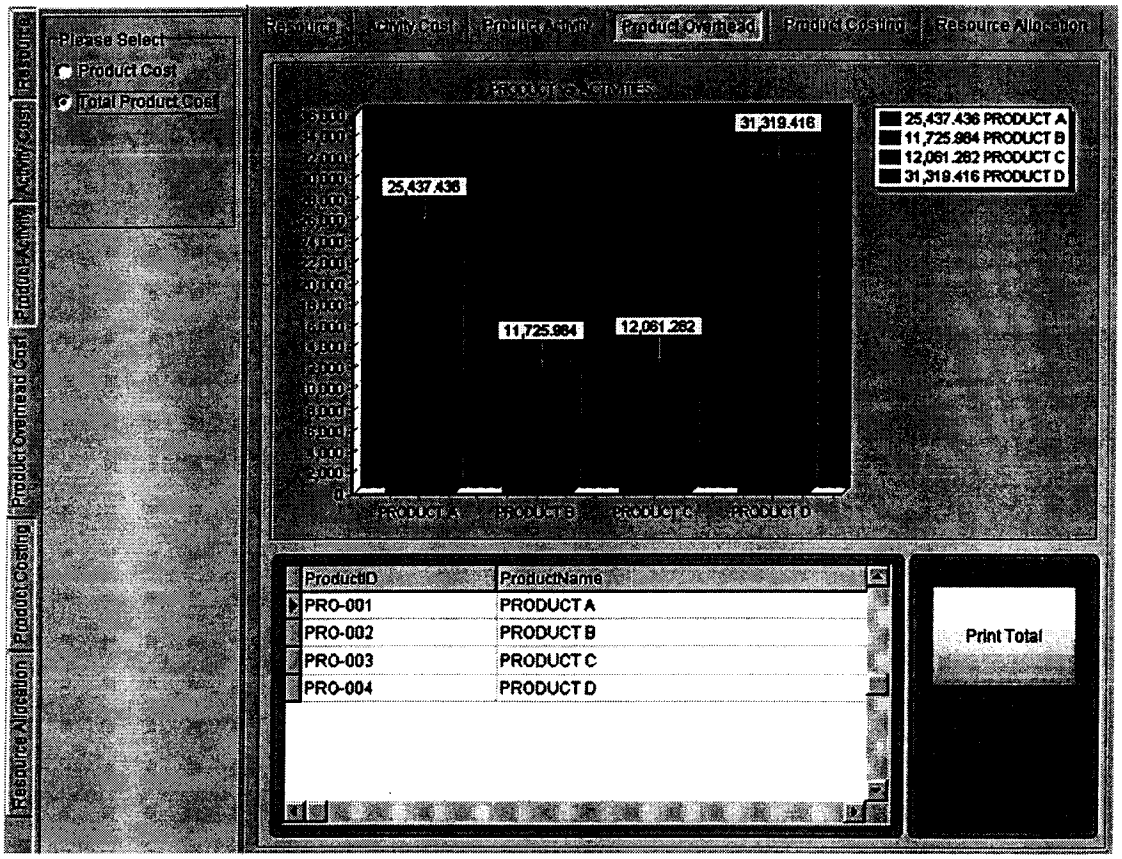
22. Report Interface (Product Overhead –Product Cost Section)

To print the report, click PRINT button.



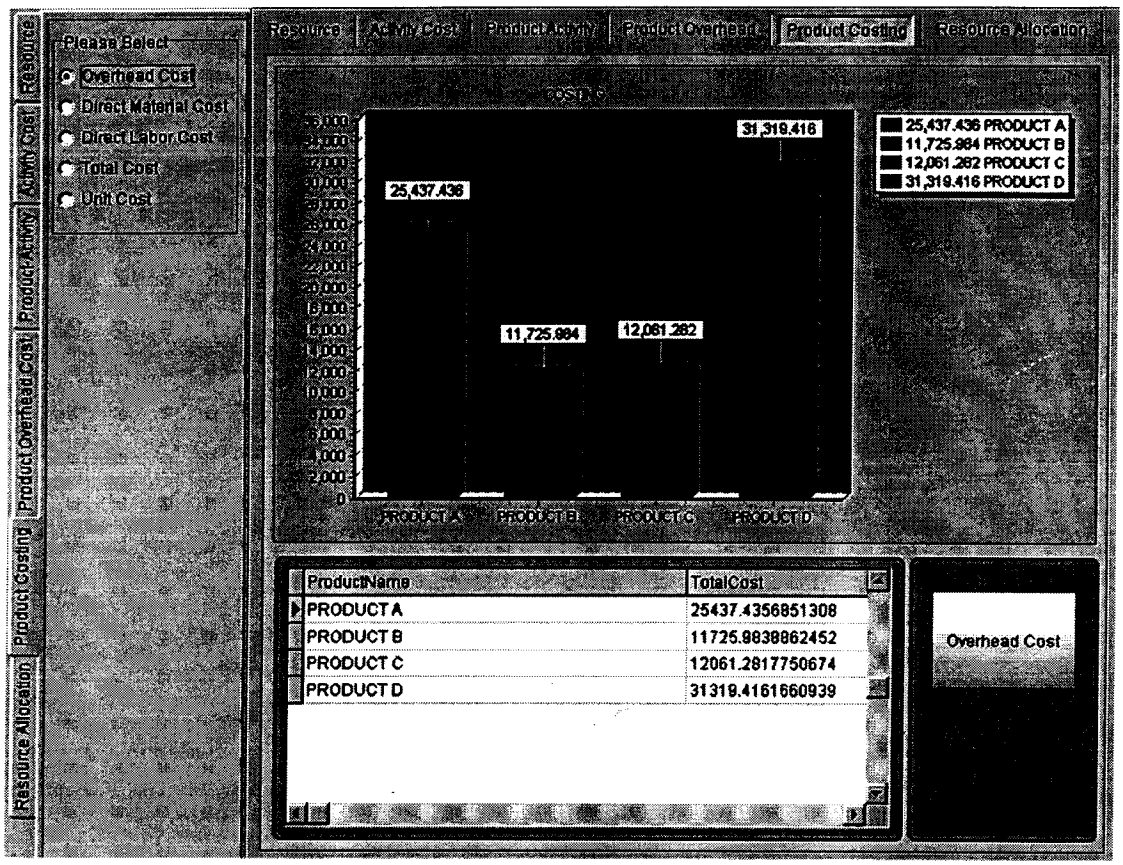
23. Report Interface (Product Overhead – Total Product Cost Section)

To print the report, click PRINT button.



24. Report Interface (Product Costing – Overhead Cost Section)

To print the report, click PRINT button.



25. Report Interface (Resource Allocation Section)

To print the report, click PRINT button.