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MODEL DEVELOPMENT OF SUPPLY CHAIN MANAGEMENT SYSTEM: *A CASE STUDY ON MESFIN INDUSTRIAL ENGINEERING PLC*

By: Mesfin Berhane

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Mesfin Berhane – June 2007

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List of Acronyms

BC	Barrier Cost
BW	Branch Warehouse
C	Customer
CFS	Central Full Store
CLM	Council of Logistics Management
D	Dealer
DRP	Distribution Requirement Planning
DS	Distribution System
DV	Domestic Vendor
EFFORT	Endowment Fund for the Rehabilitation of Tigrai
EGS	Empty Goods Store
EN	Exit Node
ES	Empty Store
FC	Flow Cost
FGS	Finished Goods Store
Fqs	Frequency
FS	Full Store
INC	Input Node Cost
IT	Information Technology
IS	Import Supplier
LS	Local Supplier
MaN	Master Node
MFS	Material Flow System
Mfg	Manufacturing
MIE	Mesfin Industrial Engineering PLC
MN	Mother Node
MPS	Master Production Scheduling
MRP	Materials Requirement Planning
MS	Manufacturing System

NAC	Node Activity Cost
PS	Planning System
R	Retailer
SCCA	Supply Chain Costs Analysis
SCCT	Supply Chain Cycle Time
SCIA	Supply Chain Inventory Analysis
SCM	Supply Chain Management
SCTA	Supply Chain Time Analysis
SN	Source Node
SS	Supply System
SSRT	Supply System Response Time
StN	Storage Node
ST	Suppler Tier
TSSC	Total Supply System Cost
V.A.T	Value Added Tax

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Abstract

Supply chain is the interconnected set of linkages between suppliers of materials and services that spans the transformation of raw materials into products and services and delivers them to a firm's customers.

Supply chain is highly recognized in developed countries for it is estimated to consume 10% of their Gross National Product (GNP). It is therefore projected to be of a greater proportion in the developing countries like Ethiopia, where a large amount of capital is tied up in inventories and in transportation systems for moving materials.

*Thus, a supply chain must be managed by controlling inventories. Developing a supply chain management system (**SCMS**) requires the analysis of the flow of materials from the initial sourcing to the final end customers. SCM has become a universal approach to cost effectiveness, timely delivery and the creation of growth oriented exchange system in goods and services. Accordingly, different researchers have made supply chain management studies in different Ethiopian process industries and have developed models capable of solving supply chain associated problems if implemented properly. And this thesis is done with the purpose of assessing the existing supply chain environment in one of the Ethiopian discrete manufacturing industries, the Mesfin Industrial Engineering PLC (**MIE**), and solving the associated problems.*

Mesfin Industrial Engineering (MIE), being one of the Endowment Fund for the Rehabilitation of Tigrai (EFFORT) companies, is a privately owned company located at the northern part of Ethiopia, in the Tigrai provincial capital, Mekelle. MIE, is the leading equipment manufacturing and industrial engineering company in East Africa. It designs and installs equipments & components for the energy, mining, manufacturing, construction, transportation, and agricultural sectors.

Because of the inherent complexity of decision making in supply chains, there is a growing need for modeling supply chain system with different methodologies. *With a focus on SCM in which cost, inventory and time are the key challenges, this thesis develops a model to aid the improvement of performance of the supply chain of MIE. The model is developed based on existing SCM knowledge (Initiated or adopted from literature review and pervious research works of Vikas Chandra (India-IIT, 1999)[30],*

Ato Abreham Debebe (Ethiopia-AAU, 2004)[8], and others recently done on similar area and as result of the circulated questionnaires, interviews made, and the results of an assessment or observations of supply chain management in the Mesfin Industrial Engineering PLC.

While the case study was conducted, MIE's awareness of SCMS, existing measurement of costs, all the inputs from the supply side, the production process and the out puts were assessed. Consequently, a supply chain model is developed with modifications on the existing model in such a way that non-value adding activities are avoided to reduce the supply chain cost. Thus, based on the new model, supply chain cost analysis is done and when compared to the traditional accounting system cost analysis there is a reduction (saving) of about Birr 1,235,743.80 (1.06%) in the annual production cost when supply chain cost analysis is used.

Finally, the researcher has made conclusions of the study and put recommendations to the industry, MIE, on how to use the concept of SCMS for creating satisfied customer and enhancing its profit margin.

Keywords: *Supply Chain Management System (**SCMS**), Supply Chain Cost Analysis, Supply System (direct and indirect materials), Manufacturing System, Distribution System (Dealer & Branch Warehouse), Modeling, and Material Flow System.*

CHAPTER ONE

1. Introduction

The Ethiopian industries are operating today in a business environment characterized by unprecedented global competition and technological change. In order to alleviate the problem of being unable to be competent in market and technology, the concept of supply chain management is important for the firms.

Supply chain management has become a universal approach to cost effectiveness, timely delivery and the creation of growth oriented exchange system in goods and services. In Ethiopia, this issue is a major area of economic activities that concerns, directly or indirectly, private and public institutions, investors, contractors, national and international organizations as well as the diplomatic community.

1.1 Background of the Study

The Ethiopian economy has an agrarian economy in which the livelihood of about 85% of the population directly or indirectly depends on the agricultural sector. The sectoral structure of the value-added to the national economy in 2004 (GDP composition of sectors) is,

- Agriculture 46%
- Service Sector 41.4%
- Industry 12.6%

Out of the total share of the industry sector, manufacturing represent 7%. Major industrial sub-sectors are food, beverage, tobacco, textiles, leather, printing, paper, and non-metallic minerals. In consumer goods manufacturing food, beverage, textile, leather and shoe dominate the large and medium scale-manufacturing sub-sector in Ethiopia. These four groups, including the chemical process industries, account for 78% of the gross value of output of the large and medium scale-manufacturing sector. [34] Obviously the metallic manufacturing industries account only less than 22% of the manufacturing sector.

The Ethiopian manufacturing industries are facing serious weaknesses and constraints hindering their productivity and competitiveness. Most of the manufacturing industries are plagued with the problem of low financial & managerial capacity, lack of machineries & facilities, shortage of highly qualified workers. Moreover, they have been seriously affected by under-capacity utilization and declination of total resource productivity. Even if the contribution of the manufacturing sector to export earnings has increased over the last few years, considering the unutilized capacity, unexploited potential, and low market share of the manufacturing industry, a lot remains to be done. Thus, the problems which contributed a lot towards the above limitations & backwardness of the sector should be rectified by implementing a Supply Chain Management System (SCMS) in one of the manufacturing industries of Ethiopia in such a way that it can be extended to others with a little modification. In this thesis, Mesfin Industrial Engineering is selected as a center of the case study to analyze the above problems so as to set solutions by using the ***Supply Chain Management System*** (***SCMS***).

Mesfin Industrial Engineering (MIE) being one of the Endowment Fund for the Rehabilitation of Tigrai (EFFORT) companies, is a privately owned company located at the northern part of Ethiopia , in the Tigrai provincial capital, Mekelle. MIE, is the leading equipment manufacturing and industrial engineering company in East Africa. It designs and installs equipments & components for the energy, mining, manufacturing, construction, transportation, and agricultural sectors. [9]

Consequently, the researcher believes that, the case study that is attempted in this largest local manufacturing industry will be highly useful as well for the other similar industries of the country.

1.2 Statement of the Problem

The following are some of the problems associated with supply chain management in Ethiopian manufacturing industries.

A. **Poor strategic alliance**

Having proper alliance with customers, carriers, and suppliers and using information and communication technologies and management methods results in better quality of products and services with reduced costs. But the Ethiopian industries don't have such strategic alliance. Thus, due to the lack of supply chain networking, the Ethiopian industries are highly subjected to unnecessary costs (storing, handling, moving, etc).

B. **Longer lead times**

The other problem that is observed in Ethiopian industries is longer lead times (procurement, conversion, distribution) which results in unnecessary inventory costs (that adds cost to products without adding value) and thus result in customer dissatisfaction due to due to poor delivery and increased price of products.

C. **Low customer service level**

Ethiopia is one of the developing countries where more value is not given to increase customer service level and product expectation, which result in loss of customers that have large economical impact on the organization. So this problem can be rectified using supply chain management system that can serve to increase customer service level.

1.3 Objectives of the Study

General objectives:

- To introduce how a supply chain management model is going to be developed for Ethiopian discrete manufacturing industries that might be used as a reference for future researchers on similar issue.

- To assess and then to create awareness of the concept of supply chain management in Mesfin Industrial Engineering PLC.
- To introduce the concept of SYNERGY & its application in EFFOERT sister companies using SWOT analysis.

Specific Objectives:

⇒ To identify & evaluate the existing supply chain management system in Mesfin Industrial Engineering using different methodologies & applying the tools: ***Supply Chain Cost and Pareto Analysis***.

⇒ . To develop a model of supply chain management system for Mesfin Industrial Engineering PLC.

1.4 Significance of the study

The significance of this research is to explore solution to problems related to supply chain management area in Ethiopia. It can improve efficiency and effectiveness of flow of materials and information from suppliers to customers and vice versa. It will try to address the problems associated with supply chain management in Mesfin Industrial Engineering PLC by using different methods and tools. Consequently, suitable supply chain management model will be developed for the industry to achieve appropriate customer service in a cost effective manner. Besides, it is an initiative to create awareness about SCMS in the industry.

It is also intended to fill the gap between suppliers, manufacturers, distributors and consumers in exchanging information and helping each other across the supply chain. Moreover, the researcher believes that only with a little modification, the result of this research can be useful to other similar Ethiopian industries.

1.5 Scope of the Study

The scope of this thesis work is assessment of the existing supply chain management (***SCMS***) in the production process of Mesfin Industrial

Engineering PLC (***MIE***) by analyzing one of the most relevant SCMS' derivatives, i.e. Cost, throughout the supply and manufacturing systems. For the Cost associated with the distribution process in this industry is negligible compared to the supply & manufacturing processes, it is not considered (analyzed) further. The ultimate goal of this thesis is then to develop a SCMS model for one of the EFFORT's sister companies, i.e. MIE & to forward highly valuable recommendations that if implemented properly be resulted in making the company successful in the business it is dealing with and in creating satisfied & delighted customer.

As it was manifested in the introduction part of this thesis, 7% of the country's industrial sector share of the economy is manufacturing. Among the currently existing manufacturing industries MIE, MARU and TECHALE are the prominent ones for that these are able to design, manufacture and assemble bodies of fuel and dry cargo truck trailers and semi trailers, and other products that do not exist in other industries of the country.

Supply chain management in manufacturing industry, which starts from supplier to end customers, is a complicated system, which includes tiers of suppliers and transaction of multiple semi-finished products. The level of complexity varies from organization to organization. Accordingly ***MIE,*** is selected as the industry where the research is to be conducted for that its volume of production, market share of its products throughout the country and the product mix is larger than that of MARU and TECHALE.

1.6 Limitations of the Study

As the nature of the study mainly depends on the quantity and quality of the collected data, shortage of finance was a limitation to round through all the places were EFFORT's companies present, to prepare, distribute and collect several questionnaires papers and to extend the research to other similar manufacturing industries in Addis Ababa.

Besides to the above, some employees of MIE were reluctant to fill the questionnaires & to extend their cooperation in providing the requested data for their own different perception to the research work and other reasons.

1.7 Structure (Organization) of the Thesis

This thesis contains a total of eight chapters and eight appendices. The report is structured so that the information presented to the reader is arranged in a logical sequence. It is presented in such a manner that the necessary background information is covered before going further into the next level of detail for maintaining the continuity of the subject matter.

The contents of the chapters are as follows:

Chapter 1 – Introduction: - This chapter is to give introductory view to the reader about the thesis work, what initiated it, the problem statement, objectives, scopes, significance, limitations and how the whole thesis is organized or structured.

Chapter 2 – Research Methodologies: - will describe different aspects of the methods used and situations that the researchers must consider during each phase of the study. Different ways of carrying out a study and ways of collecting information will be discussed. The purpose of this chapter is to make the reader understand the methodological choices made on the study.

Chapter 3 – Literature Survey: - This chapter will review in detail the literature available in the area of supply chain management system. It will cover the ideas evolving around supply system, manufacturing system, and distribution system based on the experience, research and teaching of prominent writers. Basic principles of supply chain management, the elements, and the benefit of a supply chain management system are dealt thoroughly. The aim of this chapter is to give the reader fundamental background on the concept of supply chain management.

Chapter 4 – Background of Mesfin Industrial Engineering PLC. : - This chapter will give a review of the company background such as, company profile, organizational structure, values, motto, mission, objectives, location, types of product produced, types of services provided to customers, customer supplier relationship, existing cost analysis and so on.

Chapter 5 –Data Analysis and Interpretation: - This chapter will cover the finding of supply chain management elements for the model and supply chain cost analysis, and analysis and interpretation of the survey questionnaires for the case study on Mesfin Industrial Engineering PLC.

Chapter 6 –Model Development of SCMS: - This chapter will develop a supply chain management model for Mesfin Industrial Engineering PLC based on the findings presented in the previous chapters.

Chapter 7 –Evaluation (Analysis) of the Model

This chapter compares the existing cost analysis methods of MIE with that of supply chain cost analysis method by describing parameter for both methods, and then searching for improvement.

Chapter 8 –. SYNERGY and Cooperation in EFFORT sister companies

This chapter initially manifests the concept of synergy and then discusses the existence of synergy and cooperation in EFFORT sister companies by analyzing the compiled responses of employees to the formerly disseminated and collected questionnaire surveys. [41]

Chapter 9 – Conclusions, Recommendations and Future works: - This chapter will present the conclusions drawn from the study, and give recommendations as to how the Models can be used by the Mesfin Industrial Engineering PLC to reduce the existing costs using supply chain method in product costing. It will also include suggestions for further researches in the area.

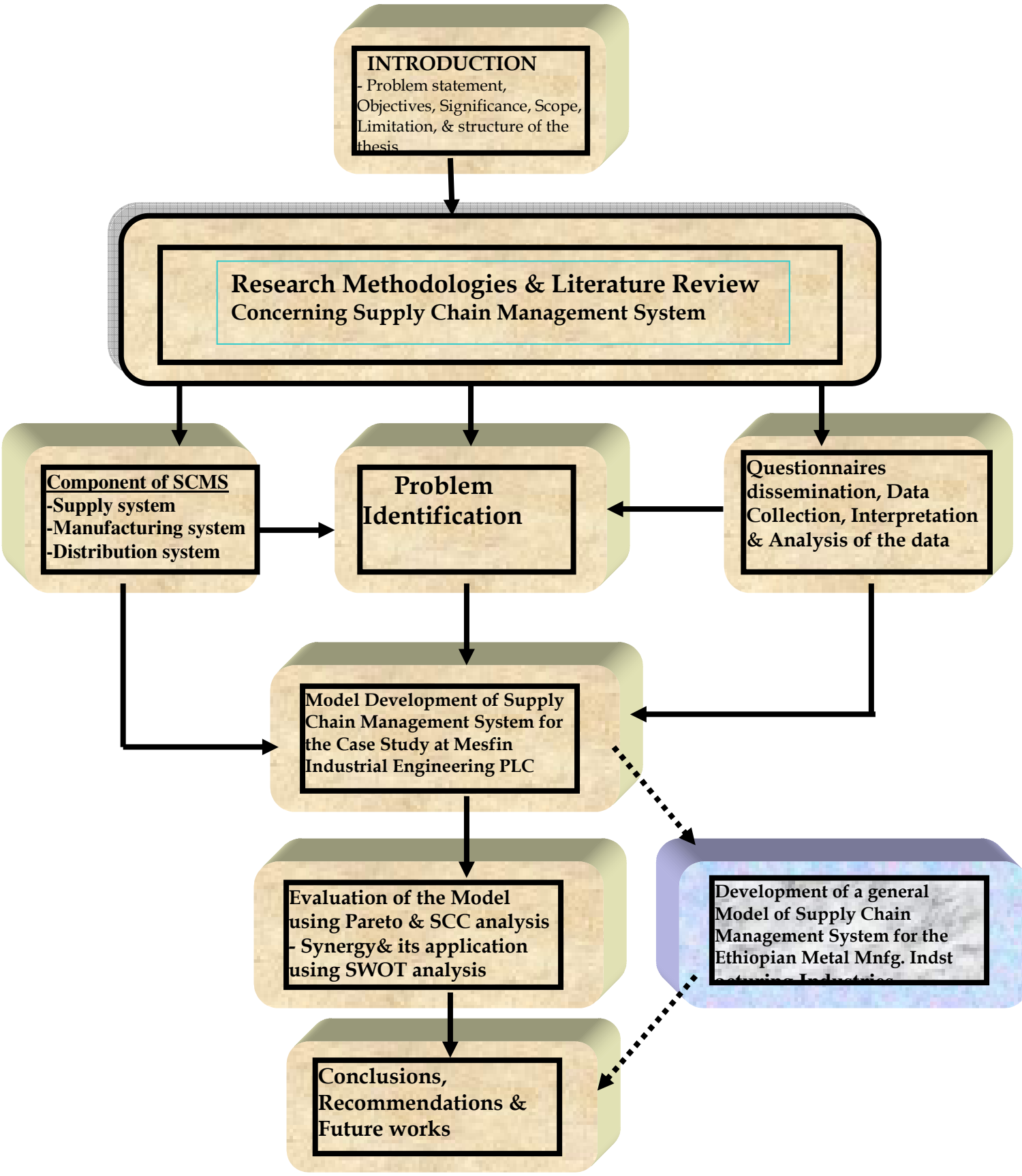

Figure 1-1: The Structure of the Thesis

CHAPTER TWO

2. Research Methodologies

Data are collected to analyze the existing supply chain and then to develop an improved SCMS Model for the Mesfin Industrial Engineering PLC. The collected data are summarized and analyzed to reach into a meaningful conclusion and recommendation.

2.1 Research Strategies (Methods of data collection)

For producing empirical research, there are two methods of data collection: Qualitative and Quantitative. These two methods have their own strength and weakness. The qualitative method permits researchers to study selected issues in detail. Approaching fieldwork without being constrained by predetermined categories of analysis contributes to the depth, openness, and detail of *qualitative* inquiry. This method, however, typically produces a wealth of detailed information about a much smaller number of people and cases, which in turn increases understanding of the cases and situations studied but reduce generalization.

The *quantitative* method, on the other hand, requires the use of standardized instruments so that the varying perspective and experiences of the people can fit a limited number of predetermined response categories, to which numbers are assigned. The advantage of quantitative method is to measure the reaction of many people to a limited set of questions. Thus, it facilitates comparison and statistical aggregation of the data, which in turn gives a broad and generalized set of findings presented succinctly and parsimoniously.

In order to avoid their respective disadvantage, one important way to strengthen a research design is to use both qualitative and quantitative methods. Hence, the kinds of research strategies adopted in this study are *qualitative* and *quantitative* ones. While structured interview is designed for the *qualitative* one, questioner survey is distributed for the *quantitative*. Moreover,

Literature review and practical observations are used to strengthen the research strategy technique.

2.2 Sources of Data Collection

The data used for the study is based on both primary and secondary sources. The primary data are collected through questionnaire and face-to-face interview. Specifically speaking, questionnaires are designed and distributed to selected staff members of Mesfin Industrial Engineering PLC on the basis of their educational background. Besides, structured interview is held to top management officials of the company. The researcher has also consulted university lecturers who are expected to have enough knowledge on SCMS. The secondary sources of data that the researcher used are from different relevant books, Journals, Articles, senior thesis work, manuals, available documents, organizational chart, brochures, magazines, company manuals, and electronic retrievals.

2.3 Sample Design

Reasonable sampling technique is employed in this research paper. Firstly, of the currently serving 460 permanent employees of Mesfin Industrial Engineering PLC, 258 with an educational level of college diploma and above are purposely selected. This is because of the assumption that employees with college diploma and above will understand about supply chain management easily. Of the 258, 105 employees (41%) were randomly selected and were provided with the questionnaires. As a result the employees responses filled in the questionnaires were collected, tabulated, analyzed and interpreted in the form of frequency and percentage to arrive at reasonable conclusion.

Secondly, to get a more qualitative data, structured interviews were conducted to top management officials of the plant and responses were collected as up.

It is, therefore, believed that the sample size leads to a reliable and better conclusion due to the selected personnel educational level, to which introducing supply chain management concept is easy, and the reasonable nature of questionnaire distribution system according to the number of the staff with an educational level of college diploma and above.

Both, the circulated questionnaires and structure interview are depicted in appendix 8 and 9 respectively.

2.4 Questionnaire Survey

The methodologies: interviewing & disseminating questionnaire have advantages such as:-

- The data taken from the questionnaire is used as input for modeling supply chain management.
- Disseminating questionnaire is a way of creating awareness of supply chain management by MIE,s staff. The result of the circulated questionnaire gives some insight into the working environment of the Mesfin Industrial Engineering PLC.

Each questionnaire consists of 40 questions. These were distributed to 105 Mesfin Industrial Engineering PLC staffs', which are representative employees of each department shown in table 2-1 below. Out of the 105 questionnaires, 89 were filled and returned. This means 84.76% respondent rate.

Table 2-1: Summary of data distributed & returned

Data Collection			
Name of Departments	Number of Questionnaires Circulated	Number of Questionnaires returned	Respondent rate
Planning & IT	9	9	9/9= 100%
Quality Management Representative	8	7	7/8= 87.5%
Supply	11	10	10/11=90.9 %
Human Resource	5	4	4/5= 80%
Finance	10	8	8/10=80 %
Manufacturing	24	20	20/24=83.3 %
Industrial Maintenance Center	13	11	11/13=84.6%
Design & Technology Center	11	10	10/11=90.9%
Electro-Mechanical Work Center	5	4	4/5=80%
Vehicle Maintenance & Equipment Repair	5	3	3/5=60%
Marketing & Sales	4	3	3/4=75%
Total	105	89	89/105= 84.8%

Nature of the Circulated Questionnaires

The questionnaire has issues that can be categorized in to four as described below.

Category One: Questions 1-12 are mainly concerned with finding out the general attitude and awareness of the employees towards supply chain management system and the company's background such as, company profile,

organizational structure, motto, mission, objectives, location, customer supplier relationship, and existing cost analysis.

Category Two: Questions 13-26 are mainly concerned with assessing the *supply system*. The supply system consists of the types of direct and indirect raw materials used, types of store, and criterion of supplier selection, origin & names of suppliers, major foreign and local suppliers and factors for proper decision of inbound logistics.

Category Three: Questions 27-30 are mainly concerned with the *manufacturing system* such as major process, types of products produced, production flow chart, production capacity, annual consumption of materials, and product costing parameters.

Category Four: Questions 31-40 are mainly concerned with distribution system, such as customer survey mechanism, types of service provided to customers, types and numbers of distribution channels, percentage of product distribution, internal market share, and factors for proper decision of out-bound-logistics.

CHAPTER THREE

3.Background of Mesfin Industrial Engineering PLC

3.1 Historical Background of MIE

Mesfin Industrial Engineering PLC was established in 1992 G.C being as the engineering wing of the endowment fund for the rehabilitation of Tigrai (EFFORT) in the capital of the Tigrai province, Mekelle (Please see Appendix – 4, for the detail of the companies under EFFORT). It was initially founded with a paid capital of Br. 3 million and an authorized share capital of Br. 10 million. There are about 500,000 ordinary shares with a value of Br. 20 each. Currently the authorized share capital is fully paid in cash and contribution in kind. The major shareholder is the parent company (EFFORT) and holds 484,999 shares out of the total shares.

The name of the company ***Mesfin*** is taken from the name of a former heroic TPLF fighter who was martyred fighting for the freedom of his people. [31]

Starting its activity by giving maintenance services of vehicles & small-scale shop floor duties, pertaining to its long time vision & implementation strategies, it is now the leading equipment manufacturing and industrial engineering company in the East Africa. It designs and installs equipments and components for the energy, mining, manufacturing, construction, transportation, and agricultural sectors. A wide range of products is manufactured at its industrial complex (35, 000m2 covered premises on a 250, 000m2 site , ***please see Appendix –5***), which is fully equipped with the state of the art machinery. Within its industrial complex, MIE has the full capacity to manufacture and erect hydraulic power components such as penstocks, steel liners, gate liners, gates, turbine elements & transmission. Its material testing laboratory provides radiographic, ultrasonic & other tests. [9]

3.2 Vision, Mission, values, Objectives and Motto MIE

Vision: To be a fully-fledged 'best in class' engineering company in the electromechanical and manufacturing sector.

Mission: Creating superior value to owners, customers and employees and be a pioneer in the industrialization of the nation.

Values:

1. Executing all works in a genuine, transparent and accountable manner.
2. Adding value, handle company property with maximum care and ensure efficient utilization of resources.
3. Giving full customer satisfaction and strive to exceed their expectations.
4. Working hard to be best in class and lead the way for quality.
5. Building sustainable, closer, long-lasting relationship with our customers and partners.
6. Giving maximum respect to employees, customers and partners.
7. Ensuring employment; promotion and reward are based on merit, competence and performance.
8. As the employees are the company's main sources of competitive advantage, the company therefore will create opportunities for continuous employee development and empowerment.
9. Developing brotherhood among the employees.
10. Always ensuring safe working conditions to all employees.
11. Providing necessary support to employees as much as possible.
12. Always observing & respecting the law. [9]

Objectives : The business purposes of Mesfin Industrial Engineering PLC are: -

A. To design, manufacture, and erect industrial components for cement, textile, brewery, food industry, storage tanks etc.
B. To design & manufacture vehicle bodies, trailers, as well as high & low bed semi-trailers. Moreover, heavy-duty trucks are assembled.
C. To provide service of renting of vehicles & machinery
D. To provide maintenance of vehicles

Where as the Motto of MIE is "MIE your business partner". [9]

3.3 Capital and Number of Employees

The current capital of MIE is Birr 170, 000, 000 (One hundred seventy million Birr). And the current total number of employees of MIE is 746. Out of the total employees 460 are permanent of which 258 are diploma and above holders. The remaining 286 workers are temporary (short term contract and daily laborers). [9]

3.4 Product mixes and Services rendered by the company [9]

I. The Product Mixes of the Company are:

- 3-axle draw bar dry cargo truck-trailer
- 3-axle dry cargo semi-trailer
- 2-axle dry cargo semi-trailer
- Low bed-60 ton
- 3-axle draw fuel cargo truck trailer
- 3-axle fuel cargo semi- trailer
- Dump Truck-Afro & Miller type (10m3, 14m3)
- Antenna must (up to 60 meter height)
- Under ground and over ground tanker

- Crusher (25-100 t/h)
- Petroleum Reservoirs tanks (5000m3-5600m3)
- Overhead crane (10t, 5t, 2t)
- Bus body (40+1, 60+1 seat)

II. Electromechanical erection services

- Supply and erection of pre engineering buildings & towers
- Installation of machines and equipment
- Erection of petroleum reservoir tanks capacity of 5,600m3 with electrical & instrumentation
- Erection and installation of HVAC system
- Installation of digital congress network, audiovisual system, stage lighting & machinery installation.

III. Renting of vehicles & machinery services

- Afro-damp truck-10m3 capacities
- Crane 50-ton capacity

IV. Maintenance of vehicle services

- Light vehicle maintenance-Toyota, Nissan
- Heavy vehicle maintenance-Afro Truck

3.5 Organizational Structure

Mesfin Industrial Engineering PLC General Manager is appointed by the chairman of the board of Directors. Hierarchically, the General Manager is accountable to the Chairman of the board. [9]

Currently, the activities of the company reporting to the General Manager are grouped in the following functions:

1. Deputy General Manger (DGM) Service
2. Deputy General Manger (DGM) Operations & Engineering
3. Deputy General Manger (DGM) Marketing

4. Deputy General Manger (DGM) Projects
5. Planning & Information Technology Department Manager
6. Quality Management Representative Department Manager
7. Internal audit service
8. Legal service

As per the currently fictionalized structure, the departments reporting to the Deputy General Manger (DGM) Service are:

I. Supply & Procurement
II. Human Resource
III. Finance

And the departments reporting to the Deputy General Manger (DGM) Operations & Engineering are:

A. Manufacturing
B. Industrial Maintenance
C. Design & Technology
D. Electro-Mechanical Work
E. Vehicle Maintenance & Equipment Repair

And the departments reporting to the Deputy General Manger (DGM) Marketing are grouped in the following functions:

I. Marketing & Sales
II. Public Relation Service

The Deputy General Managers mainly deal with conceptual activities to support the General Manager.

3.6 Manufacturing Flow of MIE's Products

There are three major manufacturing processes in the production of metal structure. These are Metal preparation, Fabrication, and finishing & Painting processes.

I. Metal preparation manufacturing flow.
II. Fabrication manufacturing flow.
III. Finishing & Painting manufacturing flow

The manufacturing process flow charts of the industry's 3-axle draw bar dry cargo truck trailer is shown below in Fig.3-1

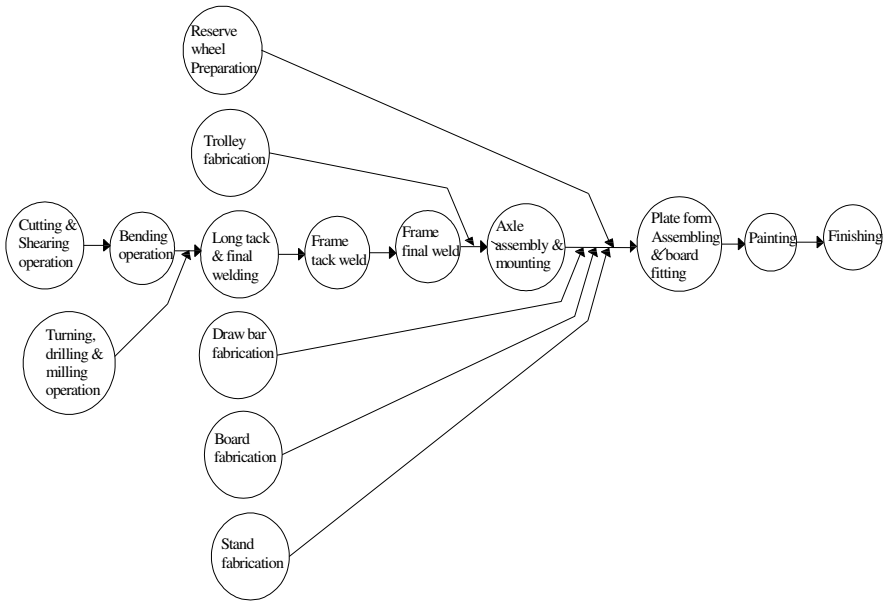

Figure 3-1: Production Flow Chart of 3 Axle Draw Bar Dry Cargo Truck Trailer

3.7 Quality certificate of MIE

The Leading Engineering Company in Ethiopia , MIE has got **ISO 9001:2000 Quality Management System certificate No, FM 512406 from BSI** for the following scope:

- Design, manufacture, supply and service of Low Bed/ High Bed Dry/ Liquid Trailers.
- Design, manufacture, supply and erection of Petroleum Liquid Reservoirs (including Electrical / Instrumentation System
- Supply & Erection of HVAC systems
- Manufacture and Supply of Steel Fabricated products for Industrial Application; and
- Vehicle Equipment Maintenance and Renting. [9]

Certificate of Registration

QUALITY MANAGEMENT SYSTEM - ISO 9001:2000

This is to certify that:

Mesfin Industrial Engineering Plc
PO Box 508
Mekelle
Ethiopia

Holds Certificate No: **FM 512406**

and operates a Quality Management System which complies with the requirements of ISO 9001:2000 for the following scope:

1. Design, Manufacture, Supply and Service of Low Bed / High Bed Dry/Liquid Trailers;
2. Design, Manufacture, Supply and Erection of Petroleum Liquid Reservoirs (including Electrical / Instrumentation System);
3. Supply & Erection of HVAC Systems
4. Manufacture and Supply of Steel Fabricated products for Industrial Applications; and
5. Vehicle Equipment Maintenance and Renting

For and on behalf of BSI:

Managing Director, BSI Management Systems (CEMEA)

Originally registered: 31/01/2007 Latest Issue: 31/01/2007

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BSI Management Systems

CHAPTER FOUR

4 Literature Review

The term Supply Chain Management (SCM) confuses some people. Does it refer to a managerial process? Is it concerned with material management or purchasing? Is it just another name for integrated logistics? Just what is supply chain management? The definition may vary, but According to Stephen Lemay, David J.Bloomberg, and Joe B. Hanna, SCM is: "The process of planning, organizing, and controlling the flow of materials and services from suppliers to end users/customers. This integrated approach incorporates suppliers, supply management, integrated logistics, and manufacturing system. [5]

When you manage a supply chain, you coordinate supply management, operations, and integrated logistics into a seamless pipeline to maintain a continual flow of products or services to include all firms involved, from the raw materials source to the final customers. [5]

4.1 Fundamentals of Supply Chain Management System

4.1.1 Principles of Supply Chain Management

To balance customers' demands with the need for profitable growth, many companies have moved aggressively to improve supply chain management. Their efforts reflect seven principles of supply chain management that working together can enhance revenue, cost control, and asset utilization as well as customer satisfaction. Successful implementation of these principles enhances creation of delighted customers and improved profit margins for the organization. The seven principles of supply chain managements are: [1, 7]

A. Customer segmentation

B. Customizing logistics networks
C. Demand planning
D. Product differentiation
E. Sourcing suppliers strategically
F. Integration of technology
G. Performance measures

Good managers recognize two important things. First, they think about the supply chain as a whole all the links involved in managing the flow of products, services, and information from their suppliers to their customers. Second, they pursue tangible outcomes-focused on revenue growth, asset utilization, and cost reduction.

Rejecting the traditional view of a company and its component parts as distinct functional entities, these managers realize that the real measure of success is how well activities coordinate across the supply chain to create value for customers, while increasing the profitability of every link in the chain.

Adherence to the seven principles transforms the tug of war between customer service and profitable growth into a balancing act. By determining what customers want and how to coordinate efforts across the supply chain to meet those requirements faster, cheaper, and better, companies enhance both customer satisfaction and their own financial performance. But the balance is not easy to strike or to sustain.

A. Customers Segmentation

Segmentation has traditionally grouped customers by industry, product, or trade channel and then taken a one-size-fits-all approach to serving them. Segmenting customers by their particular needs equips a company to develop a portfolio of services tailored to various segments. Surveys, interviews, and industry research have been the traditional tools for defining key segmentation criteria.

B. Customize the Logistics Network

Companies have traditionally taken a monolithic approach to logistics network design in organizing their inventory, warehouse, and transportation activities to meet a single standard. For some, the logistics network has been designed to meet the average service requirements of all customers; for others, to satisfy the toughest requirements of a single customer segment.

C. Demand Planning According to Market Signal

Forecasting has historically proceeded silo by silo, with multiple departments independently creating forecasts for the same products-all using their own assumptions, measures, and level of detail. Many consult the marketplace only informally, and few involve their major suppliers in the process. Such independent, self-centered forecasting is incompatible with excellent supply chain management.

Uneven distributor demand unsynchronized with actual end-user demand made real inventory needs impossible to predict and force high inventory levels that still failed to prevent out-of-stocks.

Distributors should share information on actual (and fairly stable) end-user demand with the manufacturer, and the manufacturer will begin managing inventory for the distributors. This coordination of manufacturing scheduling and inventory deployment decisions paid off handsomely, improving fill rates, asset turns, and cost metrics for all concerned.

D. Differentiate Product Closer to the Customer

Manufacturers have traditionally based production goals on projections of the demand for finished goods and have stockpiled inventory to offset forecasting errors. These manufacturers tend to view lead times in the system as fixed, with only a finite window of time in which to convert materials into products that meet customer requirements.

E. Sourcing of Supplier Strategically

Determined to pay as low a price as possible for materials, manufacturers have not traditionally cultivated warm relationships with suppliers. Excellent supply chain management requires a more enlightened mindset. While manufacturers should place high demands on suppliers, they should also realize that partners must share the goal of reducing costs across the supply chain in order to lower prices in the marketplace and enhance margins. The logical extension of this thinking is gain-sharing arrangements to reward everyone who contributes to the greater profitability.

F. Develop a Supply Chain -wide Technology Strategy

To sustain reengineered business processes, many progressive companies have been replacing inflexible, poorly integrated systems with enterprise-wide systems.

Organizations need to build an information technology system that integrates capabilities of three essential kinds. For the short term, the system must be able to handle day-to-day transactions and electronic commerce across the supply chain and thus help align supply and demand by sharing information on orders and daily scheduling. From a mid-term perspective, the system must facilitate planning and decision-making, supporting the demand and shipment planning and master production scheduling needed to allocate resources efficiently. To add long-term value, the system must enable strategic analysis by providing tools, such as an integrated network model, that synthesize data for use in high-level "what-if" scenario planning to help managers evaluate plants, distribution centers, suppliers, and third-party service alternatives.

G. Performance Measures

To answer the question, "How are we doing?" most companies look inward and apply any number of functionally oriented measures. But excellent supply chain

managers take a broader view, adopting measures that apply to every link in the supply chain and include both service and financial metrics. First, they measure service in terms of the perfect order - the order that arrives when promised, complete, priced and billed correctly, and undamaged. Second, excellent supply chain managers determine their true profitability of service by identifying the actual costs and revenues of the activities required to serve an account, especially a key account. For many, this amounts to a revelation, since traditional cost measures rely on corporate accounting systems that allocate overhead evenly across accounts. Such measures do not differentiate, for example, an account that requires a multi-functional account team, small daily shipments, or special packaging. Traditional accounting tends to mask the real costs of the supply chain-focusing on cost type rather than the cost of activities and ignoring the degree of control anyone has (or lacks) over the cost drivers. [1,7]

4.1.2 Material Flow System

Materials, in the process of passing through materials flow system are either in transit through various transportation modes, or are waiting in areas, which may be called stores. Even processing at production work centers is akin to storage for a period of processing. Therefore the materials within a material flow system is in either transit or storage mode. [4]

4.1.3 Supply System

Supply system (SS) is used for collection of materials from the vendors and for bundling them into finished products. Each material or stock number required by the subject firm has a unique set of nodes and flow paths associated with it. However, if the material is sourced from several different vendors or utilizes different nodes and flow paths, several different unique sets of nodes and flow paths will emerge. For instance, if a material is sourced from vendor A and transported by air-fright to incoming stores, and the same materials sourced from vendor B and

transported by trucks to incoming stores, then it can be consider and treated as two different sets of unique nodes and flow paths.

A unique set of material; nodes and flow paths are defined as a supply chain. For the same material, alternative supply chains may exist, leading to opportunities for cost reduction through selection of optimal supply chains for each material. [2, 3]

A. Supplier Selection and Certification

Purchasing is the eyes and ears of the organization in the supplier market place, continuously seeking better buys and new materials from suppliers. Consequently, purchasing is in a good position to select suppliers for the supply chain and to conduct certification programs.

Supplier selection. To make supplier selection decisions and to review the performance of current suppliers, management must review the market segments it wants to serve and relate their needs to the supply chain. Competitive priorities are a starting point in developing a list of performance criteria to be used. Three criteria most often considered by firms selecting new suppliers are price, quality, and delivery. Because firms spend a large percentage of their total income on purchased items, finding suppliers that charge low prices is a key objective. However, the quality of a supplier's materials is also important. The hidden costs of poor quality can be high, particularly if defects are not detected until after considerable value has been added by subsequent operations. For a retailer, poor merchandise quality can mean loss of customer goodwill and future sales. In addition to this, shorter lead times and on-time delivery help the buying firm maintain acceptable customer service with less inventory. The benefits to fast, on time delivers also apply to the manufacturing sector. Many manufacturers demand quick, dependable deliveries from their suppliers to minimize inventory levels. This constraint forces suppliers to have nearby plants of warehouses.

A fourth criterion is becoming very important in the selection of suppliers-environmental impact. Many firms are engaging in *green purchasing*, which involves identifying, assessing, and managing the flow of environmental waste and finding ways to reduce it and minimize its impact on the environment. Suppliers are being asked to be environmentally conscious when designing and manufacturing their products, and claims such as biodegradable, natural, and recycled must be substantiated when bidding on a contract.

Supplier certification. Supplier Certification program verify that potential suppliers have the capability to provide the materials of services the buying firm requires. Certification typically involves site visits by a cross-functional team from the buying firm which does an in-depth evaluation of the supplier's capability to meet cost, quality, delivery, and flexibility targets from process and information system perspectives. The team may consist of members from operations, purchasing, engineering, information systems, and accounting.

B. Suppliers Relations

The nature of relations maintained with suppliers can affect the quality, timeliness, and price of a firm's products and services. [2]

Competitive orientation. The competitive orientation to supplier relations views negotiations between buyer and seller as a zero-sum game: Whatever one side loses, the other side gains. Short-term advantages are prized over long-term commitments.

Cooperative orientation. With the cooperative orientation to supplier relations, the buyer and seller are partners, each helping the other as much as possible. A Cooperative orientation means long-term commitment, joint work on quality, and support by the buyer of the supplier's managerial, technological, and capacity development.

Both the competitive and cooperative orientations have their advantages and dis advantages. The key is to use the approach that serves the firms' competitive

priorities best. Some companies utilize a mixed strategy. A company can pursue a competitive orientation by seeking price reductions from its suppliers of common supplies and infrequently purchased items on an electronic marketplace, and use a cooperative orientation with suppliers of higher volume, more continually used materials and services and negotiating long term contracts with them.

C. Outsourcing

A special case of the cooperative orientation is outsourcing. The decision to outsource an activity, sometimes referred to as the make-or buy decision, has implications for supply chain management because it affects the number of activities under the direct control of the firm in its internal supply chain. This decision is not trivial because a firm must first have a clear understanding of its core competencies and retain them. Outsourcing has direct relevance for supply chain management because of its implications for control and flexibility. [2]

Degree of sourcing control: Sourcing control amounts to choosing the appropriate contract relationship with the supplier. This relationships range from full ownership and strategic alliances and long term contracts, which provide high degrees of control, to short-term contracts, which provide low degrees of control.

Flexibility to change the supply chain: A firm has a more flexible arrangement with a supplier if it has a short-term agreement with it. The firm can choose to renegotiate the terms of the contract or change suppliers frequently. Supply chain managers must balance the advantages of high degrees of control with those of flexibility to change. Long-term arrangements should be used only when the firm is confident that the supplier will fit into its long-term strategic plans.

D. Centralized versus localized buying

When an organization has several facilities (e.g., stores, hospitals, or plants), management must decide whether to buy locally or centrally. This decision has implications for the control of supply chain flows. [2]

Centralized buying has the advantages of increasing purchasing clout. Saving can be significant, often on the order of 10 percent or more. Increased buying power can mean getting better service, ensuring long term supply availability, or developing new suppliers capability. Companies with oversea suppliers favor centralization because of the specialized skills (e.g., understanding of foreign languages and culture) needed to be from foreign sources. Buyers also need to understand international commercial and contract law regarding the transfer of goods and services. Another trend that favors centralization is the growth of computer based information systems and the Internet. However the biggest disadvantage of centralized buying is the loss of control at the local level. When plants or divisions are evaluated as profit or cost centers, centralized buying is undesirable for items unique to a particular facility. This item should be purchased locally whenever possible. Besides, centralized purchasing often means longer lead-time and another level in the firm's hierarchy. Perhaps the best solution is a compromise strategy, whereby both local autonomy and centralized buying are possible.

4.1.4 Manufacturing System

Manufacturing system (Operations) matches production capacity and output to customer demand. This may appear simple: a customer wants 24 metal products, so the factory produced 24 metal products. Some factors work this way, but many cannot. This simplicity vanishes when quantities increase, demand patterns vary by cycle and by season, and production capacity varies as well. Most production facilities must deal with simultaneous demand from many customers: let 100 customers each want one crate or 24 metal products at same time. Not only that, but each wants different metal products. At times demand exceeds capacity, creating a backlog. At other times, capacity is underused, creating costs without creating revenues. Once variation is introduced, the problem of matching out put demand becomes complex. [5]

Operation techniques focus on manufacturing, but often apply equally well to services. Three factors greatly influence the performance of an operating system: throughput, work in process, and queue length. [5]

4.1.5 Distribution System

Distribution system (DS) refers to the movement of finished goods outward from the central finished goods store to the customer, frequently via intermediaries. It subsumes the delivery of finished products to customers through the distribution networks. The activities within the distribution system include warehousing, transportation (often undertaken by third-party logistic providers), customer service and administration. A product may pass through a number of intermediate warehouses before reaching at customer or can also be sold directly to the customer from the central finished goods store. Therefore, a product can follow different distribution system in order to arrive at customer hand. Figure 3.1 below depicts a typical distribution system for a product passing through a number of intermediaries.

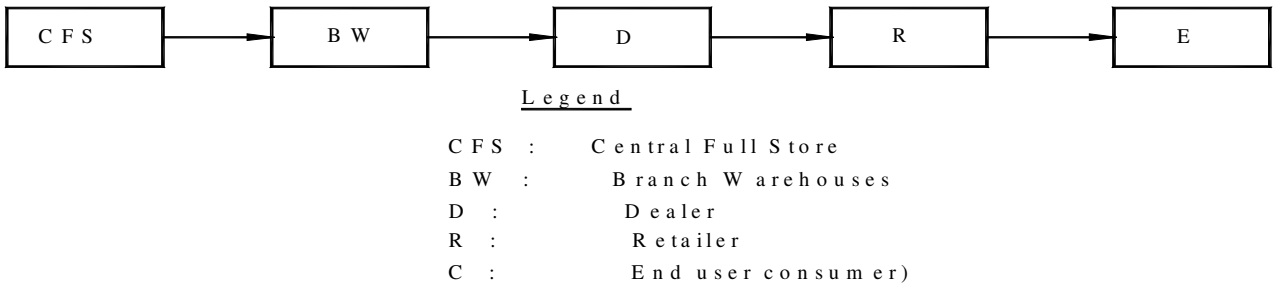


Figure 4-1: Typical Distribution System for Manufacturing Firm

4.1.6 Integrated Supply Chains

A basic purpose of supply chain management is to control inventory by managing the flows of materials. Inventory is a stock of materials used to satisfy customer demand or support the production of goods or services. Figure 3.2 shows how inventories are created through the analogy of a water tank. The flow of water into tanks raises the water level. The inward flow of water represents input materials such as steel, component parts, office supplies, or finished Products. The water level

represents the amount of inventory held at a plant, service facility, warehouse, or retail outlet. The flow of water from the tank lowers the water level in the tank. The outward flow of water represents the demand for materials in inventory such as customer orders suppliers or requirements for suppliers. Another possible outward flow is that of scrap, which also lowers the level of usable inventory.[2]

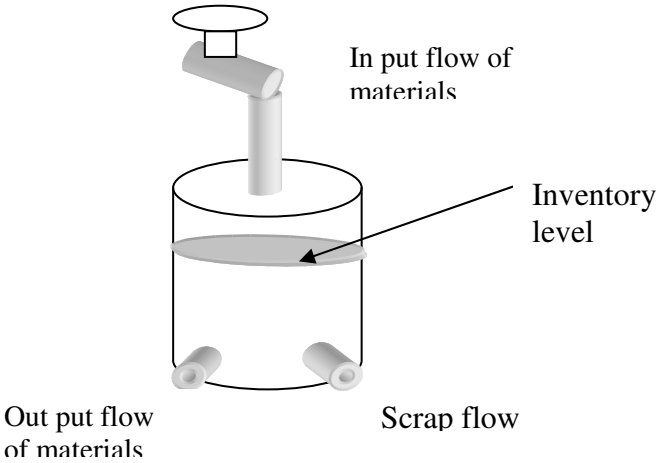


Figure 4-2: Creation of Inventory

Inventory exists in three aggregate categories, which are useful for accounting purposes. Raw materials are inventories needed for the production of goods. Work in process consists of items such as components or assemblies needed for a final product in manufacturing. Finished goods in manufacturing plants, warehouses, and retail outlets are items sold to the firm's customers.

Supply chain is the interconnected set of linkages between suppliers of materials and services that spans the transformation of raw materials into products and services and delivers them to a firm's customers. Fig. 3-3 below shows a typical supply chain for a manufacturing firm.

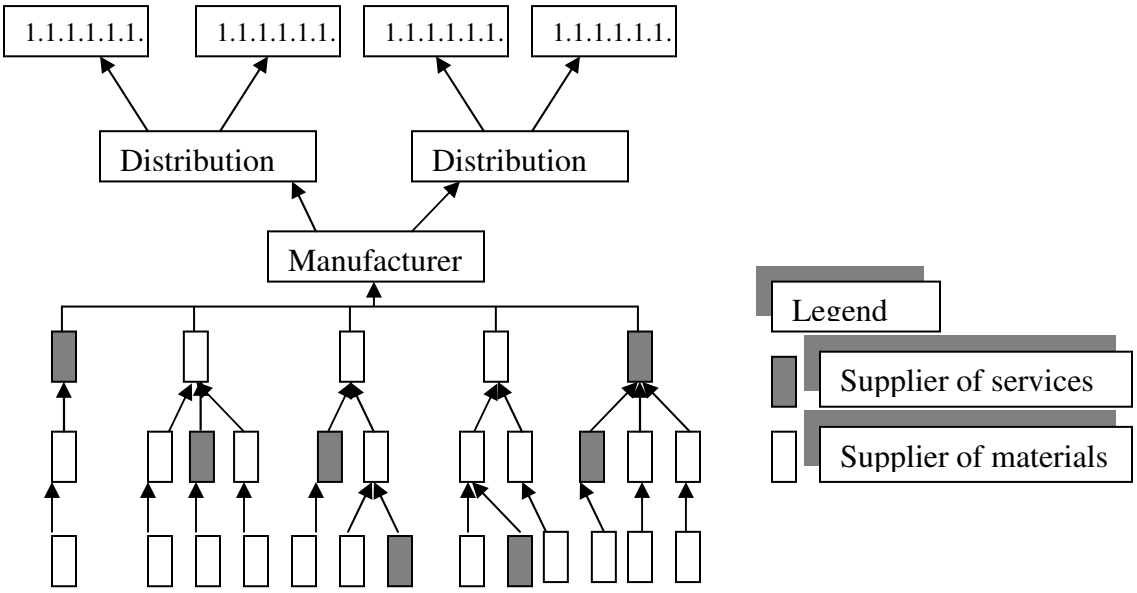


Figure 4-3: Supply chain for a manufacturing firm

4.2 State-of- the-Art of Supply Chain Management System in Manufacturing Industries

4.2.1 Background

The concept of supply chain management has its roots in the 1960s concept of logistics management – a planning tool that seeks to develop a system–wide, integrated view of the firm. Subsequently, supply chain management extends the concept of logistics management to external integration of the firm. It is conceived as "a series of linked suppliers and customers" [4].

A supply chain is a system through which organizations deliver their products and services to their customers.

It comprises an interlinked network of supplies, manufacturers, distributors and customers whereby material flows from the supplier through manufactures and distributors to the customers. Supply chain management is the systematic effort to

provide intergraded management to the supply chain in order to meet customers' need and expectations. There are various definition of SCM, the followings are some of the definitions taken from different scholars [6,10].

- "A supply chain is the alignment of firms that bring products or services to market." (Lambert, Stock, and Ellram).
- "A supply chain is a network of facilities and distribution options that performs the functions of procurement of materials, transformation of these materials into intermediate and finished products, and the distribution of these finished products to customers."(Ganeshan and Harrison)

The importance of supply chain is well recognized. Supply chain issues in developed countries are estimated to consume 10 percent of their Gross National Product. It is projected to be a greater proportion in the developing country like Ethiopia, where a large amount of capital is tied up in inventories and in transportation systems for moving materials.

Businesses in the world are struggling to sustain in a competitive global economy. At present, they are in the midst of a revolutionary transformation- shifting from industrial age to information age. During the industrial age, companies succeeded by how well they could capture the benefits from economies of scale and scope. Technology was important, but ultimately success accrued to companies that could embed the new technology into physical assets that offered efficient mass production of standard products.

The emergency of the information era, which started in the last decades of the twentieth century, made obsolete many of the fundamental assumptions of industrial age competition. The information age environment requires new capabilities in organizations for competitive success. The ability of a company to mobilize and exploit its intangible assets has become far more decisive than

investing and managing physical, tangible assets. Intangible assets enable an organization to develop customer relationships and loyalty. [4]

4.2.2 Supply Chain – a Paradigm Shift

The role of supply chain has changed considerably over the last three decades. In the 70s it primarily focused on the integration of warehousing and transportation within the firm. Later in 1980s the focus of supply chain management shifted to re-engineering of cost structures. At the end of 1980s its focus shifted from reducing costs to improving customer service. The benefits of improving the performance of the supply chain included revenue growth and higher profitability through greater market share and price premiums. [4]

Traditionally, the focus of companies has been on the flows within the organization or flow over which the organization has direct control. But successful supply chain management requires the recognition that the firm is simply one player in the long chain that starts with suppliers and includes transporters, distributors, and customers. Close relationships between suppliers, manufactures, transporters and customers are going to be the key to success in the times to come.

Supply chain network can be a complex web of systems, sub-systems, operations, activities, and their relationships to one another belonging to its various members such as suppliers, carriers, manufacturing plants, distribution centers, retailers and customers.

Raw material can be passed through a number of intermediate tiers of suppliers before arriving at the manufacturing system. Suppliers that directly supply raw materials to the manufacturing system are supplier tier 1. A supplier tier 2 is a supplier that supplies materials to the tier 1 suppliers. A manufacturing system can have number of tiers of suppliers.

4.2.3 Success Stories in Applying Supply Chain Management

I. Success in Dell Computer Corporation

The Dell Computer Corporation (www.dell.com), a supplier of mass of customized personal computers, is experiencing phenomenal growth and profitability in an industry that traditionally has low profit margins. In 1996, Dell was selling laptops, desktops, and servers at the rate of one million dollar a day. Today, Dell's Web site sells more than thirty million products in a day. This success has catapulted Dell into the number 1 position among PC makers, ahead of Compaq, Apple Computer, and IBM. What is Dell's secret? In a single word- speed. A customer's order for a customized computer can be on a delivery truck in 36 hours. This capability allows Dell to keep parts, costs and inventories low- 16 days of sales- thereby enabling it to sell at prices 10 to 15 percent below those of competitors. [2]

A primary factor in filling customers' orders is Dell's manufacturing operations and the performance of its suppliers. Dell's focus is on how fast the inventory moves, not on how much is there. Such careful management of the materials and services from the suppliers through production to customers lets Dell operate more efficiently than any other computer company.

Supply chain management seeks to synchronize a firm's processes and those of its suppliers to match the flow of materials, services, and information with customer demand. Supply chain management has strategic implications because the supply system can be used to achieve important competitive priorities, as with Dell Computer Corporation. [2]

II. Success in DHL

DHL Exel Supply Chain is an innovative company and a reliable partner. Their customers put their trust in them because their logistics solutions offer them consistent added value. Outsourcing projects are their particular strength. Their competence and global presence make them the leading supply chain partner. [13]

DHL add values through a strong supply chain partner, performance, focus and IT.

A. Added value through a strong supply chain partner

Logistical challenges: Competition in local and international markets is becoming ever fiercer. It is forcing companies in almost all sectors to refocus on their core competences. Supply chains have to be optimized and adapted flexibly to changes in the market, fluctuations in demand and changing customer behavior. Strategic alliances with logistics partners create the necessary basis for long-term success.

Success through a high-performance partnership: More and more companies are outsourcing their logistics processes. This enables them to reduce their fixed costs, make expenditure more transparent and increase the quality of their product range and customer satisfaction. They gain time and resources to further expand their business. As one of the leading supply chain partners on the market DHL Exel Supply Chain has many years of logistical competence, a thorough knowledge of the market and global presence. Their customers have a direct link to the global DHL network via DHL Exel Supply Chain.

B. Added value through performance

DHL logistics services are a component part of integrated supply chain solutions along the entire supply chain, multi-user solutions or individual customer solutions. The experience, commitment and performance of all staff ensure that they attain their common goals. A comprehensive range of value-added services secures competitive advantages for their customers.

C. Added value through focus

DHL create synergies for their customers through a consistent sector focus. In this way they can use resources jointly and benefit from each others innovative solutions.

DHL Exel Supply Chain is today the logistics partner of the most successful companies worldwide - by focusing on the following key sectors: Automotive, Industrial, Technology, Consumer, Retail, Fashion and Life Sciences and Healthcare.

D. High-performance information systems for efficient logistics management
DHL IT networks for customized supply chain management guarantees the thorough processing of data in a range of processes and is an important factor in their success. They use SAP R/3 among other programs for interface optimization. Logistics services are only optimal when they work globally and comprehensively. Therefore, DHL Exel Supply Chain makes extensive use of the World Wide Web. They are an innovative leader in the use of RFID and their "TAG Fit" service can provide you with the fitting of RFID transponders to goods on an order-specific basis. [13]

4.2.4 The Difference among a Supply Chain, a Value Chain and JIT

"Value" is defined as "any activity that increases the market form or function of the product or service." And in today's business climate, you need to maximize the value of every process in your business.[12]

The Supply Chain focuses on the activities involved with acquiring raw materials and sub assemblies, then getting them through your manufacturing process smoothly and economically. Value Chain Management looks at every step, from raw materials (including those your suppliers' suppliers use) to your customers and the eventual end user, right down to disposing of the packaging. The goal is to deliver maximum value to the end user for the least possible total cost. And it involves you, your suppliers and your suppliers' suppliers.

So how do you turn your Supply Chain into a Value Chain? By applying Lean Manufacturing Principles. It's simple in principle, straight-forward in execution, glorious in results. By adding value and cutting waste (the foundations of Lean

Manufacturing) at any and every point in the Supply Chain, you create greater value in your end result, making it more valuable to your customers and/or end users. And Value Chain Management is much more than just optimizing each step in the supply chain.

JIT (Just In Time) – JIT production is management practice where the exact quantities of a product are produced or delivered just when needed whereas SCM is the Coordination of Production Planning, Sourcing and Logistics. Linking seemingly disparate business functions like demand planning, sourcing and logistics can often yield very positive results by reducing costs and improving performance in supply chain operations.

In short, the main emphasis in JIT system is the goal of zero inventories, where as Supply chain management emphasis on the integration of suppliers, manufacturers and customers. [12]

CHAPTER FIVE

5. Data Analysis and Interpretation

5.1 Data Collection

Having designed a first draft questionnaire, it was distributed to selected MIE's Supply, Human Resource Management, Marketing & Sales, Manufacturing, Planning & Information Technology, Industrial Maintenance Center, Design & Technology Center, Electro-Mechanical Work Center, Vehicle Maintenance & Equipment Repair, Quality Management Represent, and Finance department staff members and senior researchers for their suggestion and comment. After including the comments and suggestions provided from them, the revised questionnaires were disseminated to 105 Staffs of the industry.

The survey questionnaire contains 40 questions requiring three types of answers.

1. The first type is an ordinals scale, excellent, very good, good, fair and poor and other one is very high, high, low, very low, none.
2. The second type is a nominal scale, Yes or No.
3. The third type of questions is subjective type question that need brief answer.

5.2 Data Analysis and Interpretation

Having designed the data in to four sections: awareness of SCM, supply system, manufacturing and distribution systems, the employees were inquired to respond if they are aware of the supply chain management system, supply chain cost analysis, which department was responsible for SCMS, supply selection factors, in and out-bound logistics and its value, the extent of the plant to measure the in and out bound logistics, their distribution channel, market share and factors to be considered for the proper decision of the in and outbound logistics. Then after, the responded data are analyzed and interpreted as follows:

Section one: Awareness of SCM

Out of the 89 employees with diploma and above diploma who responded, 41% of them said poor; 15% of them fair and 4% of them put it with no response. However,

2% with excellent response, 16% & 22% respond very good & good awareness of SCM respectively.

From the above data, one can infer that the majority of employees with diploma and above diploma do not have good awareness about SCM. This result might in turn lead to the generalization that the other staffs whose educational level is below diploma might not have a better awareness of SCM in any circumstances.

Other than the above question, the respondents were requested to respond about the most responsible department/s for SCM in their plant. Consequently, 42%, articulated that the Supply and procurement, 10% Manufacturing, 30% planning and Information Technology, and 18% Marketing & Sales are the most responsible departments for SCM.

From the above data, one can infer that there is either no clear information acquired by the employees or no most responsible department (section) for the SCM at Mesfin Industrial Engineering PLC.

With regard to the usage of supply chain cost analysis methods in the company, almost 85% of the respondents said NO whereas the remaining 15% said YES.

From the above data, one can conclude that most of the employees respond that their plant do not use the supply chain cost analysis method, i.e. no awareness about supply chain cost analysis in most of the staff of MIE.

On the other hand, (21%) of the respondents confessed for their identification of the problems related to SCM though most of the respondents (47% unable to identify, and 32 % with no response) are still unable to identify the problem. Out of those who agreed to identify the problem, 84 % declared that they did not solve the identified supply chain related problems so far.

Section 2 Supply Systems

With regard to this system, 64% of the respondents confirmed that the awareness of the staff about the in-bound logistics (material flow from suppliers to manufacturers) is not good, but the rest (36 %) replied that they have better awareness.

In relation to the extent of the plant to measure the in-bound logistics, while 69% responded for the low measurement of in-bound logistics in their plants, 31 % agreed for high measurement, with ware house location (48%), warehouse size and capacity (48%) and local regulations (30%), Number of warehouse (17%) as factors considered for the proper distribution of the inbound logistics. On top of that 88% are in consent to have a common knowledge of their raw materials to be imported from abroad, with price (80%), quality (69%), vendor location (46%), long term contracting (20%) and local market implication (15%) as their criterion for suppliers' selection.

As one can see from the above data, remarkable number of staffs has poor awareness of inbound logistics & its measurement.

Section 3: Manufacturing System

In relation to the manufacturing system, the employees were requested to list the types of products manufactured in their plant. 91% of them are aware of the fact that their plant produced 3-axle draw bar dry cargo truck-trailer & 3-axle dry cargo semi-trailer, 77% 2-axle dry cargo semi-trailer, 15% Low bed-60 ton, 82% 3-axle draw bar fuel cargo truck trailer, 3-axle fuel cargo semi- trailer, 47% Dump Truck-Afro and Miller type (10m3, 14m3), 13% Antenna must (up to 60 meter height), 53% Under ground and over ground tanker, 48% Crusher (25-100 t/h), 69% Petroleum Reservoirs tanks (5000m3-5600m3), 56% Overhead crane (10t, 5t, 2t) and 28% Bus body (40+1, 60+1 seat). Finally, according to the respondents, the plant used Plant

location (43%), Plant capacity (55%), Local labor and material costs (42%), local economy (58%), and Political (67%) as their best factors to be considered for proper decision of the manufacturing system being used.

Section 4: Distribution System

The employees were requested to respond if they are aware of the out-bound logistics, and the extent the plant measures the outbound logistics, their distribution channel, and factors to be considered for the proper decision of the outbound logistics.

(68%) of the respondents admitted that their awareness about the outbound logistics is not satisfactory. Besides to this 52% of the respondents agreed that the plant measures the outbound logistics to a low extent , with direct sales in which they are highly aware of it (86%), and branch warehouse followed (75%).

Finally, according to the respondents, the plants used warehouse location (67%), warehouse size and capacity (62%), contract carriers (42%), local regulation (38%), and number of warehouse (59%) as their best factors to be considered for proper decision of the outbound logistics.

5.3 Data Analysis and Interpretation for the Model

The results of the statistical analysis are applied in the analysis of the model in chapter seven. Besides, the result of the survey findings is used in the different chapters of the thesis. For details, the summaries of survey questionnaires and structured interviews are reported in the appendix 8 and 9. Finally, the results are interpreted and used to develop the model of SCMS for the case study Mesfin Industrial Engineering PLC.

CHAPTER SIX

6. Model Development of Supply Chain Management System

Because of the inherent complexity of decision making in supply chains, there is a growing need for modeling supply chain system with different methodologies. A large number of Ethiopian Metal Manufacturing Industries like Mesfin Industrial Engineering PLC are therefore seeking modeling systems that can help, identify and implement strategies for designing and improving their supply chain networks.

Developing a supply chain management system requires the analysis of the *flow of materials* from the initial sourcing to the final end customers.

6.1 Material Flow System

Every manufacturing system has its own material flow system (MFS) in order to collect raw materials from geographically dispersed vendors and distribute finished products to customers at a widely dispersed geographical location.

Materials, in the process of passing through a materials flow system are either *in transit* through various transportation modes, or are waiting in areas which may be called *stores*. [4, 7]

Assumptions in developing the material flow model

- Materials can pass through a number of tiers of suppliers with some value addition. But, *single* tier of suppliers is assumed under this thesis. Extending the model can be possible in order to treat a multiple tier of suppliers system.
- Manufacturing firm can directly import raw materials or can have the raw materials from the source. But for this thesis work it is assumed that, raw materials are purchased either from the import suppliers or domestic vendors and stored in raw material warehouse to supply for the manufacturing system.

- Entry into the MFS takes place at any vendor's plant or point of sale. This cut-off point is usually sufficient for analysis for most purposes. On the other hand, exit from the system takes place wherever the materials are finally consumed.

- Finished products can pass through a number of stages before reaching to customer or may be directly sold to the local from the central full store.

6.2 Terminologies and Assumptions for Model Analysis

6.2.1 Terminologies

The following terms were important in the analysis of the model.

a) Nodes

These are essentially storage areas where materials:

- Wait for demand to occur;
- Wait while production or conversion activity is carried out;
- Wait for some specific node activity such as custom clearance, freight consolidation or break-bulk, inspection, loading etc...

The nodes, as stores, serve the following functions in the MFS:

- Isolate the demand side from supply side and prevents system breakdown due to differing demand/supply rates and uncertainty factors;
- Act as combiners of flows or divider of flows;
- Act as phase change point for a flow, i.e. receive multi-phase supplies and issue in single phase lots;
- Act as frequency change point, for the flow, i.e., receive at one batch frequency, issue of another.

There are five different types of nodes, which constitute a supply chain.

Source Nodes (SN): The nodes where material enters the system; these are usually vendor plant location or vendor warehouse.

I. **Exit Nodes (EN):** The nodes where material leaves the system. These are usually customer's delivery areas. However, it is possible that exit nodes may be within the subject firm.

II. **Mother Node (MN):** These are nodes where the materials undergo production /conversion activity. These can be within or without a subject firm.

III. **Master Node (MaN):** There is only one master node for each supply system and that is the node where all supply chains terminates, i.e., central full store (CFS).

IV. **Storage Node (StN):** These nodes are areas where material simply waits, without any conversion activity.

b) Flow paths

These are route/mode combinations between two nodes through which the material moves. Materials can move between two nodes A and B by rail, road, sea, air, courier etc. Conceptually, each transport mode between nodes A and B constitutes a different flow path, and has a different cost and transit time. Generally there are two types of flow paths:

I. **Normal Flow Paths**: These are flow paths along which the movement or flow of material is not impeded by barriers, which have extra cost and time implications, in addition to the usual freight and insurance costs.

II. **Barrier Flow Paths**: These are flow paths across which barriers exist, to impede flow and have additional cost and time implications.

c) Chain link

The basic building blocks of supply chains are chain links. A chain link is two nodes connected by a flow path. The supply chain will usually consist of one or more chain links. [4, 7]

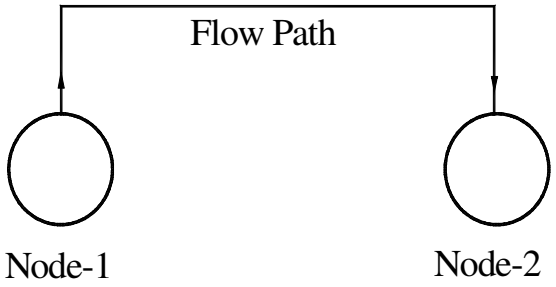


Figure 6-1: Chain Link

6.2.2 Assumptions for model analysis

The following assumptions are taken into consideration for the analysis of supply chain systems.

I. Material flows go through the MFS from source nodes to exit nodes, while cash flows take place in the reverse direction, i.e. from exit nodes to source nodes. On the other hand the flow of information is assumed to be in both directions i.e. from source node to exit node and vice versa.

II. For each item of material requirement, a unique supply chain can be identified. The items supply chain maps, the nodes and flow paths through which the material enters the MFS, moves through and exits the system. Each supply chain is a unique combination of material, nodes and flow paths.

III. There are essentially two types of costs in supply chain system, one stream of costs due to *information flows* and the other due to *material flows*. The cost due to information flow is low as compared to material flow and therefore in this thesis more emphasis is given to *material flow costs*.

6.3 Principles for Model Analysis

The achievement of supply chain objectives (profitability, high asset turnover and high level of customer service) is directly related to the efficient management of costs, inventory and time. Therefore, supply chain has three specific techniques for each of these resources. [7]

i) Supply Chain Cost Analysis (SCCA)

The primary process of material flow through the MFS involves the expenditure of costs at each and every node and flow path of the supply chain. Whether the expenditure /cost is justified or not depends upon careful design of the supply chain system. However, it is extremely important to note that cost will be incurred at each node or flow path.

At each node/flow path, costs incurred due to materials flow fall into one or more of the following categories.

a) **Input Node Cost (INC):** These costs are incurred only at source nodes of a supply chain and constitute the ex-works price paid to the vendor.
b) **Flow costs (FC):** These costs are incurred only along flow paths and include freight costs, and transit insurance costs etc.
c) **Barrier costs (BC):** These costs are incurred only at a barrier along the flow path, causing a node to appear due to the barrier. These costs includes sales tax, excise tax, custom duties etc.

d) Node Activity Costs (NAC): There are a large variety of NAC which are possible at a node. However, it is not necessary that all of them occur at all nodes. The kind of NAC at a node depends primarily upon the nature of the node. Some of the NAC which may appear in an analysis of supply chain cost are:

- Delay cost
- Custom clearance or barrier clearance cost
- Bonding/de-bonding costs at bonded warehouse
- Loading/unloading or material handling costs
- Damage/transit damage costs
- Inspection costs at inspection nodes, or quality system and surveillance costs
- Processing costs at mother nodes
- Cost due to scrap/reject or loss of yield
- Insurance costs,
- etc…

The above mentioned costs give a flavor of the range of costs which are possible and must be included in cost analysis to get a true picture of ultimate cost to the subject firm. It is absolutely essential to consider all costs along the supply chain to arrive at the correct picture of costs.

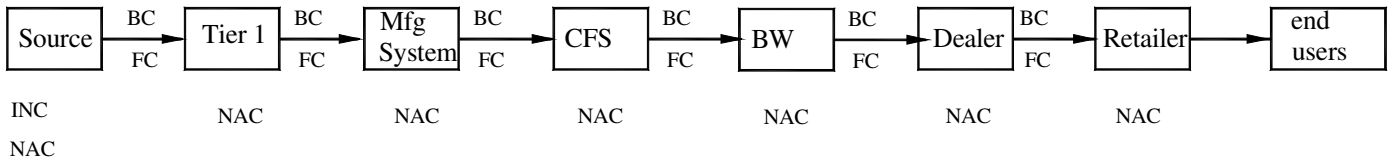


Figure 6-2: Different Costs within the Supply Chain System

Table 6: 1: *Matrix for Supply Chain Analysis*

Node No.	***INC***	***NAC***	***BC***	***FC***	***Total***
1					
2					
3					
4					
5					
.					
.					
.					
Total	$\sum INC$	$\sum NAC$	$\sum BC$	$\sum FC$	SCC

For each unique supply chain, a unique supply chain cost (SCC_j) can be defined as:

$$SCC_j = \sum_{i=1}^{m} INC_i + \sum_{i=1}^{n} FC_i + \sum_{i=1}^{p} BC_i + \sum_{i=1}^{q} NAC_i + \sum_{i=1}^{r} CTU_i \qquad (6.1)$$

Where;

m = Number of input nodes

n = Number of flow paths

p = Number of barrier flow paths

q = Number of intermediate nodes

r = Number of nodes/ flow paths where CTU is occurred

INC_i = Input node cost

FC_i = Flow cost

BC_i = Barrier cost

NAC_i = Node activity cost

CTU_i = Capital tie- up cost

Note that capital tie-up costs (CTU) are costs incurred if material spends more time in the supply chain than the credit period offered. It is defined as:

$$CTU_j = V \times R \times d_j \qquad (6.2)$$

Where:

CTU_j = Capital tie-up cost at the j^{th} node/ flow path

V = The amount of capital (usually the price to vendor plus any non-credit costs incurred)

R = Rate of capital cost

d_j = Time period at the j^{th} node after credit period has expired

The concept of supply chain cost measures the total ultimate cost of material to a subject firm arising due to the particular supply chain in question. It is obvious that the structure of the supply chain will determine supply chain cost and any modification of supply chain structure will affect the supply chain cost.

The stage by stage analysis necessitated by SCCA models the material flow or the supply process, and reveals hidden material and supply costs which may not be obvious and may be misallocated by traditional cost accounting systems. SCCA introduces a transparency or clarity, which may not be available to managers operating under information generated by standard accounting systems.

The five costs are calculated and enumerated for each node and flow path in the supply chain. During the analysis, some methodological issues are important:

a) Supply chain analysis considers a large variety of costs as forming part of a single cost. It is extremely important to normalize them to a single unit of measure. Suggested units of measure are cost/unit of material or cost/batch of materials.

b) The nature of costs involved in SCCA is such that they may vary with number of units, quality or weight or the batch size. This is due to the fact that costs have fixed and variable or semi-variable components and can vary with batch sizes or batch frequencies considered.

c) There is a problem of double counting of costs. For supply chains which share a common node such as the mother node, the costs which are incurred at the common node have to be allocated to the various supply chains passing through. For example, the processing cost at a mother node has to be allocated to individual supply chains. This allocation may be done on the basis of number of supply chains sharing a node and on the basis of value represented by each supply chain.

If SCC_j represents the cost of the j^{th} supply chain cost, then the total supply system cost $(TSSC)$ can be defined as;

$$TSSC = \sum_{j=1}^{n} SCC_j \qquad (6.3)$$

ii) Supply Chain Inventory Analysis (SCIA)

If the MFS is to meet demand in the shortest possible time, it is necessary that inventory must be carried at the nodes constituting the MFS; otherwise demands may go unmet for longer periods of time. Therefore, it is essential for the MFS, and the supply chain constituting it, to carry inventory at its nodes and flow paths. At

any given point of time, a supply chain may have inventory at its nodes and flow paths. [7]

The basic objective of SCIA is to design supply chains in consonance with a target level of customer service and system and supply chain inventories. The optimization of node/ flow path inventory levels will ensure smooth operations.

Supply chain inventory (SCI_k) for k^{th} supply chain, can be defined as;

$$SCI_k = \sum_{i=1}^{n} IN_i + \sum_{j=1}^{m} IF_j \qquad (6.4)$$

Where;

IN_i = Inventory at i^{th} node of the supply chain

IF_j = Inventory at j^{th} flow path of the supply chain

n, m = The number of nodes and the number of flow paths respectively

Similarly, the total system inventory (TSI) is defined as:

$$TSI = \sum_{k=1}^{p} SCI_k \qquad (6.5)$$

Where the supply system consist of p supply chains.

The primary problem of inventory management is to maintain optimal inventory levels at various flow paths and nodes in line with demand rates and the uncertainties associated with them.

iii) Supply Chain Time Analysis (SCTA)

The supply system has two dimensions for time associated with each node, flow path and the total system. The first dimension is related to the time taken to satisfy a demand and is designated as supply system response time (SSRT). SSRT is the difference or time elapsed between notice of a demand and arrival of material to meet demand. The second dimension is related to task performance by each node

and flow path. Each node and flow path has a characteristic task performance cycle time associated with it. This is called the node cycle time (NCT_i) for the i^{th} node and flow path cycle time (FCT_j) for the j^{th} flow path.[7]

Therefore the supply chain cycle time $(SCCT)$ is defined as the sum total of time a batch of material takes to move through the supply chain as follows:

$$SCCT = \sum_{i=1}^{n} NCT_i + \sum_{j=1}^{m} FCT_j \qquad (6.6)$$

where a supply chain has n nodes and m flow paths.

It is obvious that only under special conditions will a customer wait for the duration of the supply chain cycle time for his demand to be met. The objective of customer service demands that SSRT be as close to zero as possible. If TSI/SCI tends to zero then SSRT approaches the maximum SCCT amongst all supply chain cycle times.

Although the performance measurements for supply chain are cost, inventory and time, under this thesis, more emphasis is given to **cost**. Minimizing cost can be achieved through various reasons like *elimination of unnecessary nodes or flow paths*. Therefore, concentrating on cost minimization has *direct impact* on the other performance measures for supply chain i.e. inventory turn over rate and supply chain response time.

The basic objective of any supply chain system is to ensure effective utilization of the three resources- cost, time and inventory. Therefore, in order to achieve these objectives, properly developed model for the analysis of each parameter is essential.

The model developed under this thesis tries to achieve the above-mentioned objectives giving more emphasis to ***supply chain cost***.

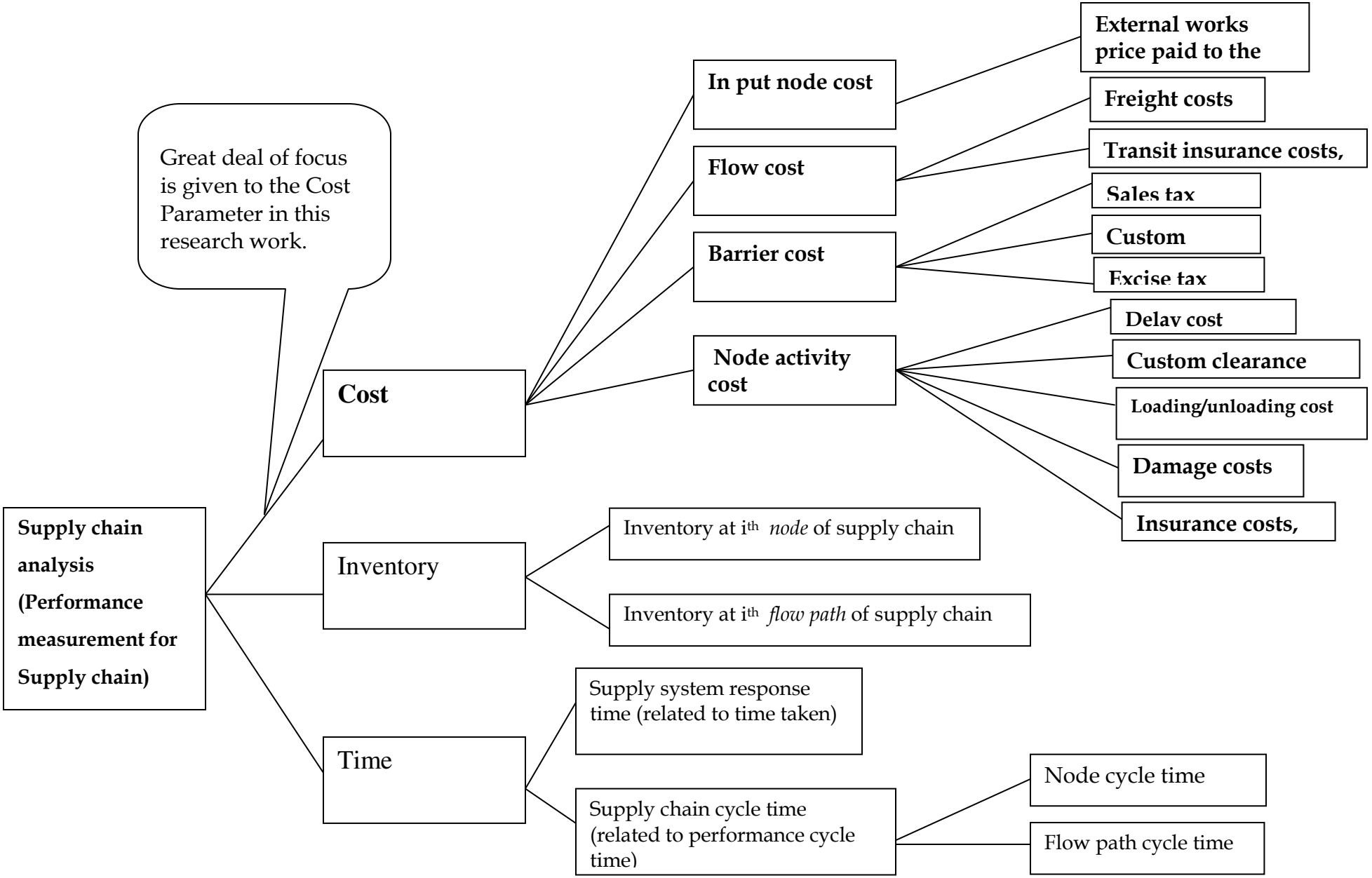


Figure 6.3: Parameters of Performance Measurement for Supply Chain

The model tries to generate different alternatives and suggest a means to select the optimal solution for the supply chain problem and can be applied either for the development of the new supply chain system or for an improvement of the existing system. As an application for the existing system, the model is used to *evaluate the performance of the existing system* and *tries to identify the areas of improvement.* On the other hand, the model can also be applicable for the development of new supply chain system from scratch by generating different alternatives.

The following procedures are important in order to apply the model either for the existing system or for developing a new system.

1. Develop material flow system for the supply chain with network representation.
2. Identify the different nodes and develop nodal representation for the material flow
3. Generate as many alternatives as possible.
4. Calculate the cost, inventory and time for each alternative.
5. Select the alternative with optimal cost, time and inventory.

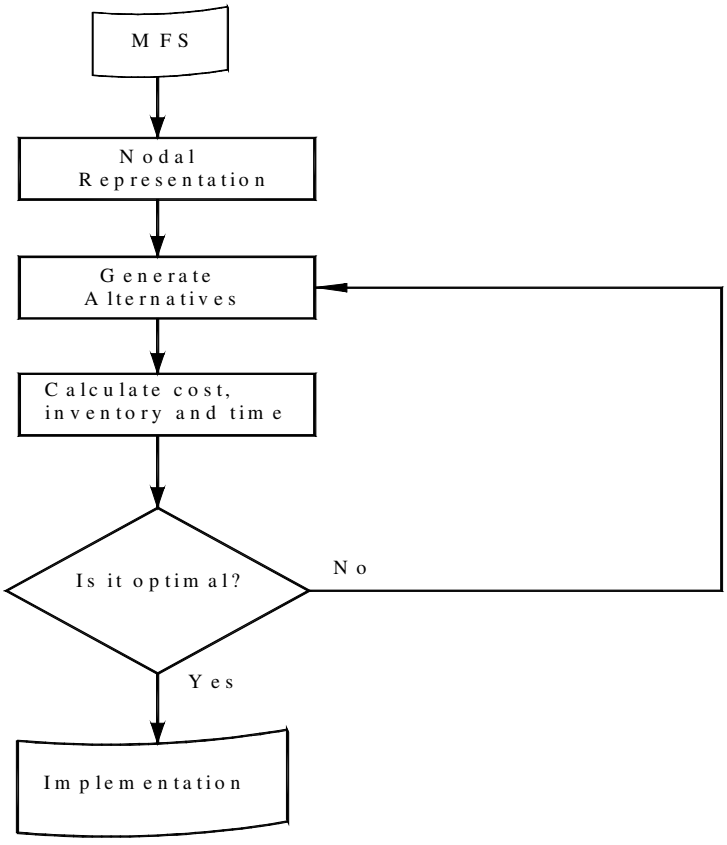


Figure 6-4: Flow Diagram for Application of the SCM Model

6.4 Proposed Model Development of SCMS for Mesfin Industrial Engineering PLC

The existing and proposed models which are shown in figures 6-4 & 5 below respectively have three systems; namely:

1. Supply system
2. Manufacturing system
3. Distribution system

1. The supply system includes sourcing suppliers (local and foreign suppliers), components and accessories stores, raw materials stores, Consumables and gas store, Spare parts store and Oxy-Acetylene preparation section.
2. The manufacturing system consists of three major processes. These are material preparation processes, fabrication process, and Finishing & Painting process.
3. The distribution system comprises different distribution channels. These are central full stores, branch warehouses, dealers and end users (consumers)

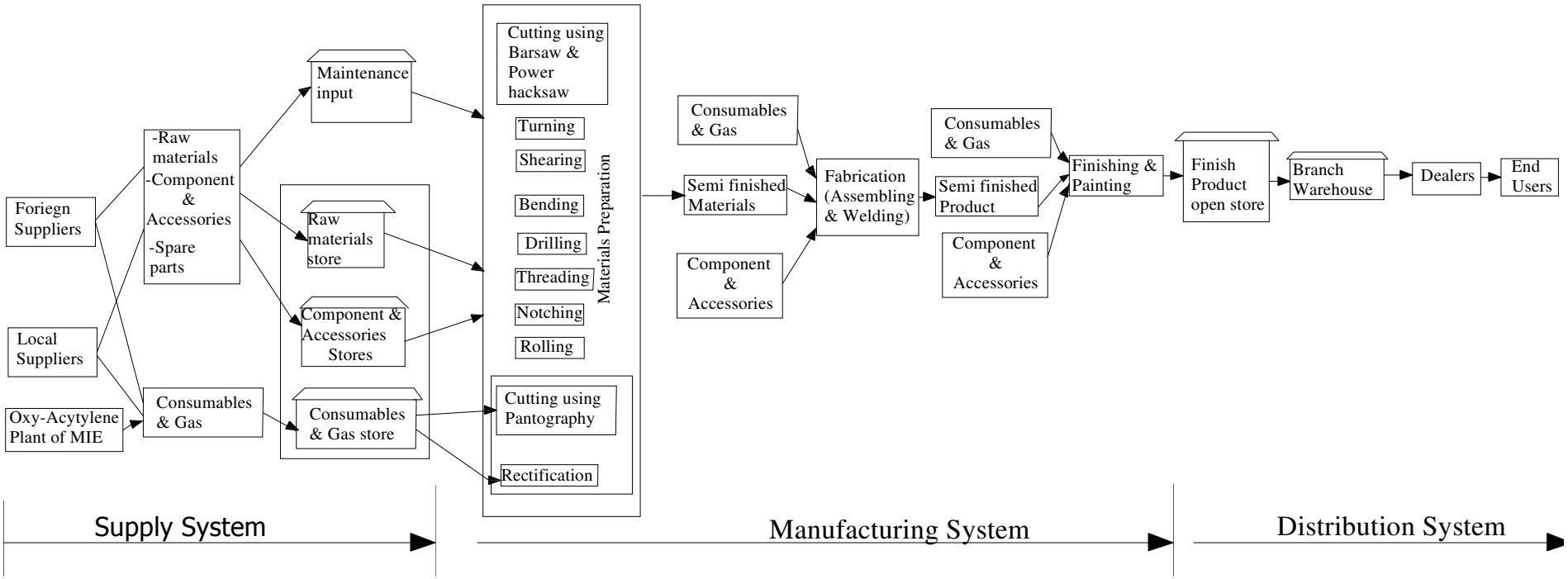


Figure 6-5: Existing Material flow of Mesfin Industrial Engineering PLC

Figure 6.5 shows the existing Model of SCMS for Mesfin Industrial Engineering PLC according to the flow system, imported raw materials (listed in appendix 8) , and locally produced raw materials (listed in appendix 8) are put into an open-air and closed stores. And then by using material handling equipment these will be transported into the manufacturing system and finally the finished goods will be distributed to the end users using distribution system such as branch warehouse and dealers.

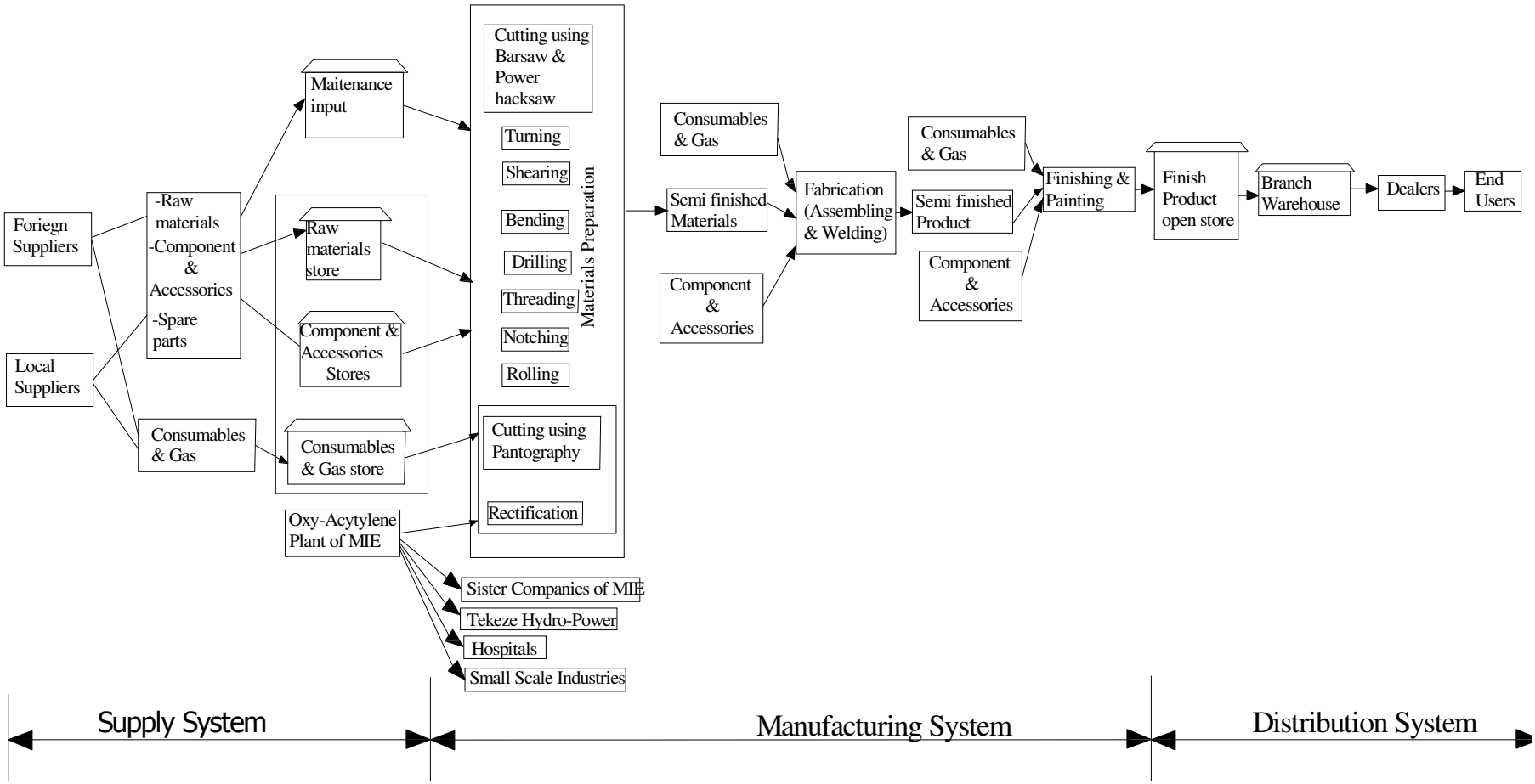


Figure 6-6: Proposed Model of SCMS for MIE PLC

CHAPTER SEVEN

7. Analysis of the Model

7.1 Existing Material Flow Model

Materials used to manufacture steel products are generally categorized as direct raw materials (such as Raw materials, Components and accessories) and indirect raw materials (consumables & gas, Spare parts and maintenance inputs). The direct raw materials are either metal products that are converted to final product through various conversion processes or components assembled to make the final product complete, while the indirect ones are materials that are consumed during the production process (may not be seen as final products). In this thesis, the researcher used the terms direct and indirect materials for the analysis of supply chain cost. Moreover, the word input materials will be used representing all the direct and indirect materials. The direct and in direct materials details are tabulated as shown in the table 7:1 below:

Table 7-1:Direct & indirect raw Materials of MIE

a. Raw materials, of different quality- St-37 up to St-52.

- Sheet metal thickness 2, 3, 4 mm & length up to 6,000 mm.
- Steel Plate thickness 5, 6,7,8,10,12,14,15,16,18 up to 120mm.and length up to 13,000 meter.
- Chequered plate, 2^{+2},3^{+2},4^{+2},6^{+2} mm
- Flat bar thickness 8, 10,12,15 mm ,width of 45,150,180,200,230,250 & 6,000mm length
- I-beam 140*140,160*160,200*190 mm & length of 6,000mm
- Pipe $ø_{Ex}$=50mm ,42mm ,32 mm, 1",3" ,4"
- Round rod $ø_{Ex}$=76 *18 ,55 mm
- U-channel 50*25*5,60*30*6,80*45*6mm
- RHS,80*30*2.5 ,40*40*2.5mm
- Angle Iron,40*40*4mm

b. Component & accessories,

- Axel with suspension-12 ton
- Manhole accessories for fuel tanker

- Rim disk type- 8″x20″
- Breaking system
- Electrical system
- Tire – 12*20
- Hydraulic Jack
- Mudguard rubber
- Bolt, Nut & washer – M8,14,24
- Rivet

C. Consumables & Gas

- Electrode ø=2.5, 3.2 mm
- Welding wire ø=1, 1.2 mm
- Oil & lubricant –
- Fuel
- Cutting & Grinding disc
- Antirust paint
- Final paints
- Stucco
- Canvas sand paper # P60, #P320, #P220,# P120
- Benzene
- Abujedid
- Oxygen
- Acetylene **(C_2H_2)**
- Carbon dioxide **(C_2O)**

d. Spare parts,

- For light vehicle
- For Afro truck & dump truck

e. Maintenance input,

- Machinery spare parts
- Electrical & electronics items
- Software

f. Project

- Steel Scrap material, machinery
- Billet
- Cement-for conceit pole

g. Labor

- Skilled welder
- Engineers

*Source: Mesfin Industrial Engineering PLC (2006/7)

7.2 Supply Chain Cost Analysis for the Model

Supply chain management is primarily concerned with the utilization of three resources efficiently to manage the flow of materials through the system, i.e. effective utilization of costs, inventory and time. If an organization operates at optimal cost with optimal inventory and optimal time, then the organization is on the way to achieve its generalized primary objectives , that are: [4, 7]

- ❖ Profitability through the profit leverage effect of cost reductions,
- ❖ High asset turnover rates, i.e. improving the velocity of material flow, and
- ❖ High levels of customer service (Ensuring customer satisfaction).

7.2.1 Existing Costing System

The existing costing method at Mesfin Industrial Engineering PLC is a traditional accounting system that has some draw back such as double counting and being unable to detect some hidden costs. Besides the traditional costing system works on the monthly or yearly basis and it is a time dependent costing method.

Although traditional cost accounting is the easiest and least complicated of the cost analysis method, this method of cost analysis typically ignores future liability costs and considers all indirect costs as overhead or omits them altogether. These overhead costs, if considered, are randomly allocated to a process or product based on some measurable, yet arbitrary parameter (e.g., labor hours, capital equipment costs).

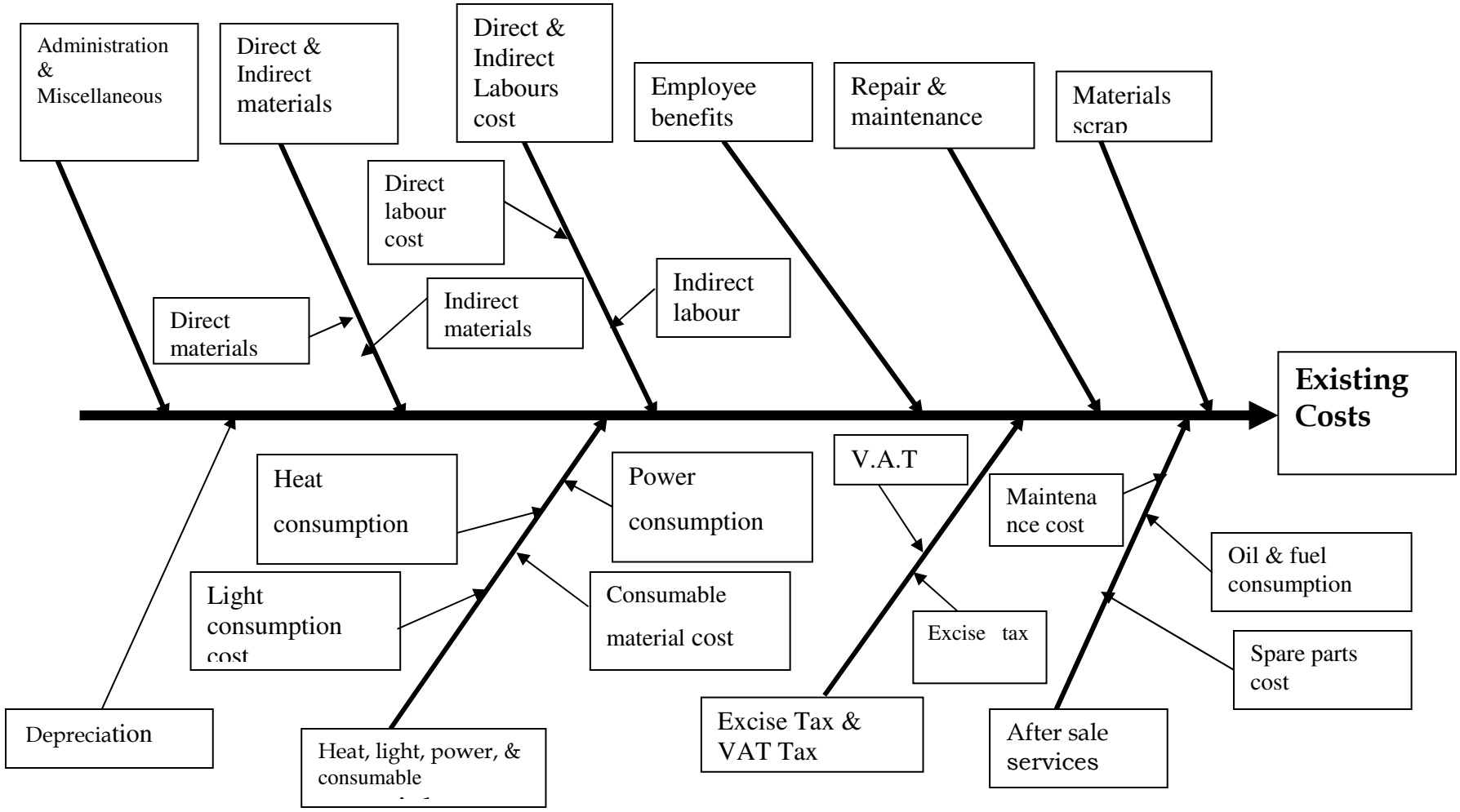


Figure 7-1: Existing Cost Drivers (Factors)

7.2.2 Proposed Method of Costing

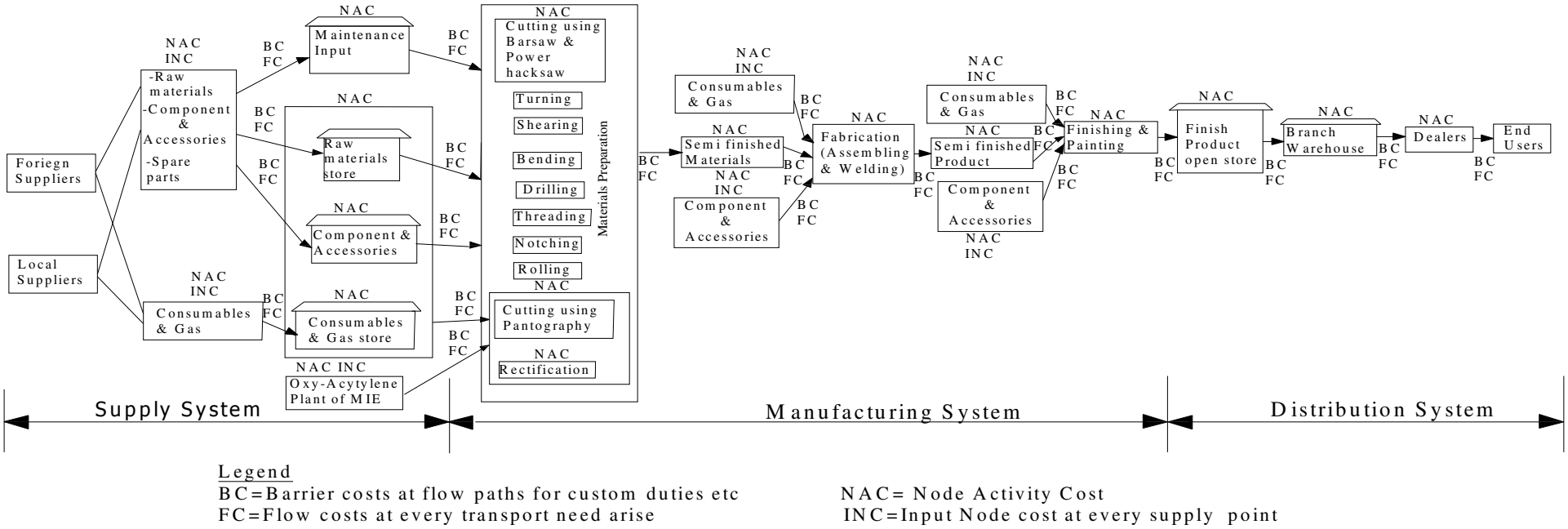
I. **Supply Chain Cost Analysis**

The stage by stage analysis necessitated by supply chain cost analysis system models the materials flow or supply chain process, and reveals hidden material and supply chain costs which may not be obvious and may be misallocated by traditional cost accounting system. Supply chain cost analysis introduces a transparency or clarity that may not be available to managers while operating using information from standard accounting system. During the analysis of cost using supply chain models, it is better to normalize to a single unit of measures. Suggested units of measure are cost/unit of materials of materials.

As it was indicated in the developed model, the cost component for supply chain system includes, input node cost (INC), node activity cost (NAC), flow cost (FC), and barrier cost (BC). Table 7.2 shows a summary of cost analysis using supply chain model.

For the computation of the supply chain analysis the researcher considers *3 axle draw bar dry cargo truck trailer* among the rest of Mesfin Industrial Engineering PLC products.

In order to use supply chain model for cost analysis, the proposed model should have to add supply chain cost component. Therefore, the proposed model along with supply chain cost component is depicted as shown in figure 7-2.



Legend

BC=Barrier costs at flow paths for custom duties etc

FC=Flow costs at every transport need arise

NAC= Node Activity Cost

INC=Input Node cost at every supply point

Figure 7-2: The proposed model along with the supply Chain Cost Component

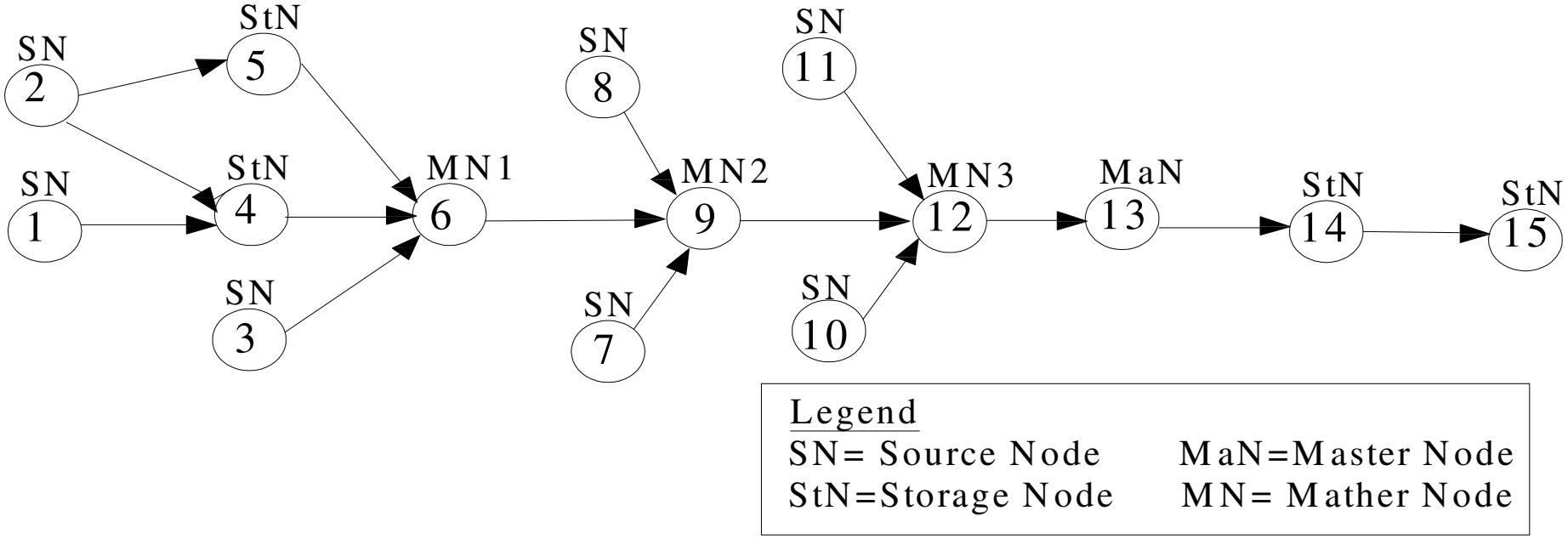


Figure 7-3: Nodal representation of the proposed model of the supply chain of MIE

Table 7-2: Matrix of Supply Chain Cost Analysis[1]

Node No.	INC	NAC	BC	FC	Total
1	4,614.23	10,756.73	5,345.72	2,022.6	22,739.28
2	16,890.58	3,831.27	30,296.72	6,388.53	57,407.10
3	749.06	965.10	0.0	689.59	2,403.75
4	4,938.53	1,483.75	98.03	0.00	6,520.31
5	5,809.00	2,176.70	84.74	0.00	8,070.44
6	9,907.40	1,089.15	0.0	0.00	10,996.55
7	932.91	619.70	118.66	4,648.27	6,319.54
8	348.73	1,370.75	141.58	1,248.75	3,109.81
9	10,129.35	56.00	0.0	0.00	10,185.35
10	2,564.57	645.00	1,292.80	845.33	5,347.70
11	2,059.44	584.00	1,532.50	239.86	4,415.80
12	6,573.28	345.00	0.0	0.00	6,918.28
13	2,762.93	53.52	8.76	0.00	2,825.21
14	7,863.84	370.60	83.40	0.00	8,317.84
15	5,314.23	2,219.37	171.14	0.00	7,704.74
Total	81,458.08	26,566.64	39,174.05	13,426.22	163,281.7

[1]Total number of products in 2005/6 year=706

Therefore, total supply chain cost for a single product can be obtained by summing up the total cost of INC, NAC, BC and FC.

$$SCC = \sum INC + \sum NAC + \sum BC + \sum FC$$

=81,458.08+ 26,566.64+ 39,174.05+13,426.22

SCC (Unit cost of a product) = 163,281.70 Birr/unit

As a result, the yearly supply chain cost for Mesfin Industrial Engineering PLC can be determined by multiplying the single supply chain cost per unit product by the number of products produced in one year.

$$SCC/year = SCC/unit \times No.of\ products/year$$

$$= 163{,}281.70 \times 706$$

$$SCC/year = Birr\ 115{,}276{,}880.20$$

[1]Source: *Note that the values in the tables are taken from the Production Cost Analysis of Mesfin Industrial Engineering PLC based on the existing traditional accounting method of 2005/6*.

The total Production cost of products determined from the traditional accounting system is *Birr **116,512,624.00*** for the year 2005/6 where as the total supply chain cost of products obtained as per the above computation is *Birr **115,276,880.20***, with difference of Birr **1,235,743.80** (1.06%). This amount (Birr1,235,743.80) which was incurred while using the existing supply chain and traditional accounting system is reduced by using the modified supply chain cost analysis due to the fact that the new model has avoided double costing effect, probably existing previous hidden costs and costs of non-value adding activities. Obviously, reducing this amount of money from the production cost increases the competitiveness of the company and enhances its profit margin.

Advantage of using supply chain cost analysis method

- Introduce total cost awareness in operational staff.
- It is a ways to eliminate double costing effect, hidden costs and non-value added activities and provides a means to focus on real value added ones.
- It does not require very sophisticated mathematics to understand and hence would be appealing to average staff members.
- In general, supply chain cost analysis is more comprehensive tool for analysis and decision making as compared to the existing fragmented tools.

II. Pareto Cost Analysis

In order to minimize the cost incurred by the input materials, it is important to ensure that materials' warehouse is located properly. But focusing on *major input materials* will have major effect to *minimize associated costs*. In order to identify the major input materials which have major impact on the *associated* cost, Pareto's law is essential.

Pareto's law, which can be succinctly stated: "the vital few the trivial many". The law was identified by Vilfredo Pareto, an Italian economist and sociologist who studied the distribution of wealth in Italy and found that most of it was held by a small percentage of the population. Pareto's law applies not only to the distribution of wealth but to many other distributions as well. The law is often identified as the 80-20 rule, although exact percentage may differ from 80 and 20. [2]

What is suggested by Pareto's law is that the most attention and effort in any study or project should be focused on the smaller portion of the population that is seen to be the most important.

Table 7-3:Supply Chain Cost Components of the year 2005/6

Supply chain cost	Cost/2005/6year in Birr
In put node cost (INC)	81,458.08
Node activity cost (NAC)	26,566.64
Barrier cost (BC)	39,174.05
Flow cost (FC)	13,426.22

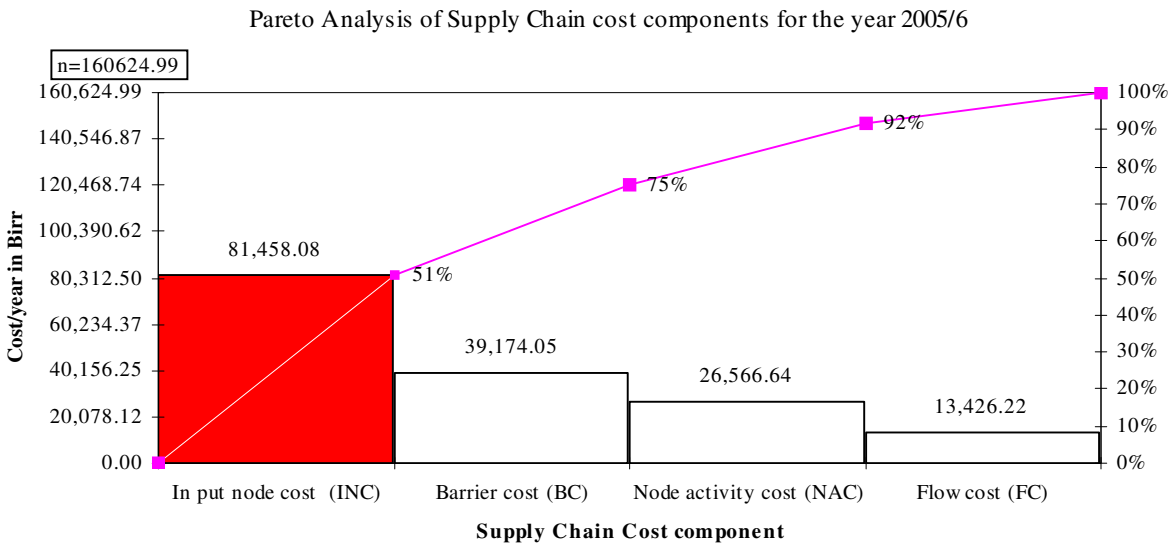


Figure 7-4: The Pareto Analysis of Supply Chain Cost of MIE for 2005/6 prod's year

According to figure 7-4, it is observed that of the supply chain cost components, Input Node Cost (51%) is the highest cost and Barrier cost (24%) is the next. Therefore, focusing on Input Node Cost and Barrier cost will be useful for further total cost reduction.

i) Analyzing the Supply System

For it is recent and timely accessed, the researcher took the 2005/6-year data for the analysis. Therefore, considering production cost, administration cost and distribution cost for computation as tabulated in table 7-4 below, the result is analyzed and interpreted using Pareto tool.

Table 7-4: MIE's Cost analysis of the year 2005/6

Cost Types	Annual Cost
Production Cost	116,512,624
Distribution cost	4,109,406
Administration cost	14,916,859
Total	135,538,889

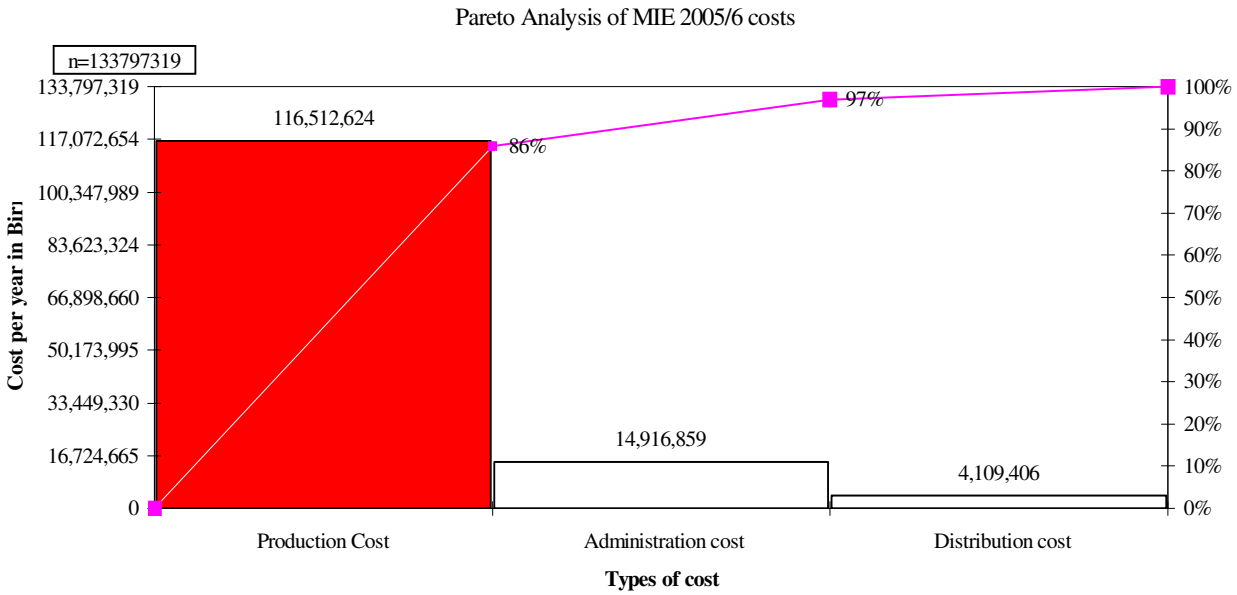


Figure 7-5: Production, distribution & administration cost of MIE of 2005/6

Therefore, from figure 7-5 Pareto analysis shows that *production cost (86%)* is the highest of all of the three costs and the company should take care of it. In this thesis also to further analyze the production cost in terms of the supply system, costs of input materials are compared as shown below.

Table 7-5:MIE 's Cost of Input Materials of 2005/6

Cost Input Materials of 2005/6 Year	
Types of Input Materials	***Cost in Birr***
Raw materials	36,290,997
Components &Accessories	66,586,650
spare parts	2,624,961
Chemicals & gas	3,683,992
General materials	3,789,859
Fixed Asset	1,794,595
Total	114,771,054

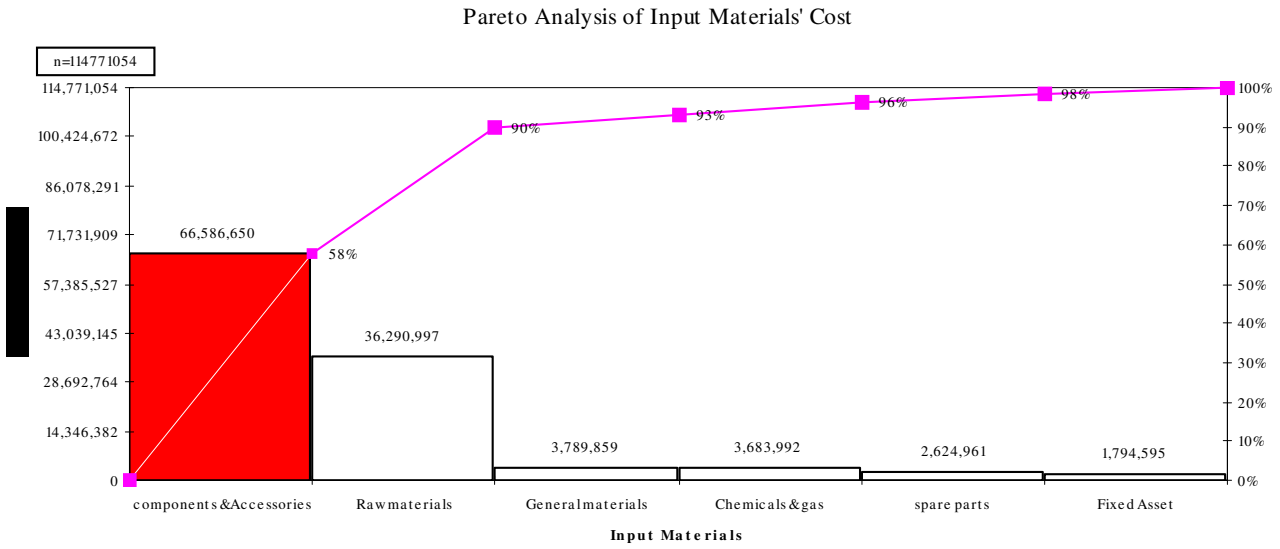


Figure 7-6: Input Materials cost analysis of MIE for the year 2005/6

According to figure 7-6 Pareto analyses indicates that components & accessories (58%) is the highest and Raw materials cost (32) is next. So concentrating on *components & accessories* as well as *raw materials* will have great influence for the analysis of cost factor.

Table 7-6:MIE's Components & Accessories Cost of 2005/6

Types of components & Accessories	Cost in Birr
Axle with suspension	35,016,918
Tyre with inner tube	12,084,637
Rim	4,057,448
Tyre with inner tube & flap Bridgestone	2,722,690
Brake system	2,369,347
Turning table	1,455,642
Mainhole cover	1,212,518
Electrical, System Kit	93,658.9
Winches assembled	864,005
OTHER	7,180,622

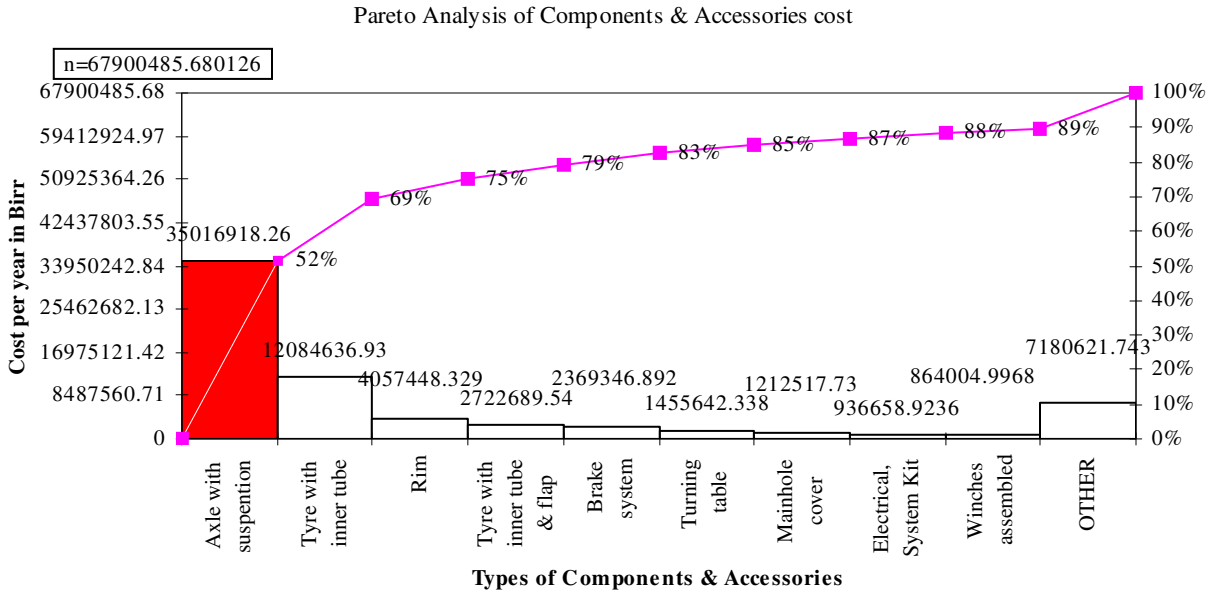


Figure7-7: Components & Accessories cost analysis of MIE for 2005/6

As per figure 7-7, Pareto analyses shows that of the *components & accessories, Axle with suspension* (52%) is the highest and Tires with inner tube (17 %) is the next. Therefore, focusing on *Axle with* suspension and Tires with inner tube will have high effect for the analysis of the cost derivative. Further analysis of the raw materials input will be seen below:

Table 7-7:Pareto analysis for Raw materials costs of 2005/6

Types of Raw materials	***Cost in Birr***
Sheet Metal	152,080,098
Steel Plate	89,284,727
Flat Bar	38,479,687
RHS	10,640,381
Pipe	8,403,852
I Beam	8,128,997
U-Channel	7,931,812
Round Bar	1,886,806
Angle Iron	1,754,995
LTZ	1,624,314

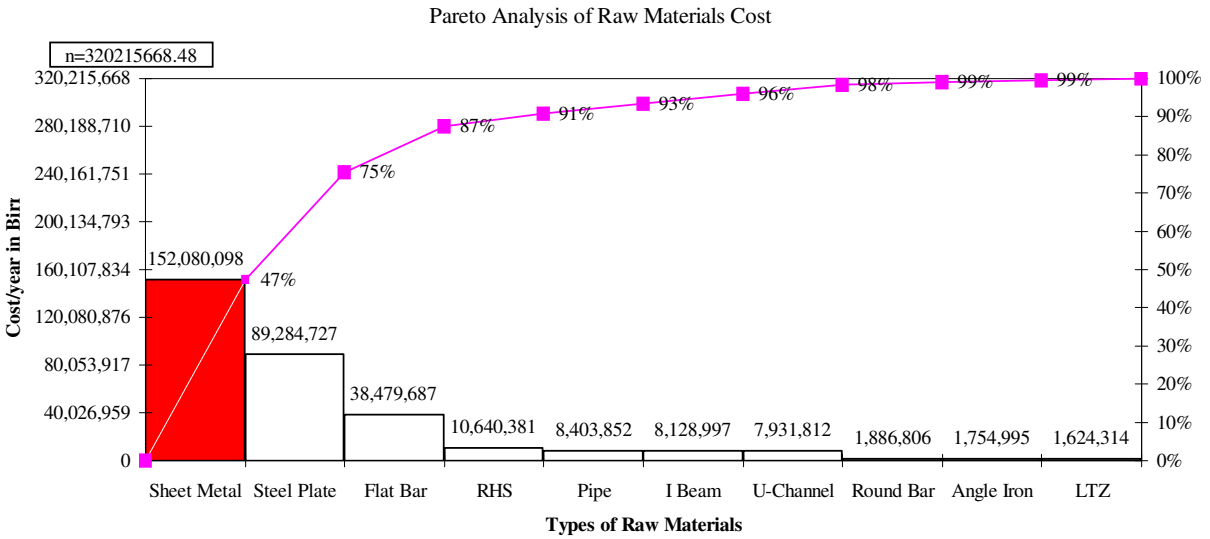


Figure7-8: Pareto Analysis of Raw materials of MIE for 2005/6

According to figure7-8 Pareto Analysis of raw materials (next highest cost to component & accessories), *Sheet Metal* (47%) is the highest and Steel Plate (28 %) is the next. Therefore, concentrating on *Sheet Metal* and Steel Plate will have great influence for the analysis of the cost.

Furthermore, another analysis is to compare local and foreign suppliers as follows.

Table 7-8: Comparison of MIE's Local and foreign suppliers of 2005/6

	Local Supplier	Foreign supplier
Raw Materials	655,747	21,474,631
Components & accessories	8,397,428	44,237,850
Spare parts	2,414,545	9,700,878
Other supplies like safety items,	2,363,457	211,403
Consumable like fuel	2,717,675	577,475

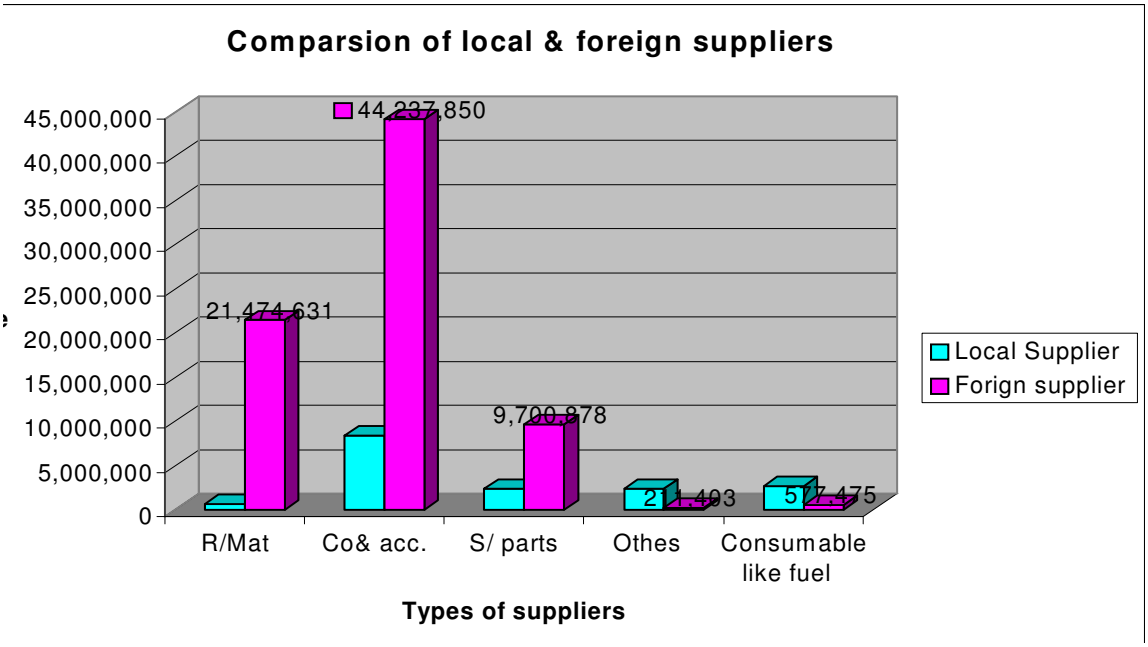


Figure7-9: Comparison of local & foreign suppliers of MIE for 2005/6

According to figure 7-9 Pareto analysis, comparison of local & foreign suppliers, components & accessories (58%) is the highest imported materials and Raw materials (32%) is next. So it is conformed that still concentrating on *components & accessories* as well as *raw materials* supply chain will have great influence for the cost analysis.

Another way of Analysis will be using procurement data

Table 7-9:MIE's Materials Procurement data of 2005/6

Raw Materials	22,130,378
Components & accessories	52,635,278
Spare parts	12,115,423
Other supplies like safety items,	2,574,859
Consumable like fuel	3,295,149
Electricity	620,000
Water	42,000
Telephone, Fax & Internet	429,323
Fuel & Lubricant	1,760,000

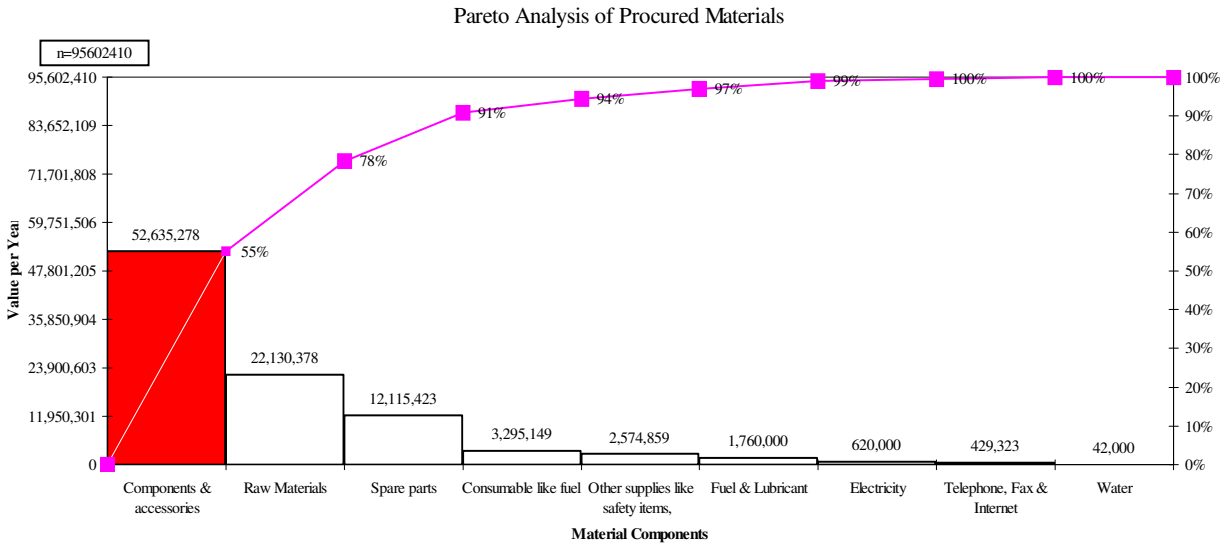


Figure7-10: Pareto analysis of Procured Materials of the 2005/6

According to figure 7-10 Pareto analysis indicates that the purchase cost of components & accessories (55%) is the highest and that of Raw materials (23%) is the next. So (still third confirmation) to concentrate on *components & accessories* as well as *raw materials* will have great influence for the cost analysis in the supply system.

ii) Analyzing the Manufacturing System

If a factory have different products, it is better to identify product(s), which have great impact on the factory supply chain cost. In order to determine such product(s), it is better to draw Pareto's diagram for the products either on the basis of quantity or cost of product produced.

Table 7-10: MIE's Production Cost of Major Products for the year 2005/6

Type of product	Quantity	Cost of product
3-Axel drawbar dry cargo Trailer	374	80,034,169
Dry cargo truck body	344	10,959,713
3-Axel dry cargo semi-trailer	5	1,220,306
2-Axel draw bar fuel cargo trailer	1	146,329
Local supply of fuel depots for NPRDA	12	16,569,414
Agricultural Trailers	12	678,840
11.2 m3 fuel tanker to be mounted on Ural Truck	25	990,338
Oxygen (M^3)	8180	65,276
Acetylene (Kgs)	2050	165,148

Source: Mesfin Industrial Engineering files(2005/6)

Out of the 2005/6 MIE's products the Percentage share of each product by cost is shown in figure 7-11 below. The researcher observed that *the share of the 3-Axel drawbar dry cargo Trailer is 71% and is the highest.*

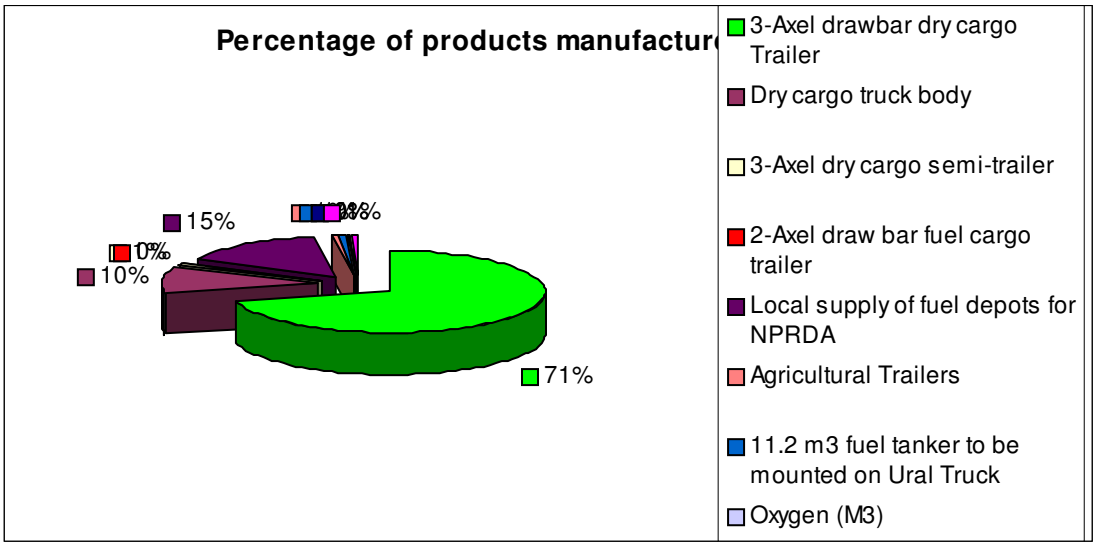


Figure 7-11: Comparison of products Manufactured in 2005/6 by % of their production cost using Pie Chart.

Similarly, Pareto Analysis using the same data as for the above is shown below:

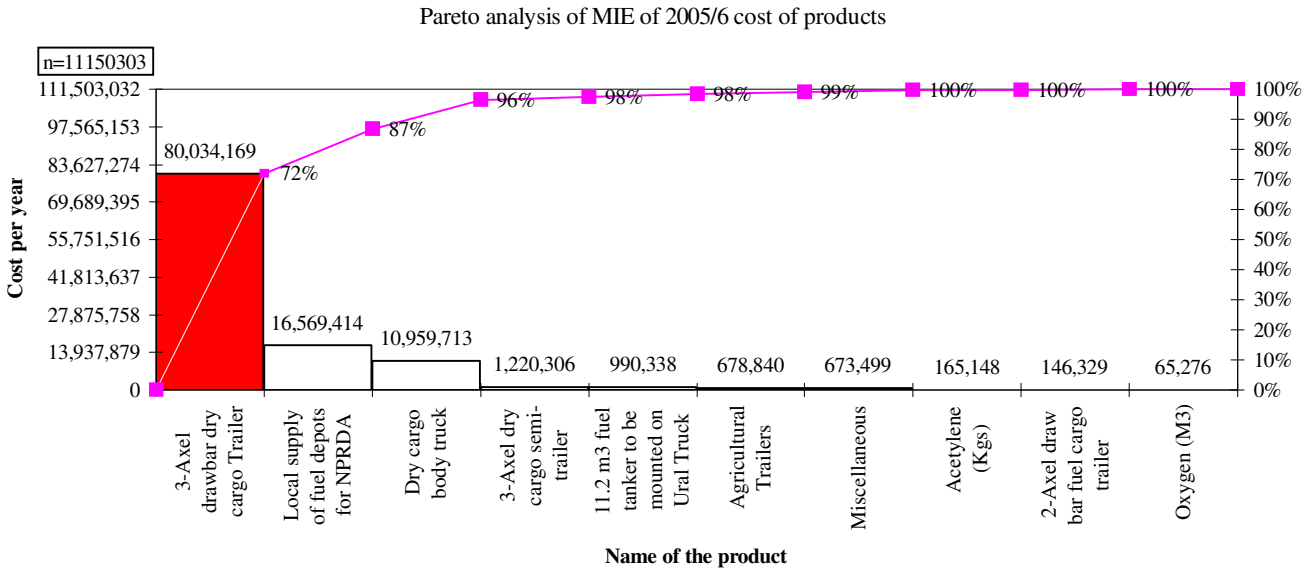


Figure 7-12: Figure 7-12: Comparison of products Manufactured in 2005/6 by % of their production cost using Pareto Diagram.

According to figure 7-12, the highest production cost is utilized for the manufacturing of *3-Axel drawbar dry cargo Trailer*. Therefore, concentrating on *3-Axel drawbar dry cargo Trailer* will have great influence for the analysis of the cost.

The researcher observes that the Oxy-acetylene plant of MIE, which was functional last year and before have currently stopped its activities. As a result of this, MIE is forced to purchase the product from outside producers that incurs transportation cost, delay cost, damage of cylinder during transportation and other costs. Thus it is the researcher's opinion that the plant should resume its function and contribute in the cost reduction mechanism of the company.

Besides to the above, the previous analysis indicates that out the 2005/6 budget year production cost , costs of components and accessories, axle with suspension and of the cost of raw materials, the annual cost of sheet metal and steel plate were the largest ones. Thus, had it been that the company uses a data base analysis; it would have been very easy to focus on the items that have greater influence when supply chain cost is concerned. Thus, the researcher reminds the company to design a database using visual basic access (VBA) or other software that tries to synchronize all the inputs from different work fronts about the different types of the supply chain costs. A visual basic access user interface database is included with this thesis just to give high light on how to use it. The database can be used for easy information access and minimization of labor to collect data when required. It is designed in a user friendly approach hence can be used without difficulty. The database has the following capabilities:

- Adding/deleting distribution, supply and manufacturing systems data
- Navigating the distribution, production and supply cost database
- Editing existing records

The overview of customer and raw materials-based interface database using access for the case study conducted at MIE is depicted in appendix 6.

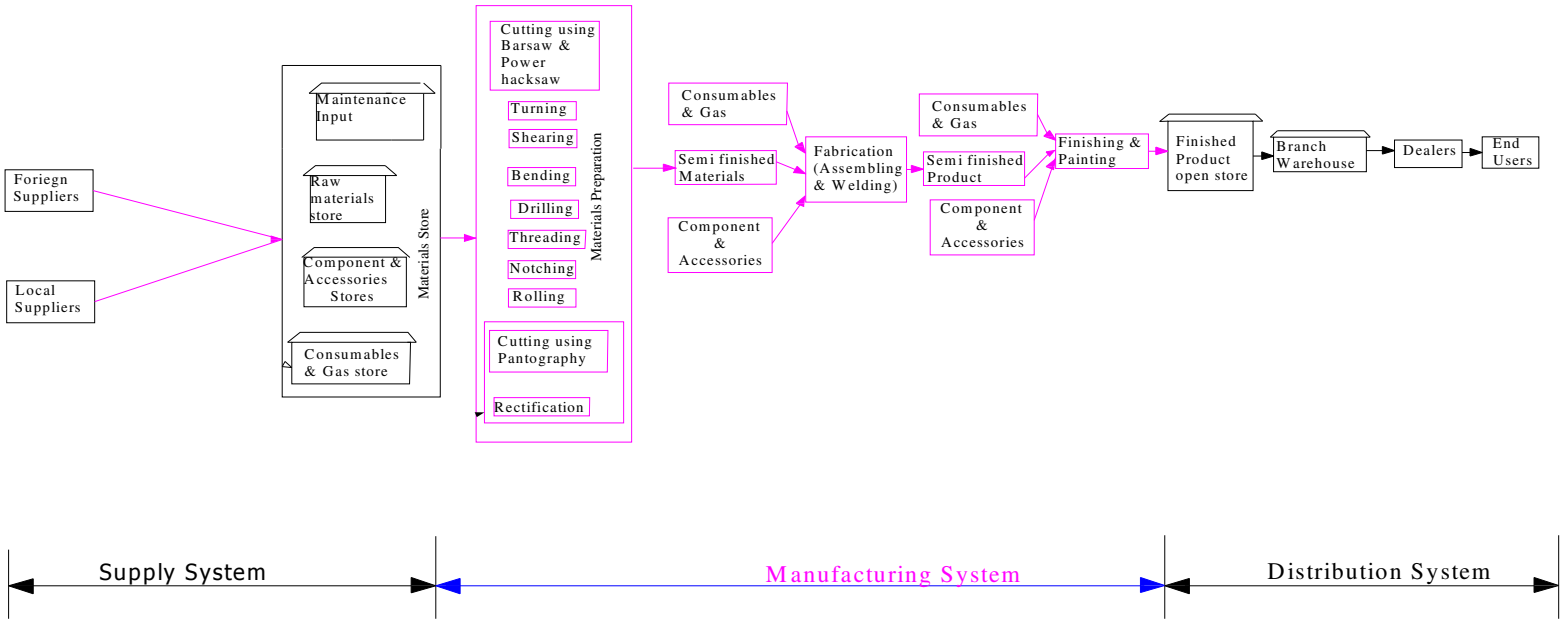


Figure 7.13: General Model of SCMS for Ethiopia's Metal Products Manufacturing Industries

CHAPTER EIGHT

8. SYNERGY and Cooperation in EFFORT sister companies

The word ***Synergy*** comes from the ***Greek word Synergos***, meaning working together. It refers to the phenomenon in which two or more discrete influences.

Thus synergy can be defined as:

•A mutually advantageous conjunction where the whole is greater than the sum of the parts. [or in other term **2>1+1**]

•A dynamic state in which combined action is favored over the sum of individual component actions.

•Behavior of whole systems unpredicted by the behavior of their parts taken separately. More accurately known as emergent behavior

•The opposite of synergy is antagonism, the phenomenon where two agents in combination have an overall effect which is less than that predicted from their individual effects.

Although the term synergism is as well applicable to Drug interactions and theological expressions, human synergy which is related to interacting humans is considered in this chapter. For example, if person A alone is too short to reach an apple on a tree and person B is too short as well. Once person B sits on the shoulders of person A, they are more than tall enough to reach the apple. In this example, the product of their synergy would be one apple. Another case would be two politicians. If each is able to gather one million votes on their own, but together they were able to appeal to 2.5 million voters, their synergy would have produced 500,000 more votes than had they each worked independently.

A third form of human synergy is when one person is able to complete two separate tasks by doing one action. For example, if a person was asked by a teacher and his boss at work to write an essay on how he could improve his work, that would be considered synergy.

Synergy usually arises when two persons with different complementary skills cooperate. The fundamental example is cooperation of men and women in a couple. In business, cooperation of people with organizational and technical skills happens very often. In general, the most common reason why people cooperate is that it brings a synergy. On the other hand, people tend to specialize just to be able to form groups with high synergy (see also division of labor and teamwork). [14]

Thus, effective supply chain management system in EFFORT companies creates SYNERGY that will provide a competitive advantage to all of the companies.

In this thesis work, assessment is done if there exists the concept of synergy in the day to day activities of EFFORT sister companies for it is a new concept that is highly useful specially in today's competitive market.

To introduce the concept of SYNERGY & its application in EFFOERT sister companies using SWOT analysis.

CHAPTER NINE

9. Conclusions, Recommendations, and Future Works

9.1 Conclusions

I. Based on the analysis made on supply system (raw materials flow), manufacturing system (Production flow) and distribution system (products flow), the following conclusions are drawn:

- Taking 2005/6 year's total cost of MIE that comprises production, administration and distribution costs and using Pareto diagram it was found that Production cost (86%) is the highest among of all and was selected for analysis.
- Analysis of the *supply system indicates that* of the materials cost, cost of components & accessories (58%) is the highest, followed by raw materials cost (32%) and all the remaining constitute only 10%. Further analysis of components & accessories shows *Axle with suspension* (52%) being the highest and Tires (17 %) following and all the remaining miscellaneous components constitute only 31%. Besides, Pareto analysis of Raw materials cost shows *Sheet Metal* (47%) being the highest followed by Steel Plate (28 %) and all the remaining miscellaneous raw materials constitute only 25%.
- Analysis of the *manufacturing system indicates that*, the 3-Axel drawbar dry cargo Trailer comprising 55% of the total manufacturing cost of the annual products is the highest of all the products in manufacturing cost.
- Pareto analysis of *material suppliers indicates,* taking the 2005/6 budget year imported materials have the lion's share with *Components & accessories* (55%) being the highest , *Raw materials* 23% following and all the remaining constitute 22%.
- Taking the 2005/6 budget year production data of MIE , the total production cost using the company's existing accounting system is found to be Birr 116,512,624.00. While using the supply chain cost analysis for the proposed (modified) model the total supply chain cost is found to be Birr 115,276,880.20 where a gain of Birr 1,235,743.80 (1.06%) is attained . This is obviously due to

the fact that some of the non-value adding links / chains were removed, double costing effect and possibility of existence of hidden costs are avoided.

- While looking at the data of the year 2005/6 budget yuear, the data obtained from Supply, Planning, and Finance departments for the same request was not similar. This is because of the fact that there is poor documentation and information flow among the different departments of MIE.

II. Based on analysis and interpretation of the survey questionnaires and structure interview and observation, the following conclusions are achieved.

- Most of MIE's employees (~60% of the interviewed) do not have awareness about supply chain management and are also unable to decide who should be the responsible body for the implementation & control of supply chain management in their company. Moreover, the company is not acquainted with the use of supply chain cost analysis rather than the traditional accounting system.
- Almost 69% of the interviewed staffs have less awareness about inbound and out bound logistics and its measurement. Moreover, significant numbers of employees are not able to identify source of the industry's input materials.
- As per the company's current data, the cost of one axle is Birr 68, 000 up to Birr 70,000 and the price of one 3-axle draw bar dry cargo is Birr 290,000. This shows that the cost of an axle is almost 23% of the price of the whole trailer.
- As per the data obtained from the industrial maintenance department ,the main reasons for the breakage of materials are wear, tear, overload, poor quality of materials, materials handling problem, bad working condition and lack of proper care .
- Besides to the above machine handling problem, ageing, poor preventive maintenance, lack of proper operation, and wear of spare parts are the main reasons for the breakage of *machines in* MIE.

- Still several staffs (68% of the interviewed) have poor awareness of the outbound logistics and its measurement, and whether MIE has branch warehouse or not.
- The synergy and cooperation analysis of the sister companies of EFFORT indicates that the companies have synergy potentials, however, the synergy concept is not well discussed and understood by the management of the companies, synergy areas are not well identified, and partners are not committed to strive for synergy advantages.
- From the market share point of view (year 2005/6) **:** the dry cargo (trailer or semi trailer) sales of MIE was 70% which is the leading, followed by MARU(25%) and Techale (5%) respectively. Similarly in fuel cargo MIE (80%) being the leading, followed by MARU(18%) and Techale (2%) respectively.
- It was also able to identify during the research that the major weaknesses of MIE's competitors' (of course opportunities for MIE) are limited financial & managerial capacity, not relying on quality, lack of machineries & facilities, have no qualified workers-like certified welders, no sophisticated testing machines as that of MIE and low plant capacity.
- The major strengths of MIE's competitors' (which MIE should adapt) are fast decision (highly responsive) on purchase, setting price, flexibility on procedure, and higher resource utilization like labor, fast delivery, small overhead costs and proximity to market-location.

9.2 Recommendations

Based on the given conclusions, the following recommendations are forwarded.

- MIE need to have customer & materials consumption based database interface to synchronize among departments so as to have uniform and accurate data and information flow, easily access of data, and well-organized documentation.
- MIE should implement the concept of supply chain cost analysis so as to eliminate hidden costs, non-value adding costs and double costing effect instead of using the traditional accounting system. This helps the company to determine the actual production cost so that the product price will be competitive in the global market.
- As per the findings of the cost analysis of the supply and manufacturing system of MIE in the previous chapters, special focus should be given to the supply chain cost of ***axle with suspension, tire, sheet metal and steel plates*** in the supply and manufacturing flows. Moreover, MIE should build strong alliance based on cooperative orientation with the suppliers of those input materials.
- MIE should focus on rectifying the problems that result to the interruption of the functioning of its Oxy-Acetylene plant. As per the data obtained from the industry, this plant in addition to the supply of the product for the consumption of MIE industry, external customers (the prominent ones being sister companies and the tekeze hydro power project) were using the product that is another means of income generation for the company. During the previous normal functioning of the plant, by providing its product to the industry it contributed a lot in minimization of transportation cost, damage cost, insurance and other costs if it were the fact that the product was purchased from other company.
- As the market trends shows, MIE should focus more on production & supply chain cost reduction of 3-Axel drawbar dry cargo truck trailer because of its highest demand among the other products.
- Continuous and consistent trainings and seminars should be conducted on the principles, advantages and implementation of supply chain management in the

industry. Accordingly, there should be created common and shared idea of supply chain cost reduction by all employees of MIE.

- As the effective utilization of the synergy potential existing in MIE itself and among all the sister companies of EFFORT will have a very encouraging advantage during today's competitive global market, the top management of EFFORT and sister companies should give strong attention to thoroughly discuss and understand the concept of Synergy and Cooperation and its implementation among and in each of all the sister companies.
- Employees relevant to the work should be given trainings on how to prevent *materials* from wear, tear, overload, and how to select good quality materials, how to use proper materials handling system, taking proper care of the materials so as to minimize production loss and down time. Besides similar trainings should also be given for *machines* proper handling and operation, scheduled maintenance, preventive maintenance to minimize frequent interruption of production, high maintenance cost, delay of production, high down time, high cost of spare & labor, and to avoid customer dissatisfaction.
- As aging was one of the reasons for breakage of machines, older or aged machines of MIE should be replaced by new ones in order to minimize down time, maintenance and repair costs so that the supply chain node activity cost will be reduced as well.
- Last but not least the researcher wants to say that the industry, MIE, frankly speaking is potentially the largest metal products manufacturing company in the East Africa, true. However, the potentials are under utilized. The industry market share analysis indicates that almost all of the products produced yet are sold to domestic customers. And as compared to the other similar but with limited capacity Ethiopian manufacturing industries most of (~80%) the market share is that of MIE's. However, this market depends on the purchasing capacity of Ethiopian investors. The sales trend shown in the previous years may not go linearly. Thus, the researcher recommends MIE that it should focus to:
    - ✓ Look for other external markets in addition to the domestic ones.

- ✓ Be able to produce all the items that can be manufactured by the company as per the market requirement.
- ✓ Give all the services to external customers timely and keeping the quality standards without undermining the volume of work order.
- ✓ Reducing production costs as much as possible using the current technological achievement in technical and managerial aspects. And timely delivery of products ordered.
- ✓ Strategically thinking of being competitive in the global market.
- ✓ Effective utilization of the young, dedicated and hard working work force of the company and implementation of employees motivation system.

- Finally the researcher recommends other future researchers on similar area that the developed supply chain model is specifically for the industry, MIE. However, for most of the supply chain problems of the Ethiopian industries are similar, with little modification it can be extended to other industries and they can make use of this thesis as an additional reference.

9.3 Future works

In this thesis more emphasis has been given to the design of supply chain models in metal manufacturing plants giving more attention to the cost of supply chain, using supply chain cost and Pareto analyses. The concept of supply chain management can be applied for either manufacturing industries or service giving industries. Hence one can extend the model for the analysis of supply chain system in other industries (such as textile, spare parts, and service giving industries such as Bank, Hotel, Hospital, and others) using other quantitative performance measures such as lead times, fill rate, customer response time, profitability and others.

It has been very interesting to study supply chain management system on Ethiopian metal manufacturing plants. On the other hand, one potential for further study area is to deeply look for qualitative supply chain performance measures elements (such as customer satisfaction, flexibility, information and material flow integration, effective risk management, supplier performance) for Ethiopian metal manufacturing plants. Another study prospect could be to look at supply chain management system of the other Ethiopian metal manufacturing plants. Specially conducting similar analysis on the services firms' areas would also be an interesting to investigate.

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15. Recently Compiled questionnaire responses of employees towards synergy and cooperation in EFFORT sister companies.

11. Appendices

Appendix 1: Glossary of Input Materials and Supply Chain Terminologies

1.*Supply chain* is a series of linked suppliers, manufacturers, distributors and customers.

2. *Direct raw materials* are ingredients, which are converted to product through various conversion processes.

3. *Indirect raw materials* are added in order to facilitate the various reactions.

4. *Inbound logistics* is a process material flow from suppliers to manufacturers.

5.*Outbound logistics* is the distributions of finished products to end-users.

6.*Depots*: a warehouse used for storing and distributing things (soft drinks)

7.*Dealers*: (seller or trader) a person or company whose business is buying and selling

Appendix 2: Background of the Case study Plants for survey questionnaires

Name of the Plant	Mesfin Industrial Engineering PLC
Total employee	460
Region	1
City/Town	Mekele
Location	Near Hill TOP Hotel
Area	120,000 m^2
Product produced	A, B, C, D, E, F, G, H, I, J, K, L, M
Plant established	1985E.C. or 1992/3 G.C
Current Capital (Birr)	170 million
Werda	Semen
Kebele	06
Telephone	0344400598/406800
Fax	0344406225
E-mail	MIE @ethionet.et
Web site	WWW.MIE-Ethiopia.Com
Owner ship	EFFORT

Legend

A. 3-Axle draw bar Dry cargo Truck-Trailer (payload 20 Ton)
B. 3-Axle dry cargo semi-Trailer – (payload 40 Ton)
C. 2-Axle dry cargo semi-Trailer – (Payload 35 Ton)
D. Low bed- (Payload 60 Ton)

E. 3-Axle draw bar fuel cargo Truck-Trailer- (Payload 43 m^3)

F. 3-Axle fuel cargo semi-Trailer-(Payload 43 m^3)

G. Dump Truck-Afro & Miller type (capacity 10 m^3, 14m^3)

H. Antenna Mast (up to 60 meter height)

I. Underground & over ground tanker-d/t capacity

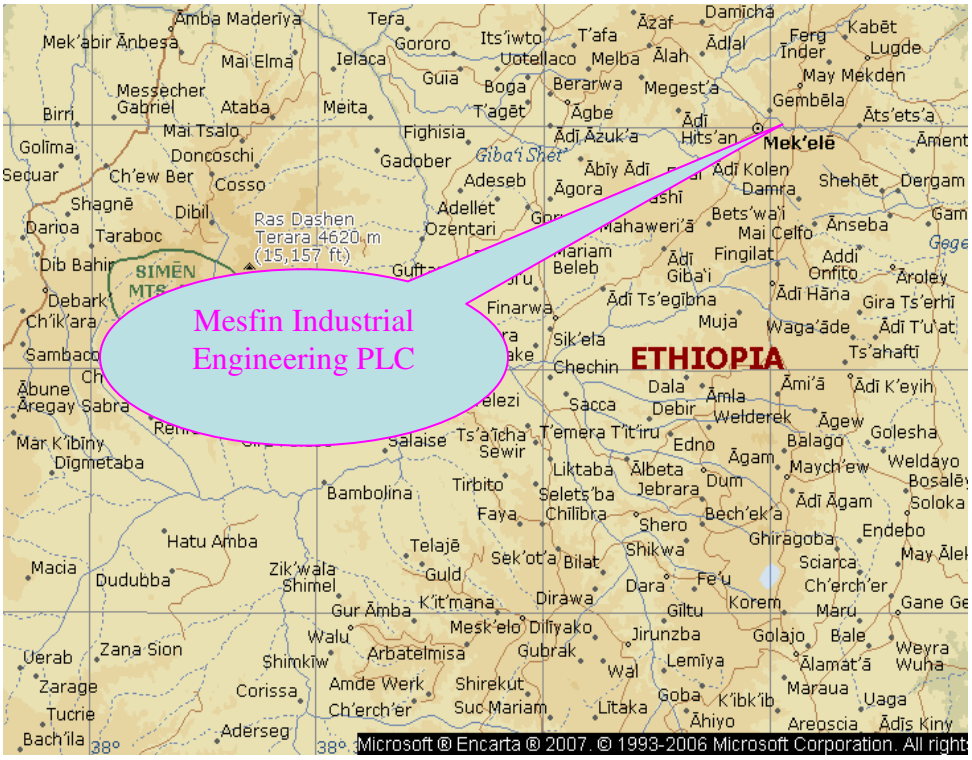
J. Crusher (25-100 tph)

K. Petroleum Reservoirs tanks (5,000m^3 -5,600 m^3)

L. Over head crane (10t, 5t, 3.2t- up to 30 Ton)

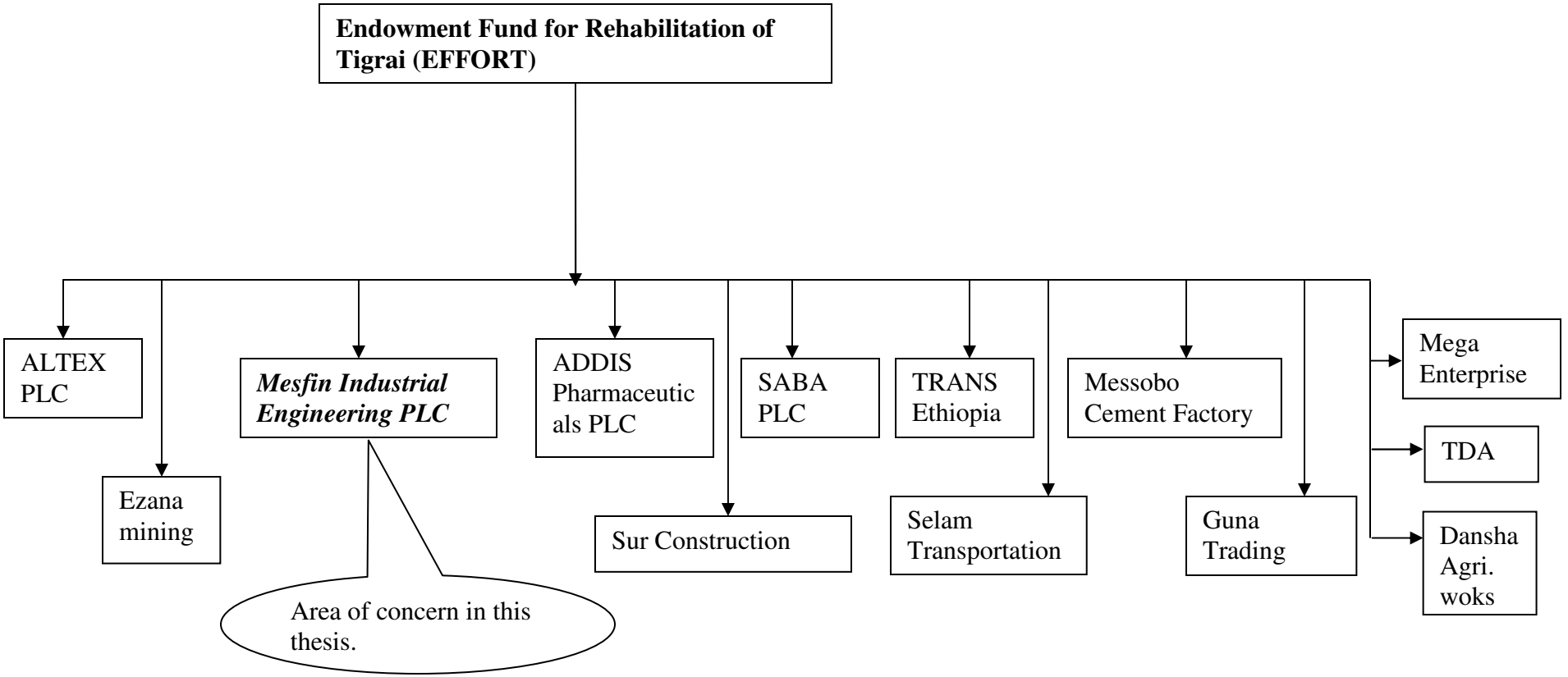
M. Bus Body (40+1, 60+1 seat).

Appendix 3: Map of the field trip to the Cite of the Mesfin Industrial Engineering PLC



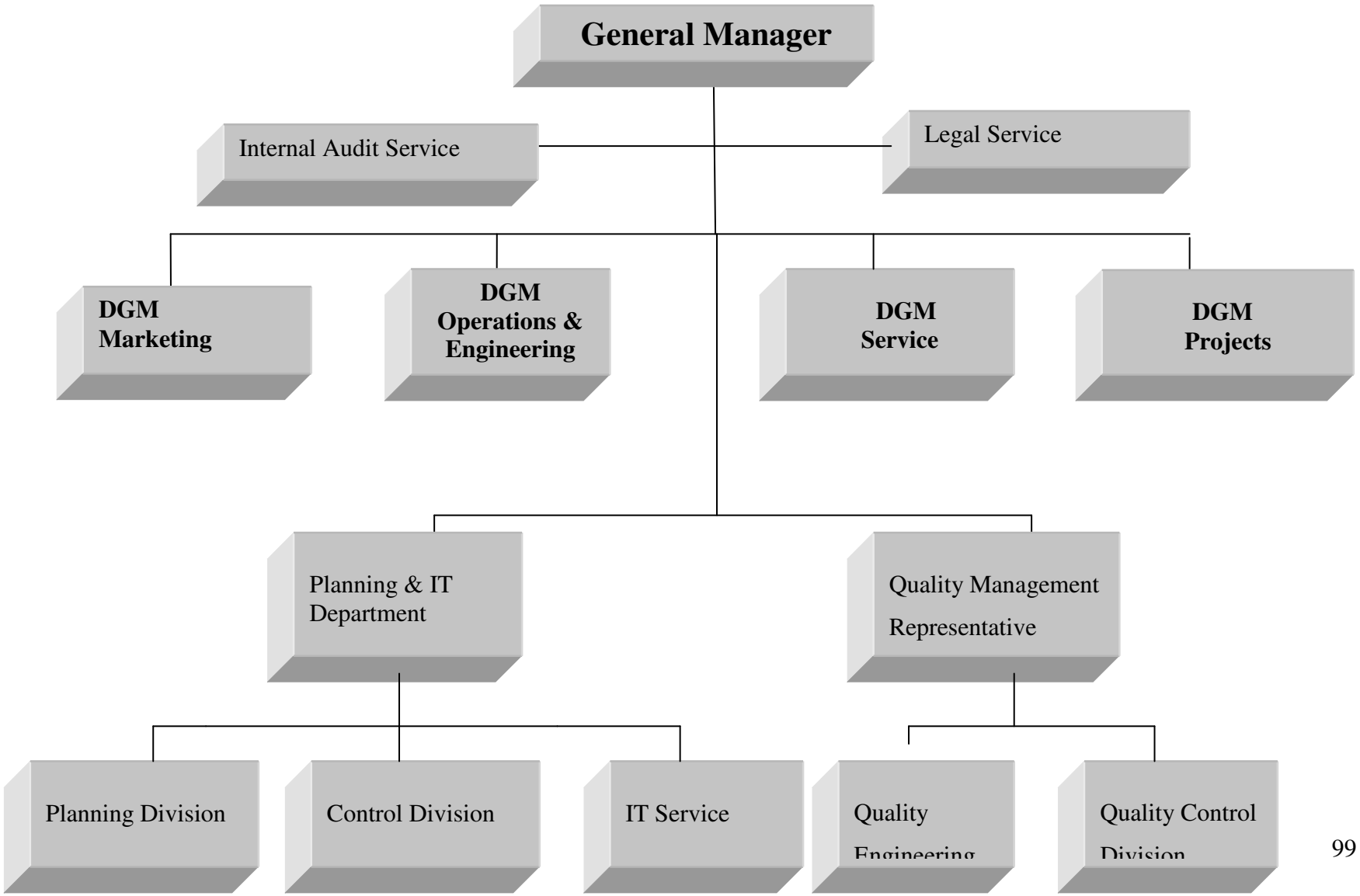
*Source: Microsoft Encarta 2007 © 1993-2006 Microsoft corporation

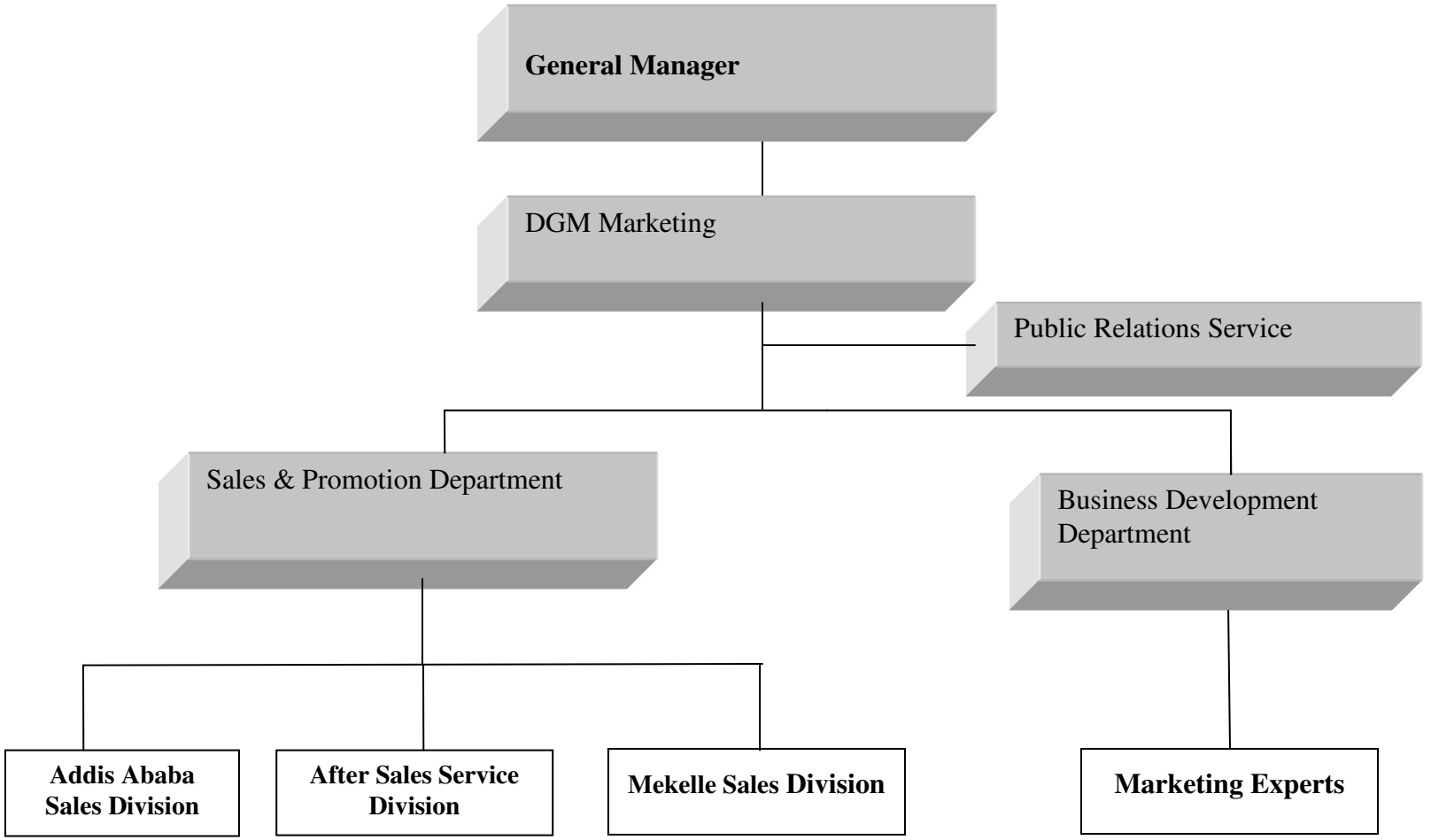
Appendix 4: Sister companies of EFFORT

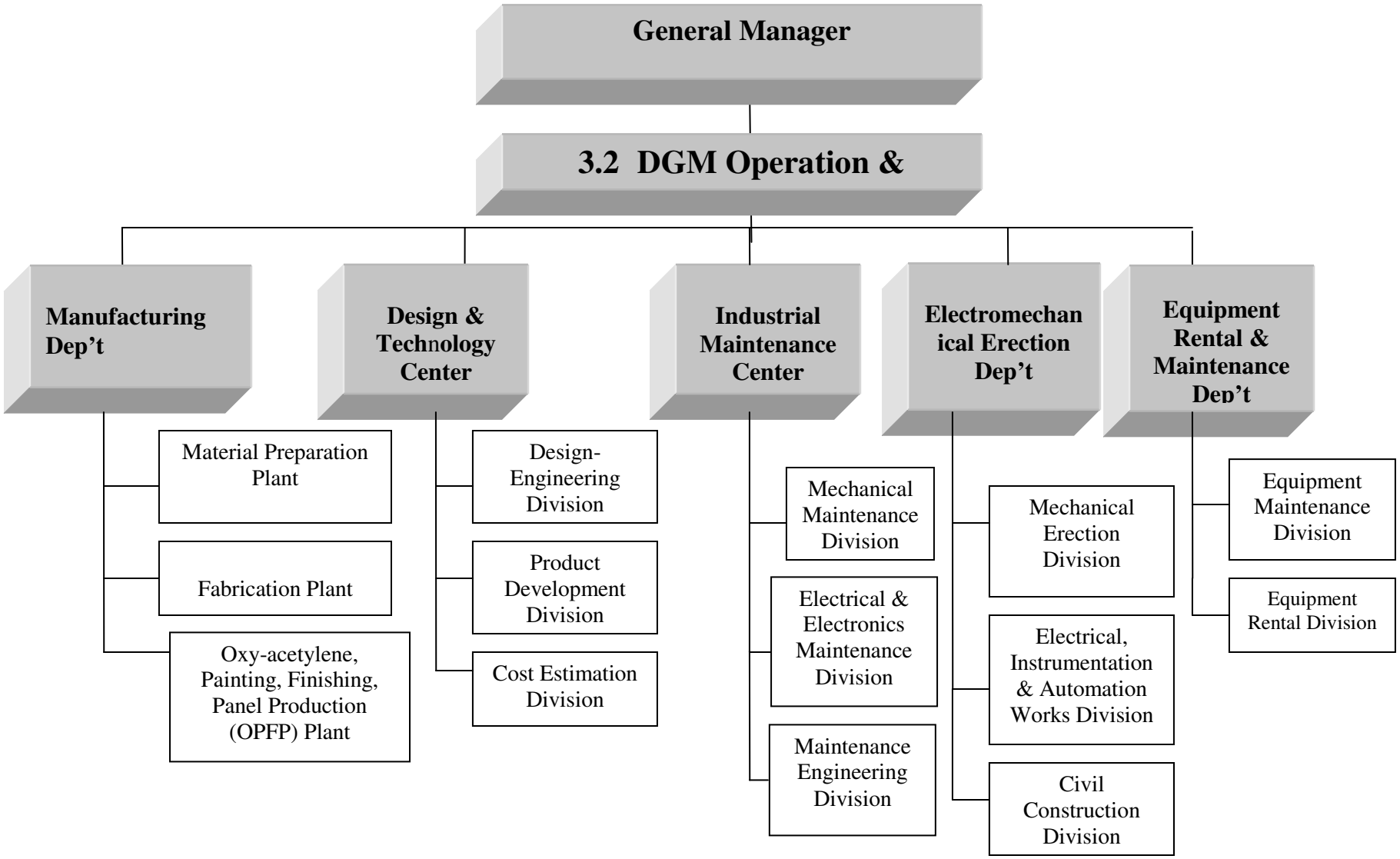


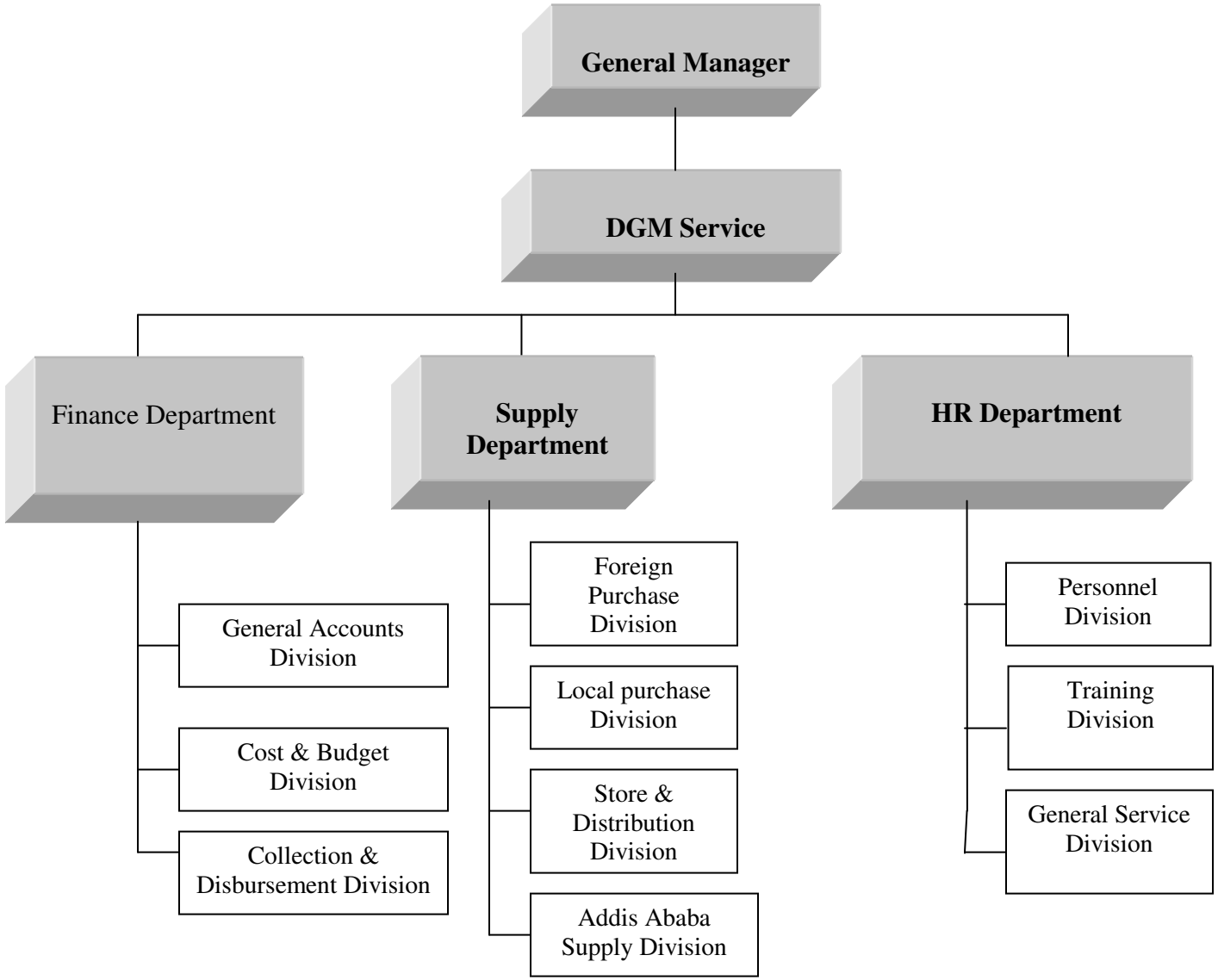
Appendix 5: Partial view of the industry MIE (at Mekelle head Office)

Appendix 6: Organizational Structures of Mesfin Industrial Engineering PLC

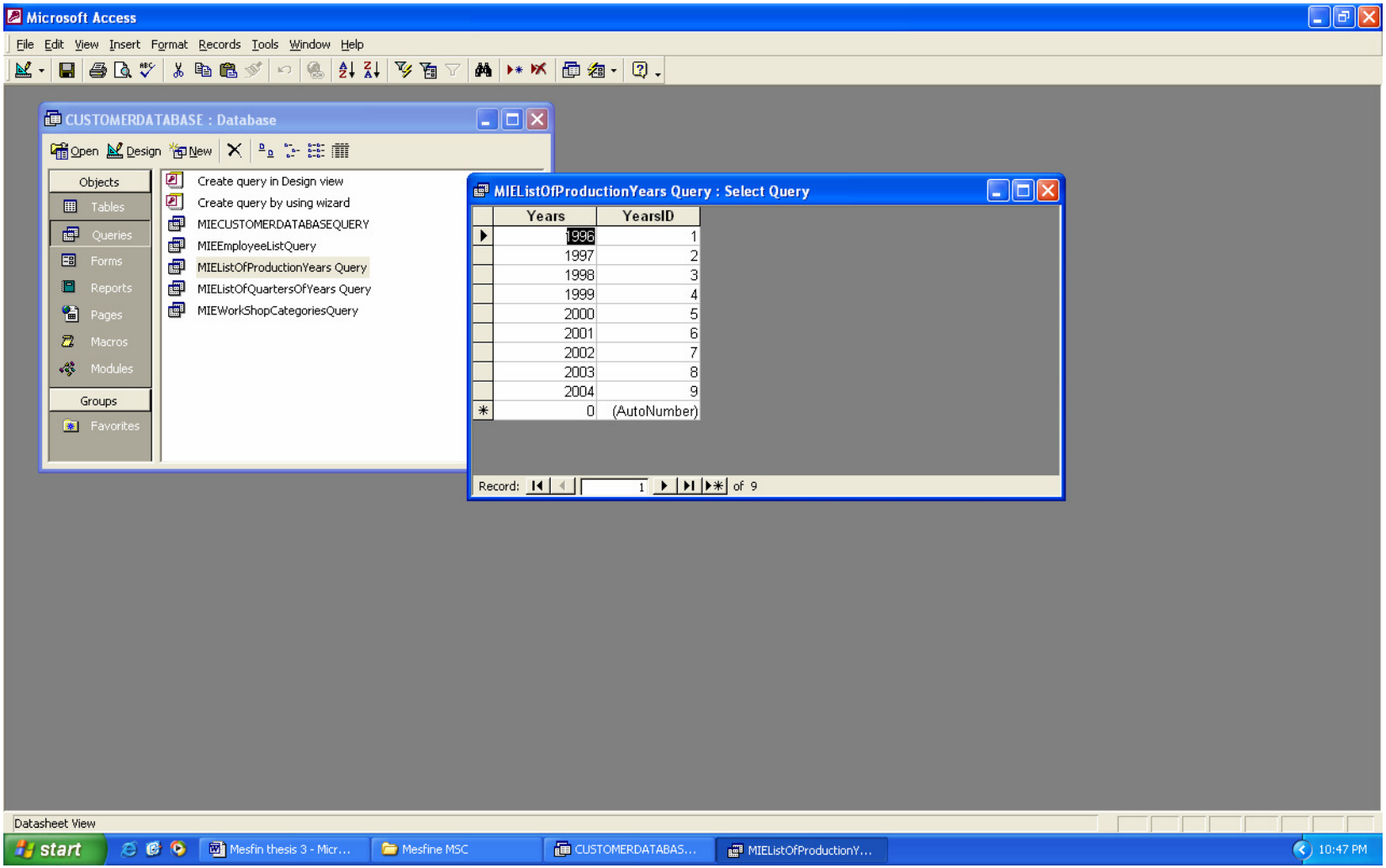


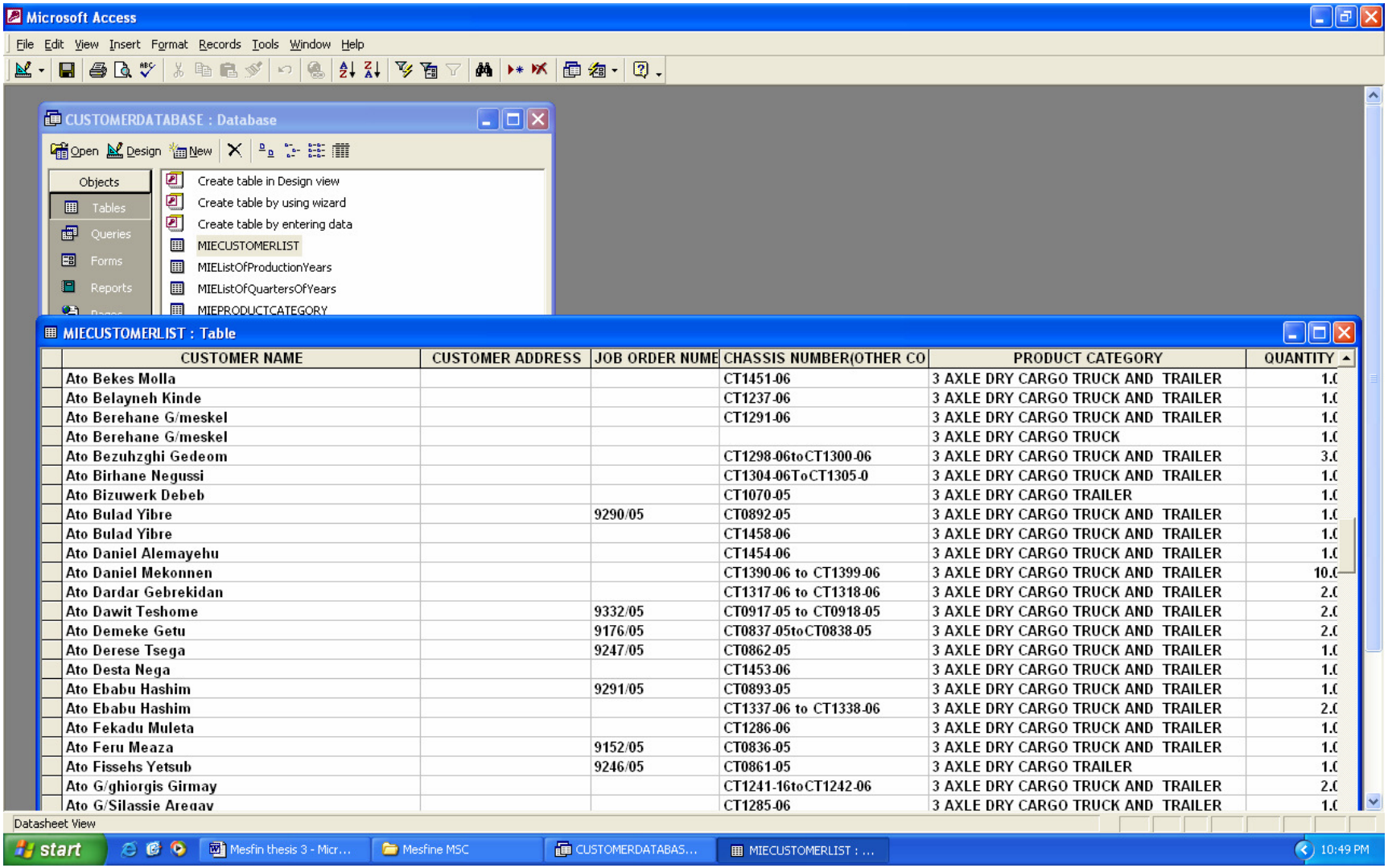

General Manager
DGM Marketing
Public Relations Service
Sales & Promotion Department
Business Development Department
Addis Ababa Sales Division
After Sales Service Division
Mekelle Sales Division
Marketing Experts


General Manager
3.2 DGM Operation &
Manufacturing Dep't
Design & Technology Center
Industrial Maintenance Center
Electromechanical Erection Dep't
Equipment Rental & Maintenance Dep't
Material Preparation Plant
Fabrication Plant
Oxy-acetylene, Painting, Finishing, Panel Production (OPFP) Plant
Design-Engineering Division
Product Development Division
Cost Estimation Division
Mechanical Maintenance Division
Electrical & Electronics Maintenance Division
Maintenance Engineering Division
Mechanical Erection Division
Electrical, Instrumentation & Automation Works Division
Civil Construction Division
Equipment Maintenance Division
Equipment Rental Division


General Manager
DGM Service
Finance Department
Supply Department
HR Department
General Accounts Division
Cost & Budget Division
Collection & Disbursement Division
Foreign Purchase Division
Local purchase Division
Store & Distribution Division
Addis Ababa Supply Division
Personnel Division
Training Division
General Service Division

Appendix 7: Overview of the Data Base for Mesfin Industrial Engineering PLC





CUSTOMER NAME	CUSTOMER ADDRESS	JOB ORDER NUME	CHASSIS NUMBER(OTHER CO	PRODUCT CATEGORY	QUANTITY
Ato Bekes Molla			CT1451-06	3 AXLE DRY CARGO TRUCK AND TRAILER	1.(
Ato Belayneh Kinde			CT1237-06	3 AXLE DRY CARGO TRUCK AND TRAILER	1.(
Ato Berehane G/meskel			CT1291-06	3 AXLE DRY CARGO TRUCK AND TRAILER	1.(
Ato Berehane G/meskel				3 AXLE DRY CARGO TRUCK	1.(
Ato Bezuhzghi Gedeom			CT1298-06toCT1300-06	3 AXLE DRY CARGO TRUCK AND TRAILER	3.(
Ato Birhane Negussi			CT1304-06ToCT1305-0	3 AXLE DRY CARGO TRUCK AND TRAILER	1.(
Ato Bizuwerk Debeb			CT1070-05	3 AXLE DRY CARGO TRAILER	1.(
Ato Bulad Yibre		9290/05	CT0892-05	3 AXLE DRY CARGO TRUCK AND TRAILER	1.(
Ato Bulad Yibre			CT1458-06	3 AXLE DRY CARGO TRUCK AND TRAILER	1.(
Ato Daniel Alemayehu			CT1454-06	3 AXLE DRY CARGO TRUCK AND TRAILER	1.(
Ato Daniel Mekonnen			CT1390-06 to CT1399-06	3 AXLE DRY CARGO TRUCK AND TRAILER	10.(
Ato Dardar Gebrekidan			CT1317-06 to CT1318-06	3 AXLE DRY CARGO TRUCK AND TRAILER	2.(
Ato Dawit Teshome		9332/05	CT0917-05 to CT0918-05	3 AXLE DRY CARGO TRUCK AND TRAILER	2.(
Ato Demeke Getu		9176/05	CT0837-05toCT0838-05	3 AXLE DRY CARGO TRUCK AND TRAILER	2.(
Ato Derese Tsega		9247/05	CT0862-05	3 AXLE DRY CARGO TRUCK AND TRAILER	1.(
Ato Desta Nega			CT1453-06	3 AXLE DRY CARGO TRUCK AND TRAILER	1.(
Ato Ebabu Hashim		9291/05	CT0893-05	3 AXLE DRY CARGO TRUCK AND TRAILER	1.(
Ato Ebabu Hashim			CT1337-06 to CT1338-06	3 AXLE DRY CARGO TRUCK AND TRAILER	2.(
Ato Fekadu Muleta			CT1286-06	3 AXLE DRY CARGO TRUCK AND TRAILER	1.(
Ato Feru Meaza		9152/05	CT0836-05	3 AXLE DRY CARGO TRUCK AND TRAILER	1.(
Ato Fissehs Yetsub		9246/05	CT0861-05	3 AXLE DRY CARGO TRAILER	1.(
Ato G/ghiorgis Girmay			CT1241-16toCT1242-06	3 AXLE DRY CARGO TRUCK AND TRAILER	2.(
Ato G/Silassie Aregay			CT1285-06	3 AXLE DRY CARGO TRUCK AND TRAILER	1.(

Appendix 8: Survey Responses Summary to Circulated Questionnaires for Supply Chain Management System in the case study MIE

Circulated Questionnaires

Addis Ababa University
School of Graduate Studies
Faculty of Technology, Department of Mechanical Engineering
Graduate Program in Industrial Engineering

TITLE: MODEL DEVELOPMENT OF SUPPLY CHAIN MANAGEMENT SYSTEM: A CASE STUDY ON MESFIN INDUSTRIAL ENGINEERING PLC

Acknowledgement to the respondent

Hereby, I would like to express my gratitude for your dedicated cooperation as this questionnaire is conducted for the purpose of fundamental scientific research. Had it not been your genuine cooperation of filling this questionnaire, it would have not been possible to conduct this thesis.

Yours Sincerely,

Mesfin Berhane

Mechanical Engineering (Industrial Engineering Stream) studies, 2006/7

SUPPLY CHAIN MANAGEMENT SYSTEM SURVEY IN MESFIN INDUSTRIAL ENGINEERING PLC

Your personal data (it is not necessary to write your name)

Position_____, Experience or Service year_____, Qualification_____, Gender_____

Note: 1. Please, give your suggestion for the points that are applicable in the company.

2. Please, give short and brief answers for subjective questions.

3. If the space is not enough, you can write your answer on the back of the paper.

Short description of supply chain management system (SCMS)

- SCMS is the process of planning, organizing and controlling the flow of materials from the supplier to the consumer /end user.
- *Supply chain* is a series of linked suppliers, manufacturers, distributors and customers.
- *Direct raw materials* are ingredients, which are converted to product through various conversion processes.
- *Indirect raw materials* are added in order to facilitate the various reactions.
- *Inbound logistics* is a process material flow from suppliers to manufacturers.
- *Outbound logistics* is the distributions of finished products to end-users.

Total number of questionnaires distributed: 105

Number of respondants: 89 (84.76%)

Respondants service Years in the Plant: 1-3 Years= 28, 4-6 Years=35, 7-10 Years=17, 11-15 Years=8, unidentified = 1

Composition of Position: Mangers, Supervisors, Engineers, senior Welder, Mechanic, Foreman and Branch managers, and V/General Managers.

Composition of Department: Supply, Human Resource Management, Marketing & Sales, Manufacturing, Planning & Information Technology, Industrial Maintenance Center, Design & Technology Center, Electro-Mechanical Work Center, Vehicle Maintenance & Equipment Repair, Quality Management Represent, and Finance department.

Composition of Qualification: Accounting, Management, Economic, Procurement & Supply, Marketing, Industrial Engineering, Mechanical Engineering and Electrical Engineering.

Section 1 Background of the Plants and Awareness of SCM

	Excellent	Very good	Good	Fair	Poor	Omitted
1. What is the supply chain management awareness level in the company?	2%	16%	22%	15%	41%	4%
	Very high	High	Low	Very low	None	

2.Which divisions or departments are the most responsible for supply chain management?

Department	**Supply**	**Manufacturing**	**Planning & IT**	**Marketing & Sales**
Percentage (%)	42	10	30	18

3. What do you know about supply chain management? Explain briefly
   - It is a system used to connect producer, distributor, supplier, and end user (customer) for mutual benefit.
   - It is the systematic control of the incoming & out going flow of materials.
   - It is a system of management that increases the cooperation of different departments of the plants for increments of their productivity.
   - It is a series linkage of the supplier, the organization and customers.
4. Does your factory have an organizational structure?

   Yes = 97% No =0% No response = 3%
5. Does your factory have a written or documented company profile?

   Yes =58% No =18% No response =24%
6. Does your company set its:

Response	Motto	Objective	Mission	Vision
Yes	77%	92%	85%	84%
No	9%	0%	2%	4%
No response	14%	8%	13%	12%

7. Where is the location of your company?

   It is located in front of **Hill TOP Hotel**
8. Does your company use supply chain cost analysis method?

   Yes =85% No=12% No response=3%
9. If your answer is **yes** for Q. 8, List the different costs within supply chain cost analysis method used?
   - Raw materials costs, Manufacturing costs and distribution expenses.
10. If your answer is **No** for Q. 8, what is your plant's cost analysis method?
    - FMAS (Fast moving, medium & slow moving) method
11. Have your company ever identified the problems related to supply chain?

    Yes = 21% No = 47% No response = 32%
12. If your answer is **yes** for Q. 11,

a. What are they? Time of delivery, quantity, Interruption in production, Availability of raw materials on time, insufficient product.
b. Did your plant solve the identified supply chain related problems?

Yes =16% No =84%

c. If your answer is **yes** for **b**, describe how you solve the problems.

- Deposit sufficient raw materials, Maintenance of machinery.

d. If your answer is **No** for **b**, describe the reason(s).

- Distance location of source, loss of computation, and availability.

Section 2 Supply System Part

	Excellent	Very good	Good	Fair	Poor	Omitted
13. What is the staffs' awareness level of inbound logistics?	5%	8%	23%	18%	46%	0%
	Very high	High	Low	Very low	None	
14. To what extent does the plant measure the inbound logistics?	11%	20%	38%	19%	12%	0%

15. What are the direct raw materials used in your production processes?

The direct materials are grouped in to Raw materials, Component & accessories and Spare parts. The details are bulleted as follow.

a. Raw materials, of different quality- St-37 up to St-52.

- Sheet metal thickness 2, 3, 4 mm & length up to 6,000 mm.
- Steel Plate thickness 5, 6,7,8,10,12,14,15,16,18 up to 120mm.and length up to 13,000 meter.
- Chequered plate, 2^{+2},3^{+2},4^{+2},6^{+2} mm
- Flat bar thickness 8, 10,12,15 mm ,width of 45,150,180,200,230,250 & 6,000mm length
- I-beam 140*140,160*160,200*190 mm & length of 6,000mm
- Pipe $\boldsymbol{ø_{Ex}}$=50mm ,42mm ,32 mm, 1",3" ,4"
- Round rod $\boldsymbol{ø_{Ex}}$=76 *18 ,55 mm
- U-channel 50*25*5,60*30*6,80*45*6mm
- RHS,80*30*2.5 ,40*40*2.5mm
- Angle Iron,40*40*4mm

b. Component & accessories,

- Axel with suspension-12 ton
- Manhole accessories for fuel tanker
- Rim disk type- 8"x20"
- Breaking system

- ❖ Electrical system
- ❖ Tire – 12*20
- ❖ Hydraulic Jack
- ❖ Mudguard rubber
- ❖ Bolt, Nut & washer – M8,14,24
- ❖ Rivet

c. Spare parts,

- For light vehicle
- For Afro truck & dump truck

16. What are the indirect raw materials used in your production processes?

The indirect materials are grouped in to Consumables & Gas namely:

- ➢ Electrode ø=2.5, 3.2 mm
- ➢ Welding wire ø=1, 1.2 mm
- ➢ Oil & lubricant –
- ➢ Fuel
- ➢ Cutting & Grinding disc
- ➢ Antirust paint
- ➢ Final paints
- ➢ Stucco
- ➢ Canvas sand paper # P60, #P320, #P220,# P120
- ➢ Benzene
- ➢ Abujedid
- ➢ Oxygen
- ➢ Acetylene **(C_2H_2)**
- ➢ Carbon dioxide **(C_2O)**

17. Which country/ies does/do the raw material come from (for imported materials)?

The imported materials are come from Italy, Turkey, Belgium, Germany, France, Saudi Arab, Russia, USA, Italy, England, UAE, and Switzerland.

18. Which city/ies or town/s does/do the raw material come from (for local materials)?

The local materials are come from Addis Ababa and Mekelle

19. Do you have foreign suppliers for raw materials?

Yes =88% No =12 Omitted =0%

20. If your answer is **yes** for Q.19, who are the major foreign suppliers for direct raw materials?

I. Fabrication

Suppliers Name	*Origin*

a. Raw material

- SAFET – Italy
- Marcegaglia Italy
- Metal Market- Turkey
- Goktas - Turkey
- MTC Turkey
- Asemetal Belgium

b. *Accessories & consumables*

- Jost WERKER Germany
- PAGG Italy
- SAFET Italy
- Anton spare parts Trading Germany
- Lafili Italy
- BPW German
- WABCO France
- Errevi Italy
- Makeersan Turkey
- Rima Italy

II. Electromechanical erection

- Zamil steel Saudi Arabia
- TrustKokso Russia
- Ultrafloat USA
- ITAL Trading Italy
- Angus England
- Airdale England
- Airmaster UAE
- Entraco Italy
- Mistral Italy
- Endress+Hauser Germany
- NOVA Switzerland

III. Vehicle maintenance

- Kamaz foreign trade Russia

IV. Industrial maintenance

- Machinery suppliers & manufacturers
  - ❖ Gasparinin Italy
  - ❖ ILT Italy
  - ❖ Officchini Italy
  - ❖ Sincosald-MAG welding Italy
  - ❖ Riga – punch & Italy
  - ❖ Omag Italy
  - ❖ Messer –pantograph Germany

21. Who are the major local suppliers of direct raw materials?

Major Local Supplier	Sector of operation
Kuli - overhead Crain	Industrial maintenance
Nyala motors	Vehicle maintenance
Ethio-Nipon	Vehicle maintenance
Moenco	Vehicle maintenance
Guna	Vehicle maintenance

22. What are the distances of major local suppliers of direct raw materials (sources) to your plant?

Major Local Supplier	Kuli - overhead Crain	*Nyala motors*	*Ethio Nipon*	*Moenco*	*Guna*
Distance (km)	785km	785km	785km	785km	1km

23. Indicate the factors of supplier selection method used in your company:

Supplier selection factor	Long term contracting	Vendor location	Capacity allocation	Local regulation	Quality	Local market implication	Price	Material cost	Others
Percentage (%)	20	46	5	3	69	4	80	2	9

24. If you mark **others** for Q.23, please list the factor(s).

- In case of Tender the supplier with the list offer can be selected
- V.A.T

25. Indicate the factors that should be considered for proper decision of the **inbound** logistics:

	Warehouse location	Warehouse size and capacity	contract carriers'	Local regulations	Number of carriers	Number of warehouse	Tax implementation	Others
Percentage (%)	48	48	2	30	3	17	30	4

26. If you mark **others** for Q. 25, list all of them?

- Market Potential of the Area of accessibility of transport.

Section 3 Manufacturing System Part

27. List the types of products your plant manufactures?

Product	A	B	C	D	E	F	G	H	I	J	K	L	M
Percentage (%)	91	91	77	15	82	82	47	13	57	48	69	56	28

28. How do you determine the production cost for one of your product?

- We have introduced the *Job Order* costing System i.e. each job order had its own cost breakdown. (53%)
- Overhead cost + Labour cost + Raw material cost+ Machinery cost. (29%)
- Engineering Cost Estimation (18%)

29. Indicate the factors that your company considers in relation to the manufacturing system being used:

	Plant location	Plant capacity	Local labour & material costs	Local economy	Political	Others
Percentage (%)	43	55	42	58	67	0

30. If you mark others for Q. 29, what is/are the factor/s consider in relation to manufacturing system?

Section 4 Distribution System Part

	Excellent	Very good	Good	Fair	Poor	Omitted
31.What is the staffs' awareness level of outbound logistics?	11%	20%	37%	19%	13%	0%
	Very high	High	Low	Very low	None	Omitted
32. To what extent does the plant measure the outbound logistics?	13%	12%	27%	26%	22%	0%

33. List the types of services your plant provides to customers?

- After sales service for the customers
- Providing best Quality, Price, Quantity product with in required time, distribution, handling of their complain, and customer sales promotion.
- Automotive & machine maintenance, renting of machine

34. Describe the relationship between customers and suppliers in your plant?

- We have good contact with our suppliers, and end users (customers) (43%)
- Some complaints due to delay in delivery 30%
- It had been very strong for many years. But now It is relatively weak (12%).
- I have no idea, I think it is very poor (15%)

35. Indicate the distribution channels used in the company to reach to the customer:

	Branch warehouses	Direct sales	Others
Percentage (%)	75	86	0

36. If you mark **others** for Q. 35, describe distribution channels?

- They don't respond other method..

37. Write the number of each distribution channels in your plant.

Range	Branch warehouses	Direct sales
	%	%
1	63	42
2	37	58

38. Write the major areas (cities) of the plant's distribution of its product?

Town	Addis Abeba	Mekele	Combolicha	Bahirdar
Frequency	33	48	12	7

39. Indicate the factors that should be considered for proper decision of the **outbound** logistics:

	Warehouse location	Warehouse size and capacity	Local Regulations	Number of Carriers	Number of Warehouse	Tax Implementation	Others
%	67	62	38	42	59	38	0

40. If you mark **others** for Q. 39, list all of them? They don't respond other method.

Appendix 9: The Structured Interview Questionnaires case of MIE

Addis Ababa University
School of Graduate Studies
Faculty of Technology, Department of Mechanical Engineering
Graduate Program in Industrial Engineering

Structured interview Questionnaires

MODEL DEVELOPMENT OF SUPPLY CHAIN MANAGEMENT SYSTEM: A CASE STUDY ON MESFIN INDUSTRIAL ENGINEERING PLC

By: Mesfin Berhane

Mechanical Engineering (Industrial Engineering Stream) studies, 2006 /7

Part I: please answer the following questions clearly and carefully. If a question is not clear please try to make a remark in front of it

1. **Date of interview**: 25/02/07__
2. **Name of the Company**: Mesfin Industrial Engineering PLC
3. **Industry/Sector type:** Manufaturing
4. **Company Website**: www.mie-ethiopia.com
5. **When was the Company established?** 1993 G.C/1985 E.C.
6. **How much is your Company's current capital (in Birr)?** About 170 million
7. **The total number of employees:** Permanent =460, Contract =26, Temporary= Varied
8. **Company address:** Mekele, worda semen, Kebele =06
9. **Company Telephone/Fax:** Tel.= +251-034-4406800, Fax =+251-034-4406225
10. **Company E-mail**: mie@ethionet.et_

Part II: Personal Information and knowledge

1. Interviewee's current position: Quality Management Represent Mgr, Planning & Information Technology Mgr., Finance Mgr., Human Resource Mgr., Procurement, Store& Supply Mgr. and Manufacturing Mgr., Design & Technology Center Mgr., Electro–Mechanical Work center Mgr., Vehicle Maintenance & Equipment Repair Mgr., Marketing & Sales division Mgr, & Industrial Maintenance Center Mgr.

2. Experience in year: 19, 8, 25, 23, 26, 22, 9 ,14,15,5,16 Years respectively

3. Qualification (s): B.Sc., B.Sc., B.A., B.A., B. Sc, B. Sc, B. Sc, B. Sc, B. Sc, B. Sc, & B. Sc

4. Field of Study: Chemistry, Industrial Engineering, Accounting, Educational administration, Accounting, Industrial Engineering, Marketing, Mechanical Engineer, Industrial Engineering , Industrial Engineering & Industrial Engineering

5. Gender: Male, Male, Male, Male, Male, Male, Male, Male, Male, Male, & Male,

Guidelines for Interview

To be filled By Human Resource Department

- Organization structure
- Human resources power by education level, sex, department, age group, etc…
- Interdepartmental relation (Internal customer relation)

Human Resource by Education Level of the Plant

1. Draw the organizational structure of your Plant. It is drawn on appendix-5
2. What is the total area of your Plant in square meter? 120,000m^2

Number of Employees by Education (Permanent employee Only) For The month of May/2007																										
S.N	**Plant/Department**	**PhD**		**MA/MSc**		**BA/BSc**		**Adv.Diploma**		**Diploma**		**Certificate**		**Vocational**		**9-12 Grade**		**5 - 8 Grade**		**4 & Below**		**DNA**		**Sub Total**		**Grand Total**
		M	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**
1	General Manager	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**	**0**	**1**
	Internal Auditor	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**	**0**	**1**
	Planning & IT	0	0	0	0	7	1	3	0	4	2	0	0	0	0	0	0	0	0	0	0	0	0	**14**	**3**	**17**
	MR For QMS	0	0	0	0	3	0	7	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	**11**	**0**	**11**
2	Deputy GM (Operation& Engineering)	0	0	0	0	1	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	**3**	**1**	**4**
	Design & Technology Center	0	0	0	0	28	0	4	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	**33**	**2**	**35**
	Manufacturing	0	0	0	0	6	0	22	0	27	2	14	1	5	0	31	0	5	0	1	0	1	0	**112**	**3**	**115**
	Industrial Maintenance	0	0	0	0	5	0	3	0	14	0	2	0	1	0	2	0	1	0	0	0	1	0	**29**	**0**	**29**
	Electro Mechanical Erection	1	0	0	0	6	0	0	0	3	0	0	0	0	0	1	0	0	0	0	0	0	0	**11**	**0**	**11**
	Equip. Maintenance & Rental	0	0	1	0	3	0	8	0	14	0	8	1	1	0	8	2	9	0	2	0	4	0	**58**	**3**	**61**
3	Deputy GM (Project	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**	**0**	**1**
	Machine shop, Foundry & Forging Plant	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**	**0**	**1**
	Dukem Subsidiary Plant Project	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**	**0**	**1**
	Structural Steel Manaufacturing Plant	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**	**0**	**1**
4	Deputy GM (Marketing)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	**0**	**0**
	Sales & Promotion	0	0	0	0	6	0	2	0	4	1	4	0	0	0	2	2	0	0	0	0	0	0	**18**	**3**	**21**
	Business Development	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	**0**	**0**
5	Deputy GM (Serivice)	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**	**0**	**1**
	Finance	0	0	0	0	2	4	0	0	12	5	0	0	0	0	1	2	0	0	0	0	0	0	**15**	**11**	**26**
	Supply	0	0	0	0	7	0	0	0	7	6	3	0	0	0	4	5	2	0	0	0	2	0	**25**	**11**	**36**
	HR	0	0	0	0	3	0	1	0	7	3	0	1	0	0	10	5	20	6	21	2	7	1	**69**	**18**	**87**
	Grand Total	**1**	**0**	**3**	**0**	**82**	**5**	**50**	**1**	**95**	**20**	**31**	**3**	**8**	**0**	**59**	**17**	**37**	**6**	**24**	**2**	**15**	**1**	**405**	**55**	**460**

To be filled By Finance Department

- Inputs (direct and indirect raw materials, etc) and annual consumption
- Products costing
- Supply chain cost analysis
- What is your company's existing costing analysis? It is drawn on Figure 7-1

Direct, indirect and packing raw materials, cost and their sources for MIE

Direct Raw Materials	Cost/year for the year 2006	Source	Indirect Materials	Cost/year for the year 2006	Source
Raw materials	36,290,997				
Components &Accessories	66,586,650				
spare parts	2,624,961				
Chemicals & gas	3,683,992				
General materials	3,789,859				
Fixed Asset	1,794,595				
Total	114,771,054				

Percentage by Quantity and Cost of Products of Mesfin Industrial Engineering PLC

Types of Product	Quantity Produced Per Year	Percentage By Quantity	Cost Of Product Produced Per Year [Birr]	Percentage By Cost
Dry cargo Truck body	220	33		
Dry Cargo Trailer	230	34.2		
Fuel cargo Truck Tanker	82	12		
Fuel Cargo Trailer Tanker	87	13		
Dry Cargo Semi-Trailer	27	4		
Fuel Cargo Semi-Trailer	26	3.8		
other	34	4.8		
	706			

1. What is your company's existing costing (Product cost) analysis?

Production cost analysis, distribution cost analysis and administration cost analysis.

Job Order Costing Engineering estimation costing

2. Supply Chain Cost Analysis Drivers (Parameters):

they didn't use it till now.

Supply chain cost analysis drivers

Description		**Year/ unit Cost (Birr) for the year 2006**
In put node cost	External works price paid to the vendor	81,458.08
	Others	---
Total in put node cost		81,458.08
Flow cost	Transit insurance costs, etc	-----
	Freight costs	13,426.22
	Others	---
Total Flow cost		13,426.22
Barrier cost	Sales tax	---
	Custom duties	---
	Excise tax	---
	Others	39,174.05
Total Barrier cost		39,174.05
Node activity cost	Delay cost	---
	Custom clearance costs	---
	Loading/unloading cost	26,566.64
	Inventory cost	---
	Damage/ in transit damage cost	---
	Others	---
Total Node activity cost		26,566.64
	Total	**163,281.79**

<u>To be filled By Marketing or Sales Department</u>

- Customer-supplier relationship
- Types of services
- Market share in Major Areas
- Percentage of products distribution
- Distribution channels

Fill Your Answers in the blank space and Put a tick (✓) mark for Yes/No questions.

1. Does your company establish promotional schemes? Yes ☐✓ No ☐
2. If your answer is yes for Q. 1, how much total cost incurred for promotional schemes?

   It is incurred about Birr 60,000.
3. Does your company establish advertisement campaigns? Yes ☐ No ☐✓

4. If your answer is yes for Q. 3, how much total cost incurred for advertisement campaigns?

   _____

5. Has your company made seasonal discount? Yes ☐ No ☐✓
6. If your answer is yes for Q. 5,

   a. At what season?

   _____

   b. How much discount?

   _____

7. Does the company have customer survey or analysis mechanism? Yes ☐✓ No ☐
8. If your answer is yes for Q. 7, which types of customer analysis mechanism is your company used?

   We used Customer satisfaction level analysis using SPC Tools

9. Percentage of Distribution of Different city for Mesfin Industrial Engineering Plant

Distribution city	**Percentage (%) of Distribution/year**
Mekelle	15
Addis Ababa	80
Bahirdar	2
Combolicha	3
Distribution city	Market share of Distribution/ year
Mekelle	90
Addis Ababa	70
Bahirdar	50
Combolicha	50

Competition & Supply

10. Are you a leader or a follower in a market in which you operate?

- Leader in truck-trailer related products
- Leader in manufacturing & erection of petroleum reservoir tank
- Beginner in electromechanical erection services

11. How much is your market share in each of your product lines?

- Dry cargo Truck-Trailer– 70%
- Fuel cargo Truck-Trailer-80%
- Electro mechanical erection service- 20%
- Light vehicle maintenance: - Not yet studied
- Heavy vehicle maintenance:-
- Renting of dump truck: - 67% of total supply of Pozolona is covered by MIE's dump trucks.

12. Please list down your major competitors in each of your product lines

Product 1		**Product 2**		**Product 3**	
Dry Cargo		**Fuel Cargo**		**Electromechanical service**	
Competitors	**Mkt share**	**Competitors**	**Mkt share**	**Competitors**	**Mkt share**
Maru PLC	25%	Maru PLC	18%	Chinese company	
Techale	3%	Other	2%	Sintech	
Others	2%			Techtra Engineering	

13. Enumerate your competitors' major weaknesses and strengths.

Weaknesses

- Limited Financial & managerial capacity,
- Not reliable service-on quality
- Lack of machineries & facilities
- Have no qualified workers- certified welder
- Low plant capacity
- Poor organization-family owned

Strength

- Fast decision (highly responsive) – on purchase, setting price
- Flexibility- on procedure
- Higher resource utilization - labor
- Fast delivery

- Small overhead costs
- Proximity to market-location
- They don't respect government rules- corruption

To be filled By Manufacturing department

- Inputs (direct and indirect raw materials, etc) and annual consumption
- Manufacturing process flow
- Production capacity
- Product Costing
- Types of products:

Fill Your Answers in the blank space and Put a tick (✓) mark for Yes/No questions.

1. List the type of **products** of your company manufactures?
   Low bed, fuel truck , fuel trailer, dry semi trailer, fuel semi trailer and depot tankers, cranes, crushers, storage tankers .
2. Describe the type of service provide for your **internal & external** customer?
   Maintenance, after sales service, different tasks up on request by customers.
3. List the **direct** raw materials used for the production process?
   Electrical system, Axle, brake system, sheet metal Tyre, turn table, RHS, Flat bar, and rim.
4. List the **indirect** raw materials used for the production process?
   Welding wire, Discs, Paints, different consumables safety items
5. Enumerate the manufacturing **process flow** of your products? Materials withdrawals→ materials preparations →fabrication →painting →finishing→ delivery to store.
   materials preparation→Assembly→welding→painting & finishing.
6. What is the **production capacity (designed & attainable)** of your company for the products enumerated above?

3 units of dry cargo trucks trailer per day
3 units of fuel trucks with its trailer per day, 1000 trailers.

I. Annual Designed capacity per each product line in Qty/Ton

a. Fabrication & Erection

Assumption: - material preparation works in three shift.

S/No	Product Type	UOM	Weight In Ton/Unit	Annual Capacity	
				In quantity	In Ton
01	3-Axel Dry cargo Truck-Trailer	Units	4.1+2.7= 6.8	1,540	10,472
02	3-Axel fuel cargo Truck-Trailer	Units	3+5=8	1,680	13,440
03	Fabrication of Roof sheeting, bottom sheeting & accessories	Units	60	48	2,880
04	Erection of petroleum storage tank	Units	30	48	1,440

b. Maintenance of Vehicle & renting

S/No	Service Area	UOM	Designed capacity	
			Per a day	Per annual
01	Light Vehicle maintenance	Units	9	2,250
02	Heavy Vehicle maintenance	Units	21	5,250
03	Transportation – 00k/m	Ton	1062	265,500

c. Maintenance service

- To give industrial maintenance service to all EFFORT owned company

d. Project

- Steel rolling mill

IV. Current attainable capacity per each product line in Qty/Ton.

a. Fabrication

S/No	Product Type	UOM	Weight In Ton/Unit	Annual Capacity	
				In quantity	In Tons
01	3-Axel Dry cargo Truck-Trailer	Units	4.1+2.7= 6.8	900	6.120
02	3-Axel fuel cargo Truck-Trailer	Units	3+5=8	900	7,200
03	Fabrication of Roof sheeting, bottom sheeting & accessories	Units	60	40	2,400
04	Erection of petroleum storage tank	Units	30	40	1,200

b. Maintenance of vehicles & renting

S/No	Service Area	UOM	Attainable Capacity	
			Per day	Per annual
01	Light Vehicle maintenance	Units	6	1,500
02	Heavy Vehicle maintenance	Units	18	4,500
03	Transportation – 00k/m	Ton	710	177,500

7. What is the average consumption of **direct** raw materials (inputs) per year in Kg or other units? Around 600 tons per year

S/No.	Direct materials	Annual Consumption
1		
2		
3		
4		
5		
6		
7		
8		

8. What is the average consumption of **indirect** raw materials (inputs) per year in Kg or other units?------

S/No.	Indirect materials	Annual Consumption
1		
2		
3		
4		
5		
6		
7		
8		
9		

10		

9. Which raw material/s is/are the **highest quantity** used to manufacture one of your products? First Axle, second sheet metal and third sheet plate
10. What is the cost of transportation of a product to transport from the Plant to the customer? Most of the time the delivery is in plant premises
11. What is the cost of transportation of raw materials to transport from the source to the Plant? The cost is 0.70 cents per ton per km most of it is from Djibouti to mekele 839 km & transport quantity is abount 5000 meteric ton/year=.70*839*5000=2,936,500 cent/year.

To be filled By Procurement, Store and Supply Department
Fill Your Answers in the blank space and Put a tick (✓) mark for Yes/No questions.
1.Lists of products/services of your company?

Major product/Services:-

A-Existing product/services

a. Fabrication

- 3-Axle draw bar Dry cargo Truck-Trailer (payload 20 Ton)
- 3-Axle dry cargo semi-Trailer – (payload 40 Ton)
- 2-Axle dry cargo semi-Trailer – (Payload 35 Ton)
- Low bed- (Payload 60 Ton)
- 3-Axle draw bar fuel cargo Truck-Trailer- (Payload 43 m^3)
- 3-Axle fuel cargo semi-Trailer-(Payload 43 m^3)
- Dump Truck-Afro & Miller type (capacity 10 m^3, 14m^3)
- Antenna Mast (up to 60 meter height)
- Underground & over ground tanker-d/t capacity
- Crusher (25-100 tph)
- Petroleum Reservoirs tanks (5,000m^3 -5,600 m^3)
- Over head crane (10t, 5t, 3.2t- up to 30 Ton)
- Bus Body (40+1, 60+1 seat).

b. Electromechanical erection,

- Supply & Erection of pre engineering buildings & towers
- Installation of Machines & equipment
- Erection of petroleum reservoir tanks capacity of 5,6000 m^3 with electrical & instrumentation
- Erection & installation of HVAC system

- Installation of digital congress network, Audio visual system, stage lighting & machinery installation.
- Erections of towers

c. Renting of Vehicles & machinery

- Afro damp truck- 10m^3 capacities
- Crane 50 ton capacity

d. Maintenance of vehicles

- Light vehicle maintenance-TOYOTA ,NISSAN,
- Heavy vehicle maintenance-Afro Truck

B-Potential product/service:-

a. Industrial Maintenance of machinery & equipment

- Hydraulics & Pneumatics maintenance
- Salvaging (Overhaul maintenance) of motors, gear box, pumps, valves etc
- Electronics card maintenance
- Electrical control system (PLC, CNC, DNC,PID…) maintenance
- Rewinding & rebuilding of Motors & Transformers
- Plant maintenance(reconditioning)

b. Projects

- Production of Concrete poles
- Cold room
- Manufacturing of Spare parts for machinery & equipment(M/c shop)
- Supply of Tractors
- Assembling of Axels
- Pre engineering building
- Transformer
- Small tractors (power trailer)
- Production of Reinforcement bar, Angle Iron, RHS ...

c. New products under development

- Construction machinery
    - Crusher-25 ton
    - Hollow concrete blocket machine - 4,
    - Concrete Mixer -500 liters.
- Honey extractors
- Liquid waste truck/Septic tank-
- Steam boiler
- LPG tank

- Silencer
- Solid waste packer
- Radiator

Hollow concrete Block (HCB) machine.

2.Lists of direct raw materials?

a. Raw materials, of different quality- St-37 up to St-52.

- Sheet metal thickness 2, 3, 4 mm & length up to 6,000 mm.
- Steel Plate thickness 5, 6,7,8,10,12,14,15,16,18 up to 120mm.and length up to 13,000 meter.
- Chequered plate, 2^{+2},3^{+2},4^{+2},6^{+2} mm
- Flat bar thickness 8, 10,12,15 mm ,width of 45,150,180,200,230,250 & 6,000mm length
- I-beam 140*140,160*160,200*190 mm & length of 6,000mm
- Pipe $\boldsymbol{ø_{Ex}}$=50mm ,42mm ,32 mm, 1",3" ,4"
- Round rod $\boldsymbol{ø_{Ex}}$=76 *18 ,55 mm
- U-channel 50*25*5,60*30*6,80*45*6mm
- RHS,80*30*2.5 ,40*40*2.5mm
- Angle Iron,40*40*4mm

b. Component & accessories,

- Axel with suspension-12 ton
- Manhole accessories for fuel tanker
- Rim disk type- 8"x20"
- Breaking system
- Electrical system
- Tire – 12*20
- Hydraulic Jack
- Mudguard rubber
- Bolt, Nut & washer – M8,14,24
- Rivet

c. Spare parts,

- For light vehicle
- For Afro truck & dump truck

3.Lists of indirect raw materials?

Consumables & Gas

- Electrode ø=2.5, 3.2 mm

- Welding wire ø=1, 1.2 mm
- Oil & lubricant –
- Fuel
- Cutting & Grinding disc
- Antirust paint
- Final paints
- Stucco
- Canvas sand paper # P60, #P320, #P220,# P120
- Benzene
- Abujedid
- Oxygen
- Acetylene **(C_2H_2)**
- Carbon dioxide **(C_2O)**

4.How do you define supply chain management based on the context of your company?
The relation ship between MIE, Suppliers and manufacturers.

5.What type of where house do your company have (bounded / enclosed or open air or other)? Open and closed

6.If your answer is bounded / enclosed for Q. 5, Where is its location and how far from the plant? It is 20 meter and for other 200 m
It is located at Mekelle near to the factory & Addis Ababa (785 km)

7.If your answer is other for Q. 5 is other, describe the type of warehouse?
_____

8.Does your company use supply chain inventory (SCI) analysis method? Yes ☐ No ☐√

9.If your answer is **yes** for Q. 56, What are the different costs within supply chain inventory analysis method used?
_____

10. If your answer is **No** for Q. 56, what is your company's of inventory analysis method?
Order or demand base of inventory method

11. Does your company use supply chain cycle time (SCCT) analysis method? Yes ☐√ No ☐

12. If your answer is **yes** for Q. 59, What are the different costs within supply chain cycle time analysis method used?
_____

13. If your answer is **No** for Q. 59, what is your company's method of for the cycle time of the products? It is based request-Delivery/lead time methods.

To be filled by Industrial Maintenance (IMC) Department

- The cost of maintenance and down time due to machine breakage.
- Cause and effect for breakage of bottles, Crown corks and others

Fill Your Answers in the Blank Space Provided.

1. Enumerate the cause for breakage of materials?
   Wear & tear, overload, poor quality of materials, materials handling problem, bad working condition and lack of proper care.
2. List the cause for breakage of machines?
   Machine handling problem, Ageing, poor preventive maintenance, lack of proper operation, and wear of spare.
3. Write the effect for breakage of materials?
   Production loss and down time
4. Describe the effect for breakage of machines?
   Loss of production, high maintenance cost, delay of production, cost of spare & labor, customer dissatisfaction
5. Write the cost of maintenance due to materials breakage?
   Spare & down time cost ,around Birr 140,000 per month
6. The cost of maintenance due to machine breakage?
   Spare & down time cost , around Birr 200,000 per month.
7. The cost of down time due to materials breakage?
   Around Birr 1,000 per hour
8. The cost of down time due to machine breakage?
   _ Around Birr 1,000 per month

Investment

- Total amount invested in land, building, plant equipment, R & D and innovation

Description	Before 1996	1996 Budget Year	1997 Budget Year	1998 Budget Year
Land				
Plant & machinery		3,636,994	307,382	4,048,098
Office Equipment		185,947	378,612	217,507
Building		1,107,040	2,551,830	427,308
R & D				
Innovation				

A. Inventory

I. 3.4.1. What is the value of inventories of finished good for?

1996 Budget Year	1997 Budget Year	1998 Budget Year
6,905,411	5,626,292	2,359,697

II. What is the value of your inventories work in progress for?

1996 Budget Year	1997 Budget Year	1998 Budget Year
11,875,820	8,239,720	21,628,509

III. What is the value of inventories of raw materials excluding fuel?

1996 Budget Year	1997 Budget Year	1998 Budget Year
52,392,347	60,438,954	70,436,610

IV.What is the value of dead stock for

1996 Budget Year	1997 Budget Year	1998 Budget Year
9,965,153	9,965,153	9,965,153

Company:-MIE

Two years detailed product sales data

S/N	Description of products sold	SITC Code	Sales in 1996 Budget Year		Sales In 1997 Budget Year		Sales In 1998 Budget Year		1998 Budget Year (buyers)			
									Domestic		Foreign	
			Qty	Value	Qty	Value	QtY	Value	Qty	Value	Qty	Value
A	Products/Services											
1. Manufacturing & steel construction plant												
1.1	3-Axel drawbar dry cargo Trailer		64	15,256,849	31	7,811,830	334	92,176,583	334	92,176,583	-	-
1.2	Dry cargo body truck		53	3,235,949	23	1,487,167	304	16,810,717	304	16,810,717	-	-
1.3	3-Axel dry cargo semi-trailer						18	5,157,051	18	5,157,051	-	-
1.4	2-Axel draw bar fuel cargo trailer		4	693,913	2	382,609	1	157,343	1	157,343	-	-
1.5	3-Axel drawbar fuel Trailer		65	16,576,271	2	556,522	-	-	-	-	-	-
1.6	Fuel cargo body for heavy truck		64	4,690,435			-	-	-	-	-	-
1.7	Fuel cargo body for 2-axel truck		9	929,722			-	-	-	-	-	-
1.8	3-Axel fuel cargo semi-trailer		6	2,155,681			-	-	-	-	-	-
1.9	Low bed		1	420,772	3	1,329,845	-	-	-	-	-	-

1.10	Local supply of fuel depots for NPRDA		-	-			12	17,475,051	12	17,475,051	-	-
1.11	Agricultural Trailers		-	-			12	483,216	12	483,216	-	-
1.12	Bottom & annular bottom		7+23	1,711,677			-	-				
1.13	Roof & its accessories		25	10,069,130			-	-				
1.14	Shell accessories		25	2,327,196			-	-				
1.15	Plasma screen stand		1,119	3,638,073			-	-				
1.16	11.2 m3 fuel tanker to be mounted on Ural Truck		-	-			25	1,100,375	25	1,100,375	-	-
1.17	Honey extractor				1750	4,043,812						
1.18	Queen Excluder				34749	1,772,199						
1.19	Oxygen (M^3)			229,560	8176	130,407	8180	130,471	8180	130,471	-	-
1.20	Acetylene (Kgs)			326,991	2919	276,663	2050	194,299	2050	194,299	-	-
1.21	Miscellaneous		LS	2,512,813		4,305,863	LS	792,352		792,352	-	-
	Sub total			**64,433,703**		**22,745,316**		**139,031,878**		**139,031,878**		
2.Industrial Maintenance & Electromechanical service plant												
2.1	Supply, installation & fixing of electromechanical works at Semera							1,810,813		1,810,813		
2.2	Erection depots on					20,042,461		3,473,295		3,473,295		

	Combolcha & Sululta site											
2.3	Miscellaneous					150,911						
	Sub Total					**20,193,371**		**5,284,108**		**5,284,108**		
3.Vehicle Maintenance & Rental Department												
3.1	Rental of dump Tucks			800,000		4,094,738		5,848,056		5,848,056		
3.2	Reconditioning shop			341,329		401,327		591,302		591,302		
3.3	Maintenance of Heavy Vehicles			1,354,792		1,376,683		1,586,203		1,586,203		
3.4	Maintenance of Light Vehicle			-		1,037,391		2,596,667		2,596,667		
3.6	Sales of dump truck		2	784,153				-		-		
3.7	Sales of afro truck shop		1	535,000				-		-		
3.8	Sales of cargo truck - dry cargo		1	452,174				-		-		
3.9	Sales of spare parts		LS	2,310,838		1,709,935		3,335,496		3,335,496		
	Sub total			**6,578,286**		**8,714,319**		**13,957,725**		**13,957,725**		
	Total Product sales			**71,011,989**		**51,653,007**		**158,273,711**		**158,273,711**		
2	By-Product											
	Total By-Product sales											

Note. SITC Code will be given at a corporate office

Company:- MIE

Three years' Detailed Production Data

S/N	Description of products sold	SITC code	Production In 1996 B.Y		Production In 1997 B.Y		Production In 1998 B.Y	
			Qty	Value	Qty	Value	Qty	Value
A	Products/Services							
1. Manufacturing & steel construction plant								
1.1	3-Axel drawbar dry cargo Trailer		64	12,369,703	31	6,140,455	334+40	80,034,169
1.2	Dry cargo body truck		53	2,777,352	23	1,104,366	304+40	10,959,713
1.3	3-Axel dry cargo semi-trailer						5	1,220,306
1.4	2-Axel draw bar fuel cargo trailer		4	636,627	2	318,314	1	146,329
1.5	3-Axel drawbar fuel Trailer		65	14,227,082	1	209,440	-	-
1.6	Fuel cargo body for heavy truck		64	4,000,003			-	-
1.7	Fuel cargo body for 2-axel truck		9	792,867			-	-
1.8	3-Axel fuel cargo semi-trailer		6	1,863,586			-	-
1.9	Low bed		1	281,483	3	844,449	-	-
1.10	Local supply of fuel depots for NPRDA		-	-			12	16,569,414
1.11	Agricultural Trailers		-	-			12	678,840
1.12	Bottom & annular bottom		7+23	2,570,149			-	-

1.13	Roof & its accessories		25	7,849,905			-	-
1.14	Shell accessories		25	1,449,504			-	-
1.15	Plasma screen stand		1,119	2,429,595			-	-
1.16	11.2 m3 fuel tanker to be mounted on Ural Truck		-	-			25	990,338
1.17	Honey extractor				1,705 0	3,150,000		
1.18	Queen excluder					1,592,025		
1.19	Oxygen (M^3)			119,112		84,726	8180	65,276
1.20	Acetylene (Kgs)			211,806		176,588	2050	165,148
1.21	Miscellaneous		LS			3,387,201	LS	673,499
	Sub total			**52,754,247**		**17,775,269**		**116,512,624**
2.Industrial Maintenance & Electromechanical service plant								
2.1	Supply, installation & fixing of electromechanical works at Semera							1,991,895
2.2	Erection depots on Combolcha & Sululta site				17	17,846,546		2,778,636
2.3	Miscellaneous					114,386		
	Sub Total					**18,408,454**		**4,770,531**
3.Vehicle Maintenance & Rental Department								
3.1	Rental of dump Tucks					3,622,264		4,977,970
3.2	Reconditioning shop			273,063		767,704		502,607

3.3	Maintenance of Heavy Vehicles			1,083,833		108,516		1,554,479
3.4	Maintenance of Light Vehicle			-		100,000		2,466,834
3.6	Sales of dump truck		2	95,824		-		-
3.7	Sales of afro truck shop		1	465,217		-		-
3.8	Sales of cargo truck - dry cargo		1			-		-
3.9	Sales of spare parts		LS	1,848,670		598,024		2,501,622
	Sub total			**3,766,608**		**4504,233**		**12,003,512**
	Total Product sales			**57,754,247**		**39,971,157**		**133,286,667**
2	By-Product							
	Total By-Product sales							

Note. SITC Code will be given at a corporate office __

Two years Detailed Raw materials procurement Data

S/N	Description of inputs/materials	Purchased for 1997 Budget year		Purchased for 1998 budget year		Supplier in 1998 Budget Year			
		In Qty	In value	In Qty	In value	Domestic		Foreign	
						In Qty	Value	In Qty	Value
1	Raw Materials purchased including fuel								
1.1	Raw Materials		5,387,251		22,130,378		655,747		21,474,631
1.2	Components & accessories		20,907,484		52,635,278		8,397,428		44,237850
1.3	Spare parts		9,751,720		12,115,423		2,414,545		9,700,878
1.4	Other supplies like safety items,		3,483,636		2,574,859		2,363,457		211,403
1.5	Consumable like fuel		2,522,465		3,295,149		2,717,675		577,475
	Total		**42,052,557**		**92,751,089**		**16,548,852**		**76,202,237**
2	Utilities consumed								
2.1	Electricity		630,000		620,000				
2.2	Water		20,000		42,000				
2.3	Telephone, Fax & Internet		79,000		429,323				
2.4	Fuel & Lubricant		370,000		1,760,000				
	Total Utilities consumed		1,099,000		2,851,000				

Note. SITC Code will be given at a corporate office

Company:- MIE
Two years detailed employee Wage & salary

S/N	Description of inputs	SITC Code	1997 Budget year		1998 Budget Year	
			Quantity (employees)	Wage & Salary	Quantity (employees)	Wage & salaries
3	**Internal Labour**					
3.1	**Direct labour**		**255**	**221,327.00**	**259**	**941,452.00**
3.1.1	**Permanent**					
1	Forman		30	38,951.00	30	50,232.00
2	Welder		68	55,468.00	64	726,540.00
3	Machinist		13	10,915.00	17	18,318.00
4	Mechanic		73	56,674.00	55	56,690.00
5	Electrician		19	15,245.00	16	17,614.00
6	Fitter		1	818.00	1	1,176.00
7	Flame Cutter		2	1,104.00	1	855.00
8	Body Man		9	8,476.00	8	10,009.00
9	Draftsman		3	2,814.00	3	3,221.00
10	Forklift & Crane Operator		6	4,779.00	5	4,819.00
11	Foundry Man		1	747.00	-	-
12	Inspectors		9	9,658.00	9	12,233.00
13	Painter		9	6,900.00	9	9,479.00
14	Radiator Man		1	623.00	1	896.00
	Sub Total		**244**	**213,172.00**	**219**	**912,082**
3.1.2	**Long term contract & Temporary**					
1	Construction Forman		-	-	2	3,500.00
2	Welder		-	-	7	5,105.00
3	Mechanic		7	5,714.00	14	11,018.00
4	Electrician		1	1,027.00	1	1,178.00

5	Flame Cutter		1	378.00	2	1,246.00
6	Machine Operator		-	-	6	3,115.00
7	Assistance Mechanic		-	-	6	3,258.00
8	Painter		1	586.00	-	-
9	Tyre Man		1	450.00	2	950.00
	Sub Total		**11**	**8,155.00**	**40**	**29,370.00**
	Grand Total		**255**	**221,327.00**	**259**	**941,452.00**
3.2	**Indirect (overhead)**		**234**	**230,131.00**	**292**	**356,906.00**
3.2.1	**Permanent**					
1	Top Managers		13	42,726.00	13	62,130.00
2	Division Managers		20	39,699.00	26	74,065.00
3	Production Manager		11	15,400.00	-	-
4	Engineer		8	11,683.00	23	40,457.00
5	Other Office Workers		78	66,639.00	90	98,180.00
6	Drivers		16	10,341.00	16	11,145.00
7	Guards & Cleaners		40	12,484.00	41	16,656.00
8	Truck Driver		5	4,210.00	10	10,760.00
	Sub Total		**191.00**	**203,182.00**	**219.00**	**313,393.00**
3.2.2	**Temporary & Long term**					
1	Bus helper		2	458.00	-	-
2	Drivers		28	22,506.00	29	26,866.00
3	Guards & Cleaners		9	2,429.00	33	10,889.00
4	Other Office Workers		4	1,556.00	11	5,758.00
	Sub Total		**43.00**	**26,949.00**	**73.00**	**43,513.00**
	Total		**234**	**230,131.00**	**292**	**356,906.00**
	Total (internal employee)		**489**	**451,458.00**	**551**	**1,298,358.00**
4	**Subcontractors**					
1	Welders/Fitters				60	

2	Painters				20	
3	Daily labourer				150	
	Sub Total				**230**	
	Grand Total Labour				781	
5	Capital Stock (Book values)					

Note. SITC Code will be given at a corporate office

Appendix 10: The SWOT analysis of SYNERGY and Cooperation in EFFORT sister companies

I. Vertical Relatedness

- Percentage value of your raw materials produced by other companies operating in the domestic market.
- It is very negligible about 0.8 % , the price is as following

Description of raw Materials	UOM	1996 Budget Year		1997 Budget Year		1998 Budget Year	
		Qty	Price	Qty	Price	Qty	Price
Paints	Gallon	30,355	707,153	5,221	319,685	3,327	629,731
Mudguard	Pcs					800	25,872
Aluminum Water tanker	Units					573	166,560

- Percentage value of your raw materials produced/supplied by other sister companies operating in the domestic market.
  - In 1996 there was no materials supplied by sister company. **i.e. 0%**
  - In 1997 it was reached to **8.3%**

Description of Raw materials	Companies	UOM	1996 Budget Year		1997 Budget Year		1998 Budget Year	
			Qty	Price	Qty	Price	Qty	Price
Pirelli tyre **12*20**	TEPLCO	Pcs	-		-		4181	8,362,000

- Percentage value of your products /output purchased by other sister companies operating in the domestic market.

Description output sold to sister companies	Companies	1996 Budget Year	1997 Budget Year	1998 Budget Year
Dry cargo Truck-Trailer	TEPLCO	21%		24%

N.B. 50 units + 100 units of Bogie-Type dry cargo-Trailer

There were also some small works like:-

- Motor winding
- Modification of machineries
- Reconditioning of engine parts
- Sales of oxygen & Acetylene
- Fabrication of miscellaneous work

- Percentage value of Services(technical, maintenance etc....) you have purchased from sister companies

Description of services	Companies	1996 Budget Year	1997 Budget Year	1998 Budget Year
Transportation of inputs	TEPLCO	100%	97%	97%

from Djibouti to Mekelle				

- Percentage value of Services (technical, maintenance etc...) you supplied to sister companies

Description of services	Companies	1996 Budget Year	1997 Budget Year	1998 Budget Year
Transporting of Posoland	Messobo		!00%	100%

Vehicle maintenance & equipment renting

Description of services	Companies	1996 Budget Year	1997 Budget Year	1998 Budget Year
Maintenance	TEPLCO	-	5	10
	Guna	-	08	10
	Ezana Mining		10	11
Maintenance	Messbo		50	50
Maintenance	Saba Dimensional		10	10

- Percentage value of logistics (transport, warehouse & stores etc...) you have purchased from sister companies

Description of logistics	Companies	1996 Budget Year	1997 Budget Year	1998 Budget Year
• **Transport**	**TPLCO**	**100%**	**97%**	**97%**

- Percentage value of logistics (transport, warehouse & stores etc...) you supply to sister companies.

Description of logistics	Companies	1996 Budget Year	1997 Budget Year	1998 Budget Year

- With which sister companies that you have linkage, which are enough to share knowledge & expertise? (Put tick mark under linkage areas).

Company's	Technology	R &D	Market	Best practices of the company

- Could you list down core problems in synergies that have already been created among you and your sister companies? (Put a shaded mark).
  - Lack of clarity of the concept of synergy ■
  - Failure to identify synergy areas ■
  - Lack of commitment among partners ■
  - Coordination mechanism;
    - Fail to agree on prices of product/Services ☐
    - Problem on quality of products/services ☐
    - " " Delivery of products/services ☐

⇒ If other, please describe it

_____

⇒ According to your opinion, is synergy a source of competitive capability of Business?

Yes ■ No □

If your answer is No, please clarify it

_____

⇒ If yr answer is yes, please describe what should be done by EFFORT & its companies to utilize existing synergy potentials.

- To utilize existing synergy potentials the management of each company should thoroughly discussed & understand the concept of synergy and apply it effectively.
- To well develop this it needs wide experience of international corporatatios in the form of training
- EFFORT should give due attention & serious follow up and take appropriate action for synergy failure.
- More over the synergy has to be practiced under equal freedom of each company unless otherwise it is disastrous.
- During Expansion of Factories, Plants and Technical Procurement of machine & equipment, EFFORT should include MIE on the Technical Committee.
- EFFORT should ensure, companies have multi-skilled & competent commission agent with close & good relationship of machinery, equipment and spare parts suppliers & manufacturers-in strategic location some where in Europe & Middle East. To facilitate TT, L/c opening, to get fast service.
- On time financial reconciliation among sister companies.

II. Horizontal Relations

⇒ Do you have an idle physical resource like machine tools, built warehouses and other fixed, invisible asset?

Yes ■ No □

- Afro dry cargo Trailer
- MEGA Rolling Machine

⇒ If the answer is yes, describe the reason for its idleness

- Dead stock-Lack of willingness to rent Afro truck-trailer
- Rolling m/c is dedicated for producing large volume tank

⇒ Did you have the experience of sharing your idle physical resources, marketing facilities (Sales force, distribution channel, warehouse etc....) and administrative functions like accounting and human resource management to other sister companies?

Yes □ No ■

⇒ If your answer is yes, please mention those companies along with areas of sharing facilities or activities.

Companies	**Area of sharing facilities**

⇒ Did you have the experience of sharing sister companies' idle physical resources, marketing facilities and administrative functions?

□ Yes No ■

⇒ If your answer is yes, please list those companies along with areas of

sharing facilities or activities.

Companies **Opportunities/activities**

_____

_____

⇒ Do you think that there is an opportunity of sharing activities and facilities among EFFORT companies?

Yes ☒ No ☐

⇒ If yes, could you list those opportunity areas along with potential related Companies.

Companies	**Areas of sharing facilities**
• Messebo Cement f.	Industrial Maintenance
• Addis Pharmaceuticals f.	Industrial Maintenance
• ALTEX Factory	Industrial Maintenance
• SABA Dimensional	Industrial Maintenance
• Sheba Tannery	Industrial Maintenance &

And others like:

- ✓ Machinery Installation
- ✓ Design & consultation service
- ✓ Supply of spare part
- ✓ Erection service during expansion

⇒ Regarding the synergy operations utilized so far;

- Is it successful and create competitive advantage for you and your partner? ☐
- Is it partially successful and create, competitive advantage for you only? ☐
- Is it partially successful and creates competitive advantage for you and your partner? ☒
- Is it successful & create competitive advantage at corporate level? ☐
- Is it totally not successful? ☐

⇒ If it is partially or totally not successful what are the reasons you feel?

- ▪ Lack of commitment from corporate, companies ☒
- ▪ Lack of efficient coordination mechanisms ☒
- ▪ Others, please describe;
- ▪ Meeting period is too long, no decision given from corporate for long outstanding

⇒ What do you recommend for the future that should be done by:

Corporate office;

- ○ The corporate must ensure that the management of sisters companies have clear understanding of the benefit of synergy

Business companies:-

- ▪ Business companies should think as family members and strive to maximize the benefit at corporate level instead of company level.