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Design of Enterprise Resource Planning (ERP) Frame work and its implementation

(With special reference to Gafat Engineering Factory)

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A thesis submitted to school of Graduate Studies of Addis Ababa University in partial fulfillment of the requirement for the Degree of Masters of Science in Industrial Engineering

Addis Ababa
Nov. 2007

Acknowledgements

First of all, I am indebted to my advisor, DR. Chandra Subhash, who shaped my research skeleton and provided the kind instruction and comments. I would like to thank Dr. Chandra Subhash, for his earnest guidance and valuable experience sharing. I also appreciate Professor E. V. Rammana who not only helped me establish clear framework of ERP but also especially take care of me during my undergraduate study.

Constructive comments by questionnaire respondents are gratefully acknowledged. In particular, I want to thank production planning head of Gafat Engineering Factory engineer Million Erko. Receiving his kind replies and useful information really made me feel warm and incentive. I also appreciate Engineer Tafesse hunduma, sharing his abundant practical experiences and kind suggestions during software development. Moreover, I am grateful to my sister Rahel Kassahun and Yetnayet Alemu for their kindly help in writing and editing the paper throughout my work. Special thanks go to my best friend Estifanos Gidey, who added various colors on my school life this, two-year time period.

Parental consideration and support is the last but not least factor that I have to note. My parents always treated me with encouragement instead of pressure during my school life. Thus I can devote myself to this work without the fear of disturbance in the rear. I dedicate this thesis to them deservedly.

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List of Acronyms

GEF: Gafat engineering Factory

ERP: Enterprise Resource Planning

MRP: Material Requirement Planning

MRP II: Manufacturing Resource Planning

HR: Human Resource

SCM: Supply chain Management

SRM: Supplier relation ship Management

CRM: Customer relation ship Management

Abstract

The Purpose of this thesis seeks to provide a conceptual model that explains the Enterprise Resource Planning (ERP) system to general and project managers in a non-technical manner that is easily understood.

The methodologies used in the thesis are evaluating the current system of the factory particularly the resources. This is very important step to determine the way of implementing ERP system. In the thesis two types of implementation schemes are suggested i.e. the company wide and Quick slice.

Company-wide implementation: total company project; all ERP functions implemented; time frame one to two years.

Quick-Slice ERP implantation: confined to one or several Pareto high-impact product lines; most, but not all, ERP functions implemented; time frame three to five months.

Thus based on the questionnaire survey, the main problem in the factory is the production delay and its immediate consequence of high manufacturing cost. The same result is obtained when a discussion is held with the heads, experts and team leaders. The past data records of the factory also depicts the same reason with that of the questionnaire survey.

Based on the given problems the reasons which cause it are identified, rated and evaluated based on ERP systems.

Business models are used as a starting point to show how the ERP systems are integrated and finally software is developed for inventory management system and human resource management.

Findings from the thesis work are that ERP is more than just software. Unless a clear understanding exists of the different components and their integration ERP projects will continue to be plagued by failure. This model is applicable to any ERP system as it is generic and vendor independent and helps determining the scope of an ERP project.

The value of the thesis is that it enables general and project managers to understand ERP systems better without becoming overwhelmed by product or technical detail. This facilitate the successful implementation of ERP systems, thus ensuring project success and, ultimately, organizational success.

CHAPTER 1

1.1 Introduction

In today's dynamic and turbulent business environment, there is a strong need for the organizations to become globally competitive. The survival guide to competitiveness is to be closer to the customer and deliver value added product and services in the shortest possible time. There has to be much greater interaction between the customers and manufacturers. Organizations today confront new markets, new competition and increasing customer expectations. This has put a tremendous demand on manufacturers to:

- Lower total costs in the complete supply chain;
- Shorten throughput times;
- Reduce stock to a minimum;
- Enlarge product assortment;
- Improve Product quality;
- Provide more reliable delivery dates and higher service to the customer;
- Efficiently coordinate global demand, supply and production.

This, in turn, demands integration of business processes of an enterprise. Enterprise Resource Planning (ERP) is such a strategic tool, which helps the company to gain competitive edge by integrating all business processes and optimizing the resources available. Enterprise resource planning (ERP) systems are large, integrated enterprise-wide standard information systems that automate all aspects of an organization’s business process. The ERP concept is that business functions incorporating manufacturing, marketing (sales and distribution), human resource, finance, and information can be supported by a single integrated system with all of the company’s data captured in a central database. ERP systems improve the flow of information among the different functions within an enterprise and also facilitate information sharing across organizational units and geographical locations. They enable managers to plan precisely, to make decisions promptly, and to control appropriately gaining the flexibility in such a dramatically changing environment through the real-time information. Implementing ERP has become an inevitable trend for the enterprise [10].

1.2 Statement of the Problem

Global competition and rapidly changing customer requirements are forcing major changes in the production styles and configuration of manufacturing organizations. Increasingly, traditional centralized and sequential manufacturing planning, scheduling, and control mechanisms are being found insufficiently flexible to respond to changing production styles and highly dynamic variations in product requirements. The traditional approaches limit the expandability and reconfiguration capabilities of the manufacturing systems. The traditional centralized hierarchical organization may also result in much of the system being shut down by a single point of failure, as well as plan fragility and increased response overheads. Thus many business houses face increasing pressure to lower production cost, improve production quality and increase responsiveness to customers [7].

GEF is one of the huge defense industries established to fulfill the large demand of artilleries and any weapons of the defense forces of the country. Currently the factory has produced modern artilleries, which were earlier imported from foreign countries. The factory has also engaged in producing some manufacturing products to meet the demand of other civilian organizations i.e. the factory has a lot of orders to manufacture various products in any quantity.

However; due to lack of integration of its business activities, like the design, manufacturing, process planning, logistics, supply chain management and others like accounting, human resources, marketing and strategic management; the factory has faced a problem in that it can’t be competent in the market. Poor production planning, problems in resource management, Poor production layout, high production cost, Poor maintenance management, problems in raw materials and tool cost and outdated machines aggravates the delay time in production and leads to increase in manufacturing cost. Nowadays various foreign companies adopting modern manufacturing environments can supply the same products having better qualities with lower price. Thus the factory has to change its current manufacturing structure to be competent and stay in the market. Actually the factory has started adopting some techniques to avoid managerial as well as production obstacles. Besides this it is very important to avoid departmental and enterprise wide barriers by implementing the enterprise resource planning (ERP).

Specifically the factory has the following problems:

- There is no strong production as well as performance measurement; evaluation and progress follow-up mechanism. The skill, capacity and training need of each individual operator is not determined.
- Since most of the machineries in the factory are old and not equipped with maintenance equipments there exists repetitive machineries breakdown. To justify its effect on the production process, there are no mechanisms to register machineries breakdown time. In addition to this there is no annual preventive maintenance plan.
- There is no clear information exchange between varies departments of the factory about the progress of job. For example the quality control test results is not prepared in such a manner that it could explain test request receiving time, result delivering date and time, causes of reject, amount of re-workable materials and possible remedial solution that have to be made by the concerning section.
- There is no effective utilization of resources (manpower, machineries, raw materials, time)

1.3 OBJECTIVE OF THE STUDY

General objective:

In the conventional organizational set-up it is very difficult to cut across various departments and meet the supply chain from one end to the other. The gaps between delivery and expectations are very critical and hence can be bridged only with an integrated process data business modeling which considers the various layers of the business and cuts across departmental barriers by meeting the supply chain effectively.

Enterprise resource planning is a term derived from manufacturing resource planning (MRP II) that followed material requirements planning (MRP).The system typically handle the manufacturing, logistics, distribution, inventory, shipping, invoicing, and accounting for a company. Enterprise Resource Planning or ERP software can aid in the control of many business activities, like sales, delivery, billing, production, inventory management, quality management, and human resources management.

The purpose of this thesis is to provide a high level conceptual frame work that will assist in understanding what ERP is and how to go about implementing it. It is important for general and project managers to understand what ERP is and what the impact is on the organization when implementing an ERP system. Since it is a high level conceptual model, it will be used by middle to top management as well as project managers that need to implement an ERP system. In addition to this it helps the top management to decide the way how they are going to implement ERP, Company wide or quick slice i.e. only some modules with high problem.

Specific objective:

The specific objectives of this study are the following:

- Increasing the responsiveness of GEF to the market requirements with high efficiency;
- Creating awareness on the factory that supply chain optimization through effective resource allocation and Involving customers in total supply chain optimization;
- Achieving dynamic optimization of materials and inventory management;
- Realizing total supply chain optimization including all linked enterprises;
- Increasing the effectiveness of the information exchange and feedback.
- Provide efficient and reliable maintenance management system.

1.4 Significance of the Study

ERP automates the tasks involved in performing a business process—such as order fulfillment, which involves taking an order from a customer, shipping it and billing for it. With ERP, when a customer service representative takes an order from a customer, he or she has all the information necessary to complete the order (the customer's credit rating and order history, the company's inventory levels and the shipping dock's trucking schedule). Everyone else in the company sees the same computer screen and has access to the single database that holds the customer's new order. When one department finishes with the order it is automatically routed via the ERP system to the next department. To find out where the order is at any point, one need only log into the ERP system and track it down. The order processes are streamlined through out the organization, and customers get their orders faster and with fewer errors than before. ERP can apply the same fundamentals to the other major business processes, such as inventory management, human resource management and employee benefits or financial reporting etc.

1.5 Thesis Organization

This thesis contains a total of nine chapters. The chapters are arranged in such away that it follows a logical sequence in which it conveys some concepts in ERP identify the main problem in GEF and apply some tools i.e. ERP implementing tools to eradicate the problems occurred within the factory.

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, the statement of the problem, objectives, scopes, significance, limitations and thesis organization.

Chapter 2 – Background of the study: This chapter gives a highlight on total background of the factory, the total productivity and general performance of the factory, company profile, organizational structure, motto, mission, objectives, location, types of product produced, types of service provided to customers, customer supplier relationship and so on.

Chapter 3 – Literature Survey: This chapter will review in detail the literature available in the area of Enterprise Resource Planning. It will cover the evolution of Enterprise Resource Planning, manufacturing system, which includes the inventory system, production, and distribution system based on the experience, research of intellectuals in the field.

Chapter 4 – Research Methodologies: will describe different aspects of the methods used and situations that the researcher must consider during each phase of the study. Different ways of carrying out the study and different 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. Finally it elaborates the data and interprets the results obtained from the questionnaire.

Chapter 5- covers Data Analysis and interpretation based on the questionnaire survey. It also covers an analysis to point out the main problem the factory has faced by rating the various existing problems through cause and effect diagram and Pareto analysis.

Chapter 6 – This chapter will cover general implementation model of ERP systems in which a company chooses suitable implementation model based on three factors. These are Time available to implement ERP, the amount of resource available and the amount of workload. This chapter also will discuss the existing systems in production planning, maintenance management, and related tasks and suggests better modules in ERP. It also shows he costs to implement the system and the benefits achieved.

Chapter 7 – Evaluation of the implementation model through conceptual design of ERP system.

Chapter 8 – Friendly user software Development and Post ERP implementation: This chapter will cover software development using visual basic 6 to integrate all the activities of the enterprise and it discusses some issues to be performed after ERP implementation.

Chapter 9 – Conclusions, Recommendations, and Future Works: This chapter will present the conclusions drawn from the study, and give recommendation. It will also include suggestions for further researches in the area.

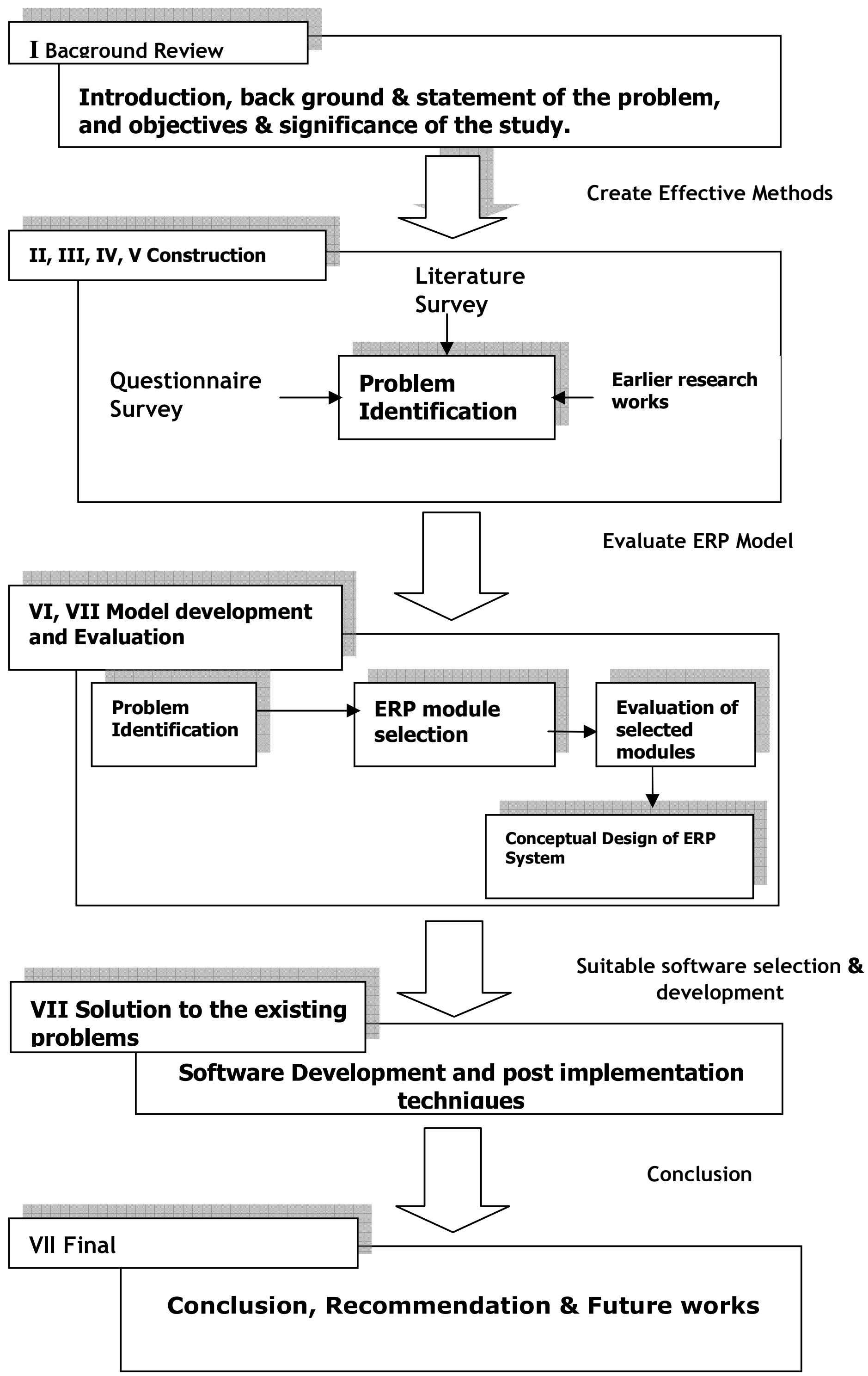


Fig.1.1 Thesis Organization

CHAPTER 2

2.1 Background of Gafat Engineering Factory

GEF originally designed to manufacture 7.62mm automatic rifle (AkM-47) and 7.62mm light duty machine guns (RPD). Physical activities of the factory commenced in early 1984 G.C. and it is anticipated to complete the project implementation period of five years. After the completion of project phase the factory commissioned and wished to produce product based on its designed purpose; with annual production capacity of:

- 7.62mm (AKM-47) Automatic rifle ---------------------------20,000pcs/year
- 7.62mm (R.P.D) Light machine gun ------------------------1,400pcs/year
- AKM-47 Automatic rifle magazine---------------------------80, 000pcs/year
- Packing wooden boxes --2000pcs/year

However, until the termination of the factory production activities in may 1991G.C. following the fall of former government only 10,420pcs of AKM-47 and 1228pcs R.P.D was produced during the two years (i.e. 1989-1991G.C.). Which are 26 % and 44% respectively compared with the available production capacity of the factory. The factory was running under capacity during the two years due to the following discovered major problems.

- Shortage of skilled man power
- Delay in delivery of ordered materials and equipment
- The management system fails to organize and lead the factory as technological activity demands

Afterwards, only some of the manufactured components were assembled. Depending on government's decision recognized the factory through careful investigation by the assigned committee from 1994-1996G.C. Depending on the committee's conclusion some outfits and equipments were purchased and installed. Activities of the producing spare parts, and some civilian products have been going on; the beginning of the project ET-97and ET-97/1 according to the contract between Ethiopian government and Korean Ryong bong General Corporation is the first action taken which realize the return of the factory to its designed purpose.

2.2 Productivity in Gafat Engineering Factory

Due to the absence of SPM and continuous working situation; the factory fails to get the technical experience regarding the production for which it is designed. After the factory reorganized again also the factory was made to engage in under capacity products and maintenance activities. Due to the above major problems the productivity of the factory is discovered to be very poor, so that the factory is forced to start from project stage like another new factory.

2.3 Mission and Vision of Gafat Engineering Factory

2.3.1 Vision of GEF

"GEF aspires to see insuring war readiness of defense forces by maintaining, upgrading and producing modern individual and group artilleries."

2.3.2 Mission of GEF

1. To produce individual and group artilleries with quality standard and competitive price by enhancing the efficiency of the defense forces and supplying proper technological aid for similar industries through research and development.
2. To ensure the war readiness of the defense forces by maintaining and upgrading individual and group artilleries.
3. To supply products which are important for the development of the country and gain additional revenue.

2.4 Organizational Structure of Gafat Engineering Factory

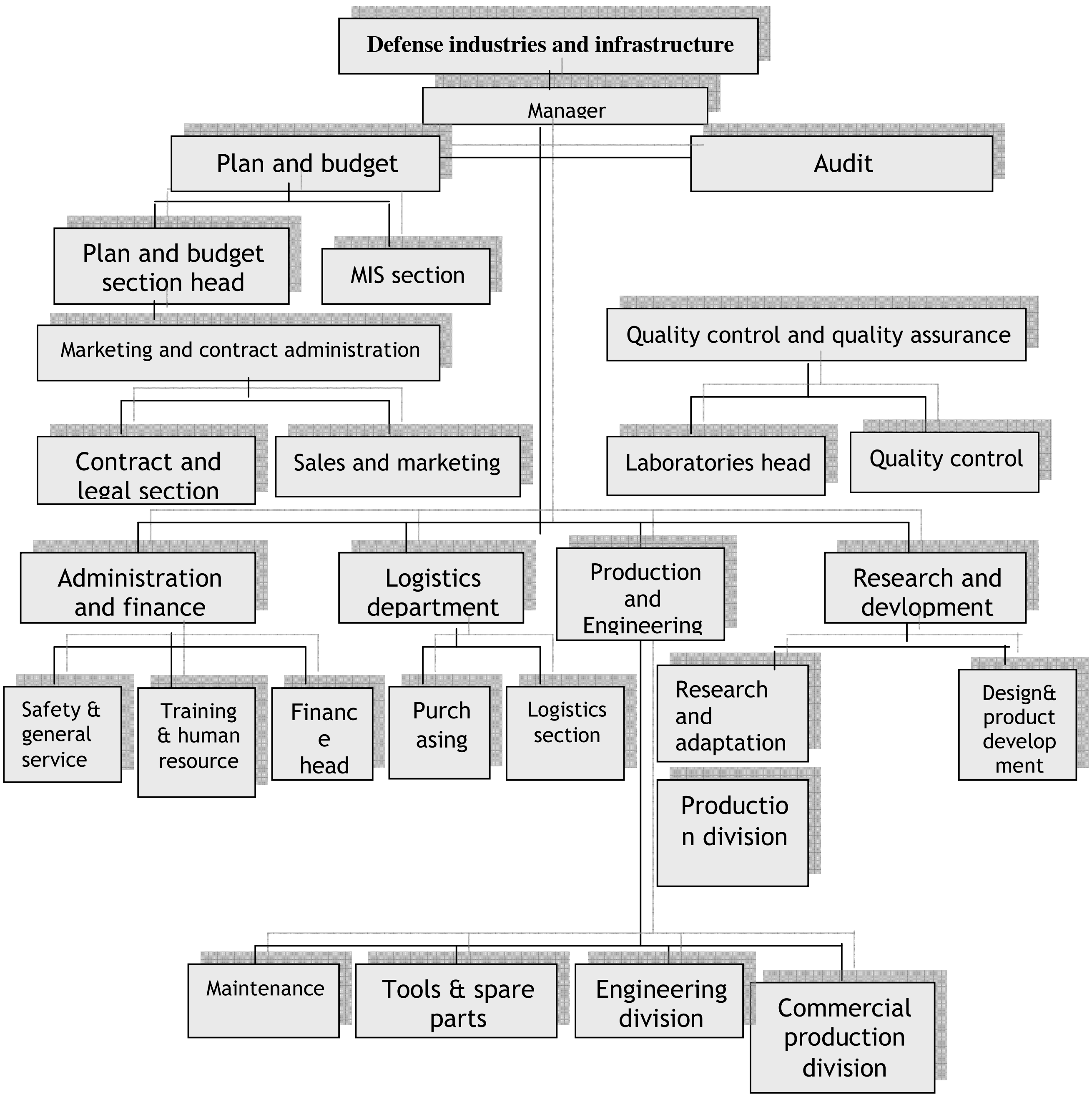


Fig. 2.1 Organizational structure of GEF

CHAPTER 3
LITERATURE SURVEY

3.1 What Is Enterprise Resource Planning?

Enterprise Resource Planning (ERP)-and its predecessor, Manufacturing Resource Planning (MRP II) is helping to transform industrial landscape. It's making possible profound improvements in the way manufacturing companies are managed. It is a strong contributor to America's amazing economic performance of the 1990s and the emergence of the New Economy. A half century from now, when the definitive industrial history of the twentieth century is written, the evolution of ERP will be viewed as a watershed event. [1]

Enterprise resource planning software, or ERP, doesn't live up to its acronym. Forget about planning—it doesn't do that—and forget about resource, a throwaway term. But remember the enterprise part. This is ERP's true ambition. It attempts to integrate all departments and functions across a company onto a single computer system that can serve all those different departments' particular needs.

That is a tall order, building a single software program that serves the needs of people in finance as well as it does the people in human resources and in the warehouse. Each of those departments typically has its own computer system, each optimized for the particular ways that the department does its work. But ERP combines them all together into a single, integrated software program that runs off a single database so that the various departments can more easily share information and communicate with each other.

That integrated approach can have a tremendous payback if companies install the software correctly. Take a customer order, for example. Typically, when a customer places an order, that order begins a mostly paper-based journey from in-basket to in-basket around the company, often being keyed and re-keyed into different departments' computer systems along the way. All that lounging around in in-baskets causes delays and lost orders, and all the keying into different

computer systems invites errors. Meanwhile, no one in the company truly knows what the status of the order is at any given point because there is no way for the finance department, for example, to get into the warehouse's computer system to see whether the item has been shipped [6].
Enterprise resource planning is described as:

An enterprise-wide set of management tools that balances demand and supply, Containing the ability to link customers and suppliers into a complete supply chain, Providing high degrees of cross-functional integration among sales, marketing, manufacturing, logistics, purchasing, finance, new product development, and human resources, thereby enabling people to run their business with high levels of customer service and productivity, and simultaneously lower costs and inventories; and providing the foundation for effective e-commerce [1].

In the conventional organization set-up it is very difficult to cut across various departments and meet the supply chain from one end to the other. The gaps between delivery and expectations are critical and hence can be bridged only with an integrated process data business modeling, which considers the various layers of the business and cuts across departmental barriers by meeting the supply-chain effectively [2].

3.2 The Evolution of Enterprise Resource Planning

3.2.1 Material Requirements planning (MRP)

Prior to 1960s, the business had to rely on the traditional ways of inventory management to ensure smooth functioning of organization. The most popularly known among them is EOQ (Economic Order Quantity). In this method, each item in the stock is analyzed for its ordering cost and the inventory carrying cost. A trade off is established on a phased out expected demand of one year, and this way the most economic ordering quantity can be decided. This technique in principle is a reactive way of managing inventory.

ERP began life in the 1960s as Material Requirements Planning (MRP), an outgrowth of early efforts in bill of material processing. MRP or Material Requirement Planning was first introduced in the 1970's as a computerized approach to planning and obtaining the required materials for manufacturing/production. MRP's inventors were looking for a better method of ordering material and components, and they found it in this technique.

MRP uses the Bill of Materials (BOM) in conjunction with the Master Production Schedule (MPS) to project the material requirements of each component/material/assembly. By comparing inventory to production quantity requirements, MRP determines if more materials need to be purchased.
The logic of material requirements planning asks the following questions;

- What are we going to make?
- What does it take to make it?
- What do we have?
- What do we have to get?

This is called the universal manufacturing equation. Its logic applies wherever things are being produced whether they are jet aircraft, tin cans, machine tools, chemicals, cosmetics etc. [5].

In addition, MRP uses Mainframe computing as the main source for input and processing. All application processing, including the user interface occurred centrally on the mainframe. The user devices were "dumb terminal" with display memory but virtually no processing power [4].

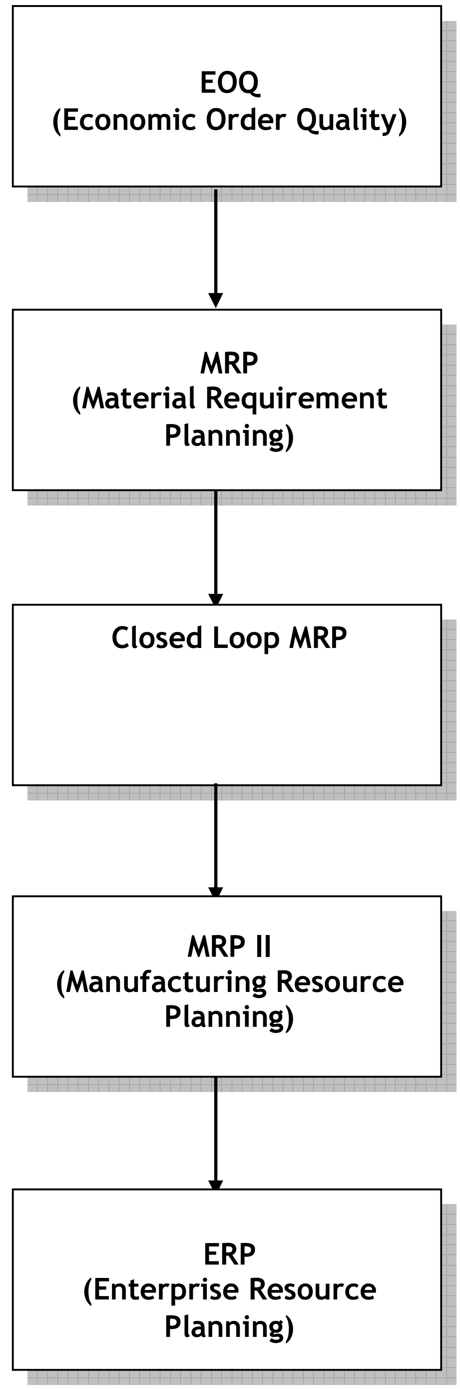


Fig 3.1 Evolution of ERP

3.2.2 Closed-Loop MRP

MRP quickly evolved, however, into something more than merely a better way to order. Early users soon found that Material Requirements Planning contained capabilities far greater than merely giving better signals for reordering. They learned this technique could hip to keep order due dates valid after the orders had been released to production or to suppliers. MRP could detect when the due date of an order (when it's scheduled to arrive) was out of phase with its need date (when it's required).

This was a break through. For the first time ever in manufacturing, there was a formal mechanism for keeping priorities valid in a constantly changing environment. This is important, because in a manufacturing enterprise, change is not simply a possibility or even a probability. It's a certainty, the only constant, the only sure thing.

The function of keeping order due dates valid and synchronized with these changes is known as priority planning. Techniques for helping plan capacity requirements were tied in with material Requirements Planning. Further, tools were developed to support the planning of aggregates sales and production levels (sales and Operations Planning); the development of the specific build schedule (master scheduling); forecasting, sales planning, and customer-order promising (demand management); and high-level resource analysis (Rough-Cut Capacity Planning). Systems to aid in executing the plan were tied in: various plant scheduling techniques for the inside factory and supplier scheduling for the outside factory the suppliers. These developments resulted in the second step in this evolution: closed-loop MRP. (See Figure 3-2.)

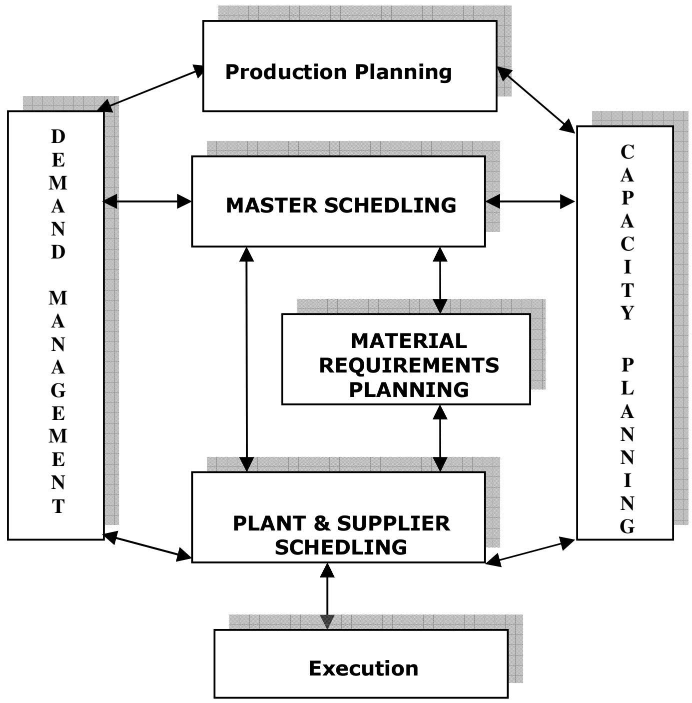


Fig 3.2 Closed Loop MRP

Closed-loop MRP has a number of important characteristics:
It's a series of functions, not merely material requirements planning. It contains tools to address both priority and capacity, and to support both planning and execution.

It has provision for feedback from the execution functions back to the planning functions. Plans can then be altered when necessary, thereby keeping priorities valid as conditions change.

3.2.3 Manufacturing Resource Planning (MRP II)

The next step in this evolution is called Manufacturing Resource Planning or MPR II (to distinguish it form Material Requirements Planning, MRP), A direct outgrowth and extension of closed-loop MRP [1].

In the 1980's MRP expanded from management of materials to plant and personnel planning and distribution planning, which in turn became MRPII (Manufacturing Resource Planning). As the materials requirements planning systems matured in the 1970s and 1980s, other portions of the productive system were naturally added to the computer software system. One of the first functions to be included was purchasing. The software modules were expanded to handle cost data and selling price capabilities. Additional data about work center capacity limitations were also integrated into many systems as detailed scheduling for the shop floor was provided by the MRP systems. It was quickly becoming obvious that "material requirements planning" no longer was adequate to describe the expanded system. Oliver Wight is credited for introducing the name "manufacturing resource planning-MRP II" to reflect the idea that a larger part of the firm was becoming involved with the program.

"The initial intent for MRP II was to plan and monitor all the resources of a manufacturing firm; manufacturing, marketing, finance, and engineering through a closed loop system generating financial figures." MRP II was also intended as a way to simulate the manufacturing system. The idea of the closed-loop system indicate that once the MRP program produce an initial production schedule, the output data is then sent to departments such as sales and operations to verify that the plans are realistic and attainable. Ideally, not only are many functions included in the output system, there is also feedback provided by the execution functions so that the planning can be kept valid at all times [3].

MRP-II Manufacturing Resource Planning, a system in which the entire production environment is evaluated to allow master schedules to be adjusted and created based on feedback from current production/purchase conditions. Materials Requirements Planning (MRP, or MRP-I) was launched in the mid-1960s and quickly became popular for providing a logical, easily understood method for determining the number of parts, components, and materials needed for the assembly of each end item in production. As computer power grew and demands for software applications increased, MRP systems evolved to consider other resources besides

materials. Software modules were added to include functions such as scheduling, inventory control, finance, accounting, and accounts payable.
MRPII also used Mainframes, but in conjunction with LAN (Local Area Networks) to input and access information. By utilizing powerful desktop computers and LANs, along with client server applications, data became decentralized. This in turn allowed departmental computing environments to emerge with local control. The benefits of local computing were many: dedicated resources meant much better response times, and departments were able to develop applications that best met their needs. These applications were often isolated and invisible to the rest of the company, with the inability to share information and resources with other parts of the company.

MRP II is a method for the effective planning of all resources of a manufacturing company. Ideally, it addresses operational planning in units, financial planning in dollars, and has simulation capability to answer "what-if" Questions. It is made up of a variety of functions, each linked together: business planning, sales and operations planning, production planning, master scheduling, material requirements planning, capacity requirements planning and the execution support systems for capacity and material. Output form these systems are integrated with financial reports such as the business plan, purchase commitment report, shipping budget, and inventory projections in dollars. Manufacturing resource planning is a direct outgrowth and extension of closed-loop MRP [5].
It involves three additional elements:

1. Sales and Operations Planning -a powerful process to balance demand and supply at the volume level, they providing top management with far greater control over operational aspects of the business.
2. Financial interface-the ability to translate the operating plan (in pieces, pounds, gallons, or other units) into financial terms (dollars).
3. Simulation- the ability to ask" What-if questions and to obtain actionable answers-in both units and dollars. Initially.

This was done only on an aggregate, "rough-cut "basis, but to day's advanced planning systems (APS) enable effective simulation at very detailed levels.

3.2.4 Enterprise Resources Planning (ERP)

The latest step in this evolution is Enterprise Resource Planning (ERP). The need to harmonize the functioning on an entire company has lead to the development of ERP in the 1990's. ERP has combined more areas within the company than either MRP or MPRII. ERP uses WANs (Wide Area Networks), which allows coordination of company activities globally. The appeal of such integrated information systems is clear. The fundamentals of ERP are the same as with MRP II. However, thanks in large measure to enterprise software, ERP as a set of business processes is broader in scope, and more effective in dealing with multiple business units, financial integration is even stronger. Supply chain tools, supporting business across company boundaries, are more robust. For a graphical view of ERP, see Figure 3.3 [5].

Enterprise Resource Planning is a direct outgrowth and extension of Manufacturing Resource Planning and, as such, includes all of MRP II's capabilities. ERP is more powerful in that it: a) apples a single set of resource planning tools across the entire enterprise, b) provides real-time integration of sales, operating, and financial data, and c) connects resource planning approaches to the extended supply chain of customers and suppliers.

The sales force enters an order on a computer, and the transaction ripples through the entire company. Inventory lists and parts supplies are updated automatically, worldwide. Production schedules and balance sheets reflect the changes. Best of all every employee has just the information necessary for the job at hand. Feedback cycles are positive and fast.

Salespeople can promise firm delivery dates, and managers can gauge almost immediately the effects of decisions affecting credit terms, discounts, inventory, or supply-chain management [5].

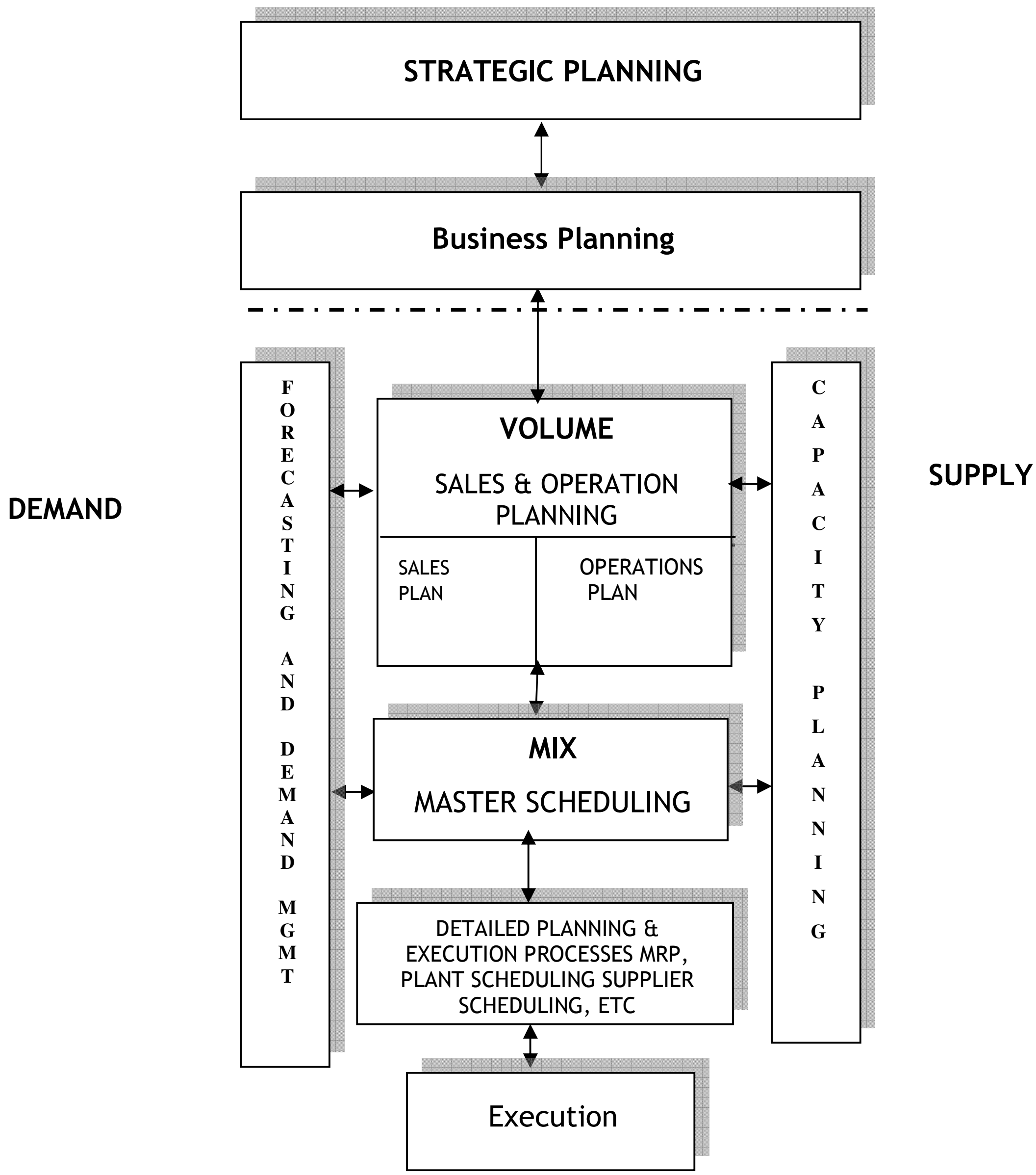


Fig. 3.3 Enterprise Resource Planning

3.3 Fundamentals of ERP Implementation

Referring to figure 3.3 the basic components of ERP are as follow

- **Strategic Planning And Business Planning**

Strategic planning defines the overall strategic direction of the business, including mission, goals, and objectives. The business planning process then generates the overall plan for the company, taking into account the needs of the marketplace (customer orders and forecasts), the capabilities within the company (people skills, available resources, technology), financial targets (profit, cash flow, and growth), and strategic goals (levels of customer service, quality improvements, cost reductions, productivity improvements, etc.). The business plan is expressed primarily in dollars and lays out the long-term direction for the company. The general manager and his or her staff are responsible for maintaining the business plan.

- **Sales & Operations Planning**

Sales & Operations Planning (S&OP) addresses that part of the business plan, which deals with sales, production, inventories, and backlog. It's the operational plan designed to execute the business plan. As such, it is stated in units of measure such as pieces, standard hours, and so forth, rather than dollars. It's done by the same group of people responsible for business planning in much the same way. Planning is done in the aggregate—in broad categories of products—and the focus is on volume, not mix. It establishes an aggregate plan of attack for sales and marketing, engineering, manufacturing and purchasing, and finance.

- **Demand Management**

Forecasting /Sales Planning

Forecasting/sales planning is the process of predicting what items the sales department expects to sell and the specific tasks they are going to take to hit the forecast. The sales planning process should result in a monthly rate of sales for a product family (usually expressed in units identical to the production plan), stated in units and dollars. It represents sales and marketing's commitment to take all reasonable steps to make sure the forecast accurately represents the actual customer orders to be received.

Customer Order Entry and Promising Customer order entry is the process of taking incoming orders and determining specific product availability and, for a make-to-order item, the product's configuration. It results in the entry of a customer order to be built/produced/shipped, and should also tie to the forecasting system to net against the projections. This is an important part of an ERP system; to look at the orders already in the system, review the inventory/backlog, available capacity, and lead times, and then determine when the customer order can be promised. This promise date is then entered as a customer commitment.

- **Rough cut Capacity Planning**

Rough-cut capacity planning is the process of determining what resources (the "supply" of capacity) it will take to achieve the production plan ("demand" for capacity). The process relies on aggregate information, typically in hours and/or units, to highlight potential problems in the plant, engineering, finance, or other areas prior to the proposed schedule being approved.

- **Master Scheduling**

Master scheduling addresses mix: individual products and customer orders. It results in a detailed statement of what products the company will build. It is broken out into two parts—how many and when. It takes into account existing customer orders, forecasts of anticipated orders, current inventories, and available capacities. This plan must extend far enough into the future to cover the sum of the lead times to acquire the necessary resources. The master schedule must be laid out in time periods of weeks or smaller in order to generate detailed priority plans for the execution departments to follow. The sum of what's specified in the master schedule must reconcile with the Sales and Operations Plan for the same time periods.

- **Material Requirements Planning (MRP)**

Material Requirements Planning starts by determining what components are required to execute the master schedule, plus any needs for service parts/spare parts. To accomplish this, MRP requires a bill of material to describe the components that make up the items in the master schedule and inventory data to know what's on hand and/or on order. By reviewing this information, it calculates what existing orders need to be moved either earlier or later, and what new material must be ordered.

- **Capacity Requirements Planning (CRP)**

Capacity Requirements Planning takes the recommended needs for manufactured items from MRP and converts them to a prediction of how much capacity will be needed and when. A routing that defines the operations involved is required, plus the estimate of time required for each. A summary by key work center by time period is then presented to compare capacity needed to capacity available.

- **Plant Scheduling**

Plant scheduling utilizes information from master scheduling and MRP to develop start and completion times for jobs to be run. The plant scheduling process can be as simple as lists derived directly from the master schedule or as complex as utilizing sophisticated finite scheduling software to simulate various plant schedules to help the plant and scheduling people select the best one.

Furthermore, a company must also monitor the flow of capacity by comparing how much work was to be completed versus how much has actually been completed. This technique is called input-output control, and its objective is to ensure that actual output matches planned output.

- **Supplier Scheduling**

Suppliers also need valid schedules. Supplier scheduling replaces the typical and cumbersome cycle of purchase requisitions and purchase orders. Within ERP, the output of MRP for purchased items is summarized and communicated directly to suppliers via any or all of the following methods: the Internet, an intranet, electronic data interchange (EDI), fax, or mail. Long term contracts define prices, terms, conditions, and total quantities, and supplier schedules authorizing delivery are generated and communicated at least once per week, perhaps even more frequently in certain environments. Supplier scheduling includes those changes required for existing commitments with suppliers—materials needed earlier than originally planned as well as later—plus any new commitments that are authorized. To help suppliers do a better job of long-range planning so they can better meet the needs of the company, the supplier-scheduling horizon should extend well beyond the established lead-time.

- **Execution And Feedback**

The execution phase is the culmination of all the planning steps. Problems with materials or capacity are addressed through interaction between the plant and the planning department. This is done on an exception basis, and feedback will only be necessary when some part of the plan cannot be executed. This feedback consists of stating the cause of the problem and the best possible new completion date. This information must then be analyzed by the planning department to determine the consequences. If an alternative cannot be found, the planning department should feed the problem back to the master scheduler. Only if all other practical choices have been exhausted should the master schedule be altered. If the master schedule is changed, the master scheduler owes feedback to sales if a promise date will be missed, and sales owes a call to the customer if an acknowledged delivery date will be missed.

By integrating all of these planning and execution elements, ERP becomes a process for effectively linking long-range aggregate plans to short-term detailed plans. From top to bottom, from the general manager and his staff to the production associates, it ensures that all activities are in lockstep to gain the full potential of a company's capabilities. The reverse process is equally important. Feedback goes from bottom to top on an exception basis—conveying unavoidable problems in order to maintain valid plans. It's a rack-and-pinion relationship between the top-level plans and the actual work done in the plant.

- **Financial Integration**

In addition to ERP's impact on the operations side of the business, it has an equally important impact on financial planning. By including the selling price and cost data, ERP can convert each of the unit plans into dollars. The results are time-phased projections of dollar shipments, dollar inventory levels, cash flow, and profits.

Incorporating financial planning directly with operating planning produces one set of numbers. The same data is driving both systems—the only difference being the unit of measure. Too often financial people have had to develop a separate set of books as they couldn’t trust the operating data. Not only does this represent extra effort, but frequently too much guesswork has to be applied to determine the financial projections.

- **Simulation**

In addition to information for operational and financial planning, simulations represent the third major capability of ERP. The ability to produce information to help answer “what if” questions and to contribute to contingency planning is a valuable asset for any manager to have. What if business increases faster than expected? What if business goes as planned, but the mix of products shifts sharply? What if our costs increase, but our prices do not? Do we have enough capacity to support our new products and maintain sales for current ones? These are common and critical issues that arise in manufacturing companies. A key part of the management job is to think through alternative plans. With ERP, people can access the data needed to help analyze the situation, play “what if,” and, if required, initiate a better plan [7].

Let's now look at a complete definition of ERP; based on the description we saw a few pages back:
Enterprises Resource Planning (ERP) predicts and balances demand and supply. It is an enterprise-wide set of forecasting, planning, and scheduling tools, which:

- Links customers and suppliers into a complete supply chain.
- employs proven processes for decision-making, and
- Coordinates sales, marketing, operations logistics, purchasing, finance, product development, and human resources.

Its goals include high levels of customer service, productivity, cost reduction, and inventory turnover, and it provides the foundation for effective supply chain management and e-commerce. It does this by developing plans and schedules so that the right re sources-manpower, materials, machinery, and money -are available in the right amount when needed [6].

3.4 THE APPLICABILITY OF ERP

ERP and its predecessor, MRP II, have been successfully implemented in companies with the following characteristics:

- Make-to-stock
- Make-to-order
- Design-to-order
- Complex product
- Simple product
- Multiple plants
- Single plant
- Contract manufacturers
- Manufacturers with distribution networks
- Sell direct to end users
- Sell through distributors
- Business heavily regulated by the government
- Conventional manufacturing (fabrication and assembly)
- Process manufacturing
- Repetitive manufacturing
- Job shop
- Flow shop
- Fabrication only (no assembly)
- Assembly only (no fabrication)
- High-speed manufacturing
- Low-speed manufacturing [7]

Table 3.1: Comparisons between MRP, MRPII and ERP

	MRP	MRP II	ERP
Focus Scope	Departments' operation	An individual plant's operations	The resources of an entire enterprise
Focus Issues	• Consumer demand • Production schedule • Inventory Levels • Available capacity at work centers • Focus on production and material planning especially. -	• Consumer demand • Production schedule • Inventory Levels • Available capacity at • work centers • Focus on manufacture resource planning of integrating sales, production, material and finance.	• Consumer demand and available capacity at company plants world wide. • Production schedule and inventory levels along its supply chains as well as throught the company. • Focus on integrating the resources of R&D, sales, production, distribution, service and finance throught company.
Information system	Mainframe	Minicomputer	Client/server
Operational cycle	Operational cycle	Operational cycle	Real time

3.5 How Can ERP Improve A Company's Business Performance?

ERP automates the tasks involved in performing a business process—such as order fulfillment, which involves taking an order from a customer, shipping it and billing for it. With ERP, when a customer service representative takes an order from a customer, he or she has all the information necessary to complete the order (the customer's credit rating and order history, the company's inventory levels and the shipping dock's trucking schedule). Everyone else in the company sees the same computer screen and has access to the single database that holds the customer's new order. When one department finishes with the order it is automatically routed via the ERP system to the next department. To find out where the order is at any point, one need only log into the ERP system and track it down. With luck, the order process moves like a bolt of lightning through the organization, and customers get their orders f aster and with fewer errors than before. ERP can apply that same magic to the other major business processes, such as employee benefits or financial reporting [10].

With ERP, the customer service representatives are no longer just typists entering someone's name into a computer and hitting the return key. The ERP screen makes them business people. It flickers with the customer's credit rating from the finance department and the product inventory levels from the warehouse. Will the customer pay on time? Will we be able to ship the order on time? These are decisions that customer service representatives have never had to make before and which affect the customer and every other department in the company. But it's not just the customer service representatives who have to wake up. People in the warehouse who used to keep inventory in their heads or on scraps of paper now need to put that information online. If they don't, customer service will see low inventory levels on their screens and tell customers that their requested item is not in stock. Accountability, responsibility and communication have never been tested like this before [7].

3.6 Issues of ERP Implementation

Organizations are spending large amounts of money implementing ERP systems in the hope of achieving significant business from integration across functions and business units, as well as from best practices embedded in the software. However, it is not certain that organizations actually experience the expected benefits.

Although such glaring benefits and full-scale influences of implementing ERP systems have been suggested, many researches indicated that the implementation of an ERP system could be an extensive, lengthy and costly process. So the ERP systems need to be implemented carefully with integral coordination among experienced experts such as project leader, external consultants, and experienced project team members of different functional areas in the enterprise. Meanwhile, the importance of commitment from top management could not be emphasized more to accomplish the ERP project [5].

3.6.1 The need for ERP implementation

The primary purpose of implementing Enterprise Resource Planning is to run the business, in a rapidly changing and highly competitive environment, far better than before.

Organizations today confront new markets, new competition and increasing customer expectations. This has put a tremendous demand on manufacturers to: (1) Lower total costs in the complete supply chain; (2) Shorten throughput times; (3) Reduce stock to a minimum; (4) Enlarge product assortment; (5) Improve Product quality; (6) Provide more reliable delivery dates and higher service to the customer; (7) Efficiently coordinate global demand, supply and production.

This means that, in order to produce goods tailored to customer requirements and provides faster deliveries; the enterprise must be closely linked to both suppliers and customers (see Figure 3-4). In order to achieve this improved delivery performance, decreased lead times within the enterprise and improved efficiency and effectiveness, manufacturers need to have efficient planning and control systems that enable very good synchronization and planning in all the processes of the organization. By becoming the integrated information solution across the entire organization, ERP systems allow companies to better understand their business. This, in turn, demands integration of business processes of an enterprise. Enterprise Resource Planning (ERP) is such a strategic tool, which helps the company to gain competitive edge by integrating all business processes and optimizing the resources available. Implementing ERP has become an inevitable trend for the enterprise. Although ERP system becomes more and more popular nearly, implementing ERP system is an even more daunting challenge. Because ERP system encompasses all major of the business, users must make literally thousands of choices about each step of each business process they operate to configure an ERP system. ERP projects are also lengthy; involve large teams of people and higher costs, vast majority of companies who have been through a less than fully successful ERP implementation.

Enterprise Resource Planning (ERP) is an industry term for integrated, multi-module application software packages that are designed to serve and support multiple business functions. An ERP system can include software for manufacturing, order entry, accounts receivable and payable, general ledger, purchasing, warehousing, transportation and human resources. With ERP software, companies can standardize business processes and more easily enact best practices. By creating more efficient processes, companies can concentrate their efforts on serving their customers and maximizing profit and optimizing the resources available. Implementing Enterprise Resource system (ERP) has become an inevitable trend for the enterprise [5].

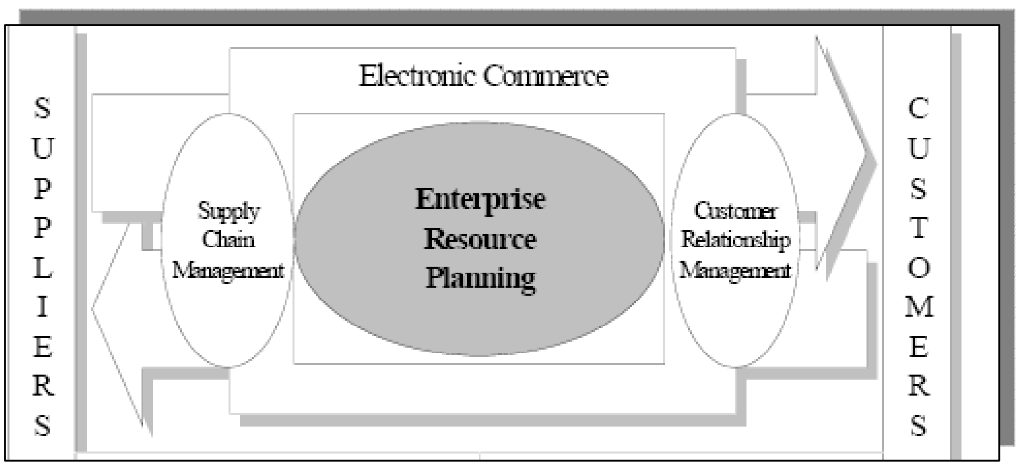


Fig. 3.4: Link between suppliers and customers

3.6.2 How long will an ERP implementation take?

- **Company-wide implementation**: total company project; all ERP functions implemented; time frame one to two years.
- **Quick-Slice ERP implantation**: confined to one or several Pareto high-impact product lines; most, but not all, ERP functions implemented; time frame three to five months.

With Quick-Slice ERP, the resources are considered a constant, because they are limited. Further, the time is considered fixed and is a very short, aggressive period. Thus the variable becomes the amount of work to be done. The principle of urgency applies here; since only a portion of the products/company will be cutting over to ERP, it should be done quickly. This is because the company will need to move aggressively to the next step, which may be to do another Quick-Slice implementation on the next product family or perhaps to convert to a company-wide implementation.

Resource constraints are only one reason why companies elect to begin implementation on a Quick-Slice basis [1].

3.6.3 The Implantation Challenge

1. It's a lot of work

Implementing ERP as a new set of decision-making processes is a major undertaking involving many people throughout the company, including general management. In essence, the entire company must learn how to deal with demand and supply issues in a new way. The speed of information flow with enterprise software combined with ERP's new approach to all of the planning and execution systems represents a major shift in company thinking – and that means a lot of work.

2. It's a do-it-yourself project.

Successful implementations are done internally. In other words, virtually all of the work involved must be done by the company's own people. The responsibility can't be turned over to outsiders, such as consultants or software suppliers. That's been tried repeatedly, and hasn't worked well at all. Consultants can have a real role in providing expertise but only company people know the company well enough and have the authority to change how things are done.

When implementation responsibility is de-coupled from operational responsibility, which can be legitimately accountable for results? If results aren't forthcoming, the implementers can say that it wasn't implemented correctly. Almost without exception, the companies who have become Class A or B and have achieved the greatest bottom-line benefits are the ones where the users implemented ERP themselves.

Therefore, a key principle of implementation is:

IMPLEMENTERS = USERS

The people who implement the various tools within Enterprise Resource Planning need to be the same folks who will operate those tools after they're implemented.

3. It's not priority number one.

The problem is, the people who need to do it are already very busy with their first priority: getting customer orders, making shipments, meeting payroll, keeping the equipment operating, running the business. All other activities must be subordinate. Implementing ERP can't be priority number one, but it does need to be pegged as a high priority within the company, preferably the number two priority, right below running the business.

It's people-intensive.

ERP is commonly misperceived as a computer system. Not so. It's a people system made possible by the computer software and hardware.

4. It requires top management leadership and participation.

If the goal is truly to run the business better, then the general manager and staff must be deeply involved because they and they alone have the real leverage over how the business is to be managed. Changes made at a lower level in the organization won't matter much if it's business as usual at the top.

5. It involves virtually every department within the company.

It's not enough for just the manufacturing or logistics or materials departments to be on board. Virtually all departments in the company must be deeply involved in implementing ERP; those mentioned, plus marketing, engineering, sales finance, and human resources [1].

3.6.4 ERP Methodology

Methodology refers to a systematic approach to implement an ERP system that will ensure the proper integration of the four components i.e. the people, product, process and performance. The ERP methodology component builds on the theory that an enterprise can maximize its returns by maximizing the utilization of its fixed supply of resources.

The five steps that make up the ERP methodology are: pre-implementation, analysis, design, construction and implementation. These five steps transcend the program management, change management, system installation and process redesign needs, and are illustrated in Figure 3.5.

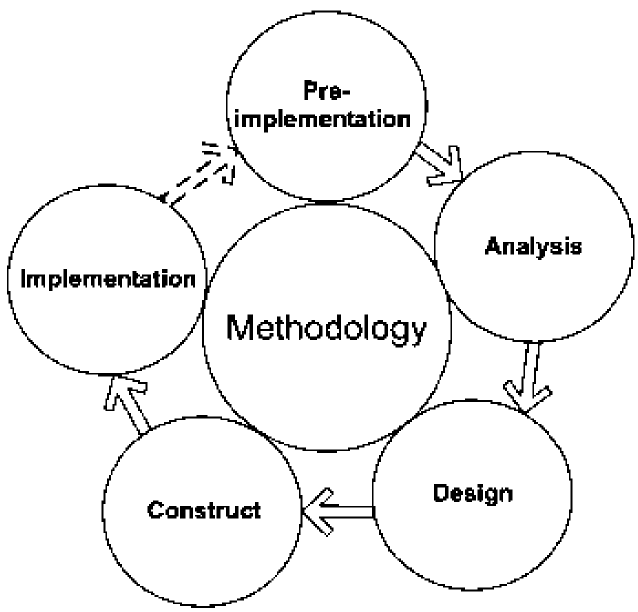


Fig. 3.5 ERP methodology

The following is a brief discussion on each of the steps.

- **Pre-implementation phase**

Pre-implementation planning helps to identify the operational needs, business drivers, strategic plans and other factors that will define the scope and objective of the ERP solution. During the pre-implementation planning process, expectations for benefits realization, magnitude of change, change ownership, process redesign and functionality delivery options are identified.

- **Analysis phase**

The analysis phase evaluates the organizational baselines that form the foundation for process redesign, the system build and change management. A system build determines the software components of the ERP system and how these components interact with each other. Business processes are analyzed to understand the current conditions. Functional and technical requirements are reviewed to determine the system build needs. Cultural and workforce skill evaluations are performed to identify workforce transition requirements.

- **Design phase**

The design phase incorporates direction-setting information from the pre-implementation phase and baseline information from the analysis phase to create new designs for a desired future state.

- **Construction phase**

The construction phase takes products from the design process to create tangible operational processes and information system support. As the process model begins to crystallize, the process model and the information system build are evaluated against each other.

- **Implementation phase**

The implementation phase prepares for the final ERP solution deployment. Final changes are made to business processes, policies, and procedures and system builds to prepare for a go-live. Go-live occurs when the ERP system is used within the organization as the system to perform all the duties and processes as determined by the design phase. Once a go-live occurs, a post-implementation audit is performed to measure the effectiveness of the ERP solution in meeting its goals and objectives. A measuring mechanism must be in place to measure the result of the implementation phase against the aims and goals of the pre-implementation phase. This measuring tool is the link between the pre-implementation phase and the implementation phase.

The methodology comes full circle when the inputs of the first phase influence the results of the implementation phase [15].

3.7 Benefits of ERP systems

There are various benefits ERP systems promise to provide:

- Provide firms with a single, unified and all-encompassing information system platform and database;
- Eliminate the duchies and baronies that make up many modern business organizations;
- Give general managers a firm-wide understanding of value creation and cost structure;
- Change business processes based on new information and knowledge; and
- Create a customer-driven rather than traditionally production-driven organization.

In addition to these benefits ERP applications also provide various benefits such as reduced development risk, increased global competitiveness, and increased business efficiency. It seems ERP systems have been the ultimate solution for business. Table 3.2 shows benefits of ERP n different departments [12].

Table 3.2: Benefits of ERP on different Departments

Dimensions	Sub dimensions
Operational	Cost reduction
	Cycle time reduction
	Productivity improvement
	Quality Improvement
	Customer service improvement
Managerial	Better resource Management
	Improved decision making and planning
	Performance Improvement
Strategic	Support for business growth and alliance
	Building business innovation and cost leadership
	Building external linkages and e-commerce
	Generating product differentiation
	Sustain competitiveness
IT infrastructure	Building business flexibility
	It cost reduction
	Increased IT infrastructure Capability
Organizational	Changing work Pattern
	Facilitating organizational learning
	Empowerment
	Building Common Vision
	Shifting work focus
	Increased Employee morale and satisfaction

3.8 Causes for ERP system failures

- Lack of top management commitment - "Part of the blame for the lack of top management commitment may be MRP's image. It sounds like a manufacturing system rather than a business plan. However, an MRP system is used to plan resources and develop schedules. Also, a well-functioning schedule can use the firm's assets effectively, thus increasing profits. MRP should be accepted by top management as a planning tool with specific reference to profit results". Executives must be educated on the use of MRP as an integrated, strategic planning tool.

- Failure to recognize that MRP is only a software tool that needs to be used correctly to adapt the organization and its processes to exploit the system's capabilities. "...MRP proponents overdid themselves in selling the concept. MRP was presented and perceived as a complete and standalone system to run a firm, rather than as part of the total system".
- Insufficient user training and education - In nearly every study conducted and in many published cases, the lack of training or understanding is considered a major barrier to MRP implementation. The lack of MRP expertise, training, and education were major problems facing MRP implementers.
- Lack of technical expertise - Not only is there a need to improve user training techniques and general understanding of MRP systems, there is also a definite lack of technical expertise to provide the leadership needed to implement the systems. Not only would the technical experts need to be familiar with the operational needs of daily production, the system integrators would also need to understand how the computer software system can be built to handle the production needs. Increasingly, the advanced MRP-type systems are seeking to integrate concepts of Just-In-Time (JIT) production into the computer applications system. Found "Lack of company expertise in MRP" to be the major implementation obstacle, followed closely by "Lack of training/experience on MRP." suggested that the use of external programming could compensate for the lack of technical expertise.
- MRP requires a high degree of accuracy for operation. This often requires changing how the company operates and how files are updated. Traditionally, production management allowed for plenty of excess buffer stock to be stored on site. The extra inventory stores allowed for differences between the recorded inventory and actual inventory. One of the aims of the MRP system is to minimize inventory, thus the accuracy of the recorded levels becomes critical. Engineering drawings and bills of materials must also be kept up-to-date if the MRP system is to function correctly. "Perhaps one of the biggest complaints by users is that MRP is too rigid. When MRP develops a schedule, it is quite difficult to veer away from the schedule if need arises" [8].

In this section, we list the main reasons of failure that ERP implement in Table3.3.

Table 3.3: Reasons for ERP Implement Failure

Author	Years	Reasons of ERP Implement Failure
Wateridge	1997	The project objectives are not defined at the outset and the project invariably does not deliver the functionality required ▪ There is a lack of any planning and control ▪ The users very often complain of a lack of any involvement in the project
Slater	1998	▪ Lack of Comprehensive budgeting of project costs
Wilder and Davis	1998	▪ Lack of aligning with business goals is the leading reasons for ERP project failure ▪ Lack of user training and failure to completely understand how enterprise applications change business process are often the offender in a problem ERP implementation ▪ Difficulty acquiring adequate knowledge and skill in software configuration (especially cross-module integration).
Caldwell	1998	▪ Lack of communication with users and business mangers, lack of training lack of software ease-of-use users do not understand the process and value and refuse to use the system.
Cilffe	1999	▪ Lack of appropriate cross-functional representation ERP project team.
Glover	1999	▪ Depend on software vendors and implementation consultants too much ▪ No on stopped to consider why he or she is implementing ERP system, what business advantages they hoped to consider. ▪ Selection of inappropriate integrator, and/or project manager-vender may not be familiar with the business/industry. ▪ System lacks critical controls-system personal and consultants do not understand the nature, importance, and value of well-controlled business.
Jordan and Krumwiede	1999	▪ Failure to link technology plans to business strategic plan ▪ Failure to match the needs requirements of powerful customers.
Sweat	1999	▪ There is not enough communication with users. ▪ Lack of mapping but business processes before implementing the software. ▪ Lack of technology transfer from external consultants.

3.9 ERP as A Foundation

Today, there are a wide variety of tools and techniques that have been designed to help companies and their people produce their products better and more efficiently. These include lean Manufacturing, Six Sigma Quality, and Employee Involvement, Factory Automation, Design for Manufacturability, and many more, these are excellent tools with enormous potential.

But none of them will ever yield their full potential unless they're coupled with effective forecasting, planning, and scheduling processes. Here's why:

- It's not good enough to be extremely efficient if you're making the wrong stuff.
- It's not good enough to make items at a very high level of quality if they're not the ones needed.
- It's not good enough to reduce setup times and cut lot sizes if bad schedules prevent knowing what really needed and when.

Improvements to business processes take one of three forms:

1. Improving process reliability. Six Sigma and other Total Quality tools are predominant here.
2. Reducing Process complexity. Lean Manufacturing is heavily used here.
3. Coordinating the individual elements of the overall set of business process. ERP lives here.

Enterprise Resource Planning, when operating at a high level of effectiveness, will do several things for a company. First, it will enable the company's people to generate enormous benefits. Many companies have experienced, as a direct result of ERP (or MRP II) dramatic increases in responsiveness, productivity, on-time shipments and sales, along with substantial decreases in lead times, purchase costs, quality problems, and inventories.

Further, ERP can provide the foundation upon which additional productivity and quality enhancements can be built-an environment where these other tools and techniques can reach their full potential.

Effective forecasting, planning and scheduling-knowing routinely what is needed and when via the formal system is fundamental to productivity ERP is the vehicle for getting valid plans and schedules of shipments to customers, of personnel and equipment requirements, of required product development resources, and of cash flow and profit [5].

JIT and ERP

Back in the early 1980's a new way of thinking about manufacturing came out of Japan and it was truly revolutionary. It is called it just-In-time (JIT), and more recently it has evolved into lean manufacturing (Also called Agile Manufacturing or Synchronous Flow Manufacturing) [2].

JIT (Just in Time) supply and delivery is a central element of Lean manufacturing. The JIT concept was invented in Japan and is premised on delivering product just in time. Simply described a pull production system controls the flow of work through a factory by only releasing materials into production as the customer demands them i.e. only when they are needed. JIT controls inventory on a just in time (JIT) basis. A push system on the other hand would release material into production as customer orders are processed and material becomes available, MRP (Material Requirement Planning / Manufacturing Resource Planning) systems are typically push systems. What must be made clear at this point is that JIT is not a scheduling system but rather a production control system [10].

The information systems used in any organization must support the operating philosophy and not vice versa. In other words, ERP is not an end in itself, but rather a means to better manage the PSS (Product Supply System). The system is not the solution; it exists to support the management of the PSS.

With the dramatic reductions in lead times and lot sizes that the TBM (Time Based Manufacturing) environment creates, the operation of MRP should be significantly altered as a planning tool. In practice, the TBM goal is to have the combined PSS lead times shorter than customer delivery lead times. With short manufacturing lead times, it becomes practical to manufacture to real demand. This facilitates the need to improve "forecasting" with suppliers, because their capacity loads will be more accurate as the total internal manufacturing lead times are in hours and days, as opposed to weeks or months. The three major areas of change caused by integrating MRPII into TBM are material flow and functions, demand management, and material planning and control. They are discussed in detail in the following section [13].

Supply Chain and ERP

Enterprise Resource Planning has proven it self to be the foundation, the bedrock, for supply chain management. It's the glue that helps bind the company together with its customers, distributors, and suppliers all on a coordinated, cooperative basis. ERP system is a transaction based execution system, and Supply Chain is a decision support system. Net working, Detail scheduling, and Available to promise (ATP) are all decision models of Supply Chain, thus their outputs are decisions. But ERP is the set of process-oriented transactions that outputs business processes. Networking focuses on the distribution level, while Detail scheduling focuses on production level, ATP on demand and supply level. ERP focuses on enterprise operations. We may say that supply chain is constructing upon the ERP. The main task of a ERP system are transaction and data collecting, while that of a Supply Chain system are planning and problem solving.

Since ERP is concerning about the inner process flow of a company, the requirement of a ERP system is its database access ability and the consistency of business process flow which is easy to configure and update. However, a Supply Chain Management system is a decision support system which focusing on integration and planning. Thus the computational ability is important of the system to optimize the business decisions and strategies. To be a reference on the system development of ERP and SCM, it is valuable to compare the requirements of these two kinds of systems. Due to the different using purpose of ERP and SCM, the data ERP keep and the data SCM will use are not in the similar types. The data in an ERP system are detail raw data that are the result of its transactions. But the data that SCM system may use must being aggregate and grouped first for its analysis and planning purpose [14].

Table 3.4 comparison for the characteristics of Supply chain and ERP

Model Characteristic	Type	Output	Level	System
Networking	**Decision Model**	**A decision**	**Distribution**	**Decision support system**
Detail Scheduling	**Decision Model**	**A decision**	**Production**	**Planning system**
ATP	**Decision Model**	**A decision**	**Demand and Supply**	**Information and decision support system**
ERP	**Process Oriented**	**A process**	**Enterprise Operation**	**Traction based system**

BPR as ERP Precedent

BPR and ERP Implementation projects can be thought of as being independent initiatives. In theory, each project could exist within an organization without the other. In practice, they are often both in process at the same time in an organization and influenced by and dependent on each other in a myriad of complex relationships often including common design for key business processes. An ERP might be selected to replace an existing system, and the execution of a BPR might be delayed. A BPR might be in place but terminate prior to completion, and an included ERP implementation might continue. BPR and ERP implementations are often at different stages of their development. A BPR project may be started and several months into the project when it is concluded that an ERP is required to support the new processes, an acquisition project commences. Similarly, a business decision might have been made to acquire a new IT system and an ERP chosen. During the implementation process it may be recognized that the ERP would enable a business reengineering and a BPR initiative's commencement.

However, BPR has been touted by many as dramatic improvements become necessary for organizations to improve competitiveness and remain strong participants in economic development. If an enterprise rushes to install an enterprise system such as ERP without first having a clear understanding of the business implications, the dream of integration can quickly turn into a nightmare. These are not technology problems. These are process problems—problems that result from a failure to recognize that process excellence or "process think" is necessary to make enterprise systems succeed. Consequently, BPR should be done as a required precedent step and a critical successful factor for the ERP implementation [15].

3.10 Previous Studies Used in Survey Development

A Study on Manufacturing Resource Planning (MRP II) Practices in Singapore

This study is sponsored by the National University of Singapore, extensively surveyed manufacturing companies in Singapore that have adopted MRP II systems for improving their business operations. The survey investigated application practices, costs and benefits obtained, and the implementation process in MRP companies. Typical titles of respondents included Materials Manager, Production and Inventory Control Manager, Master Scheduler, MIS Manager, and Production Manager. The questionnaire was sent to approximately 750 companies, 128 of which responded, from which 59 had implemented MRP. Of the industries represented, the largest representation of MRP companies was from electronic products and components, fabricated metal products, and the electrical machinery, apparatus, and supplies industries. MRP was found to be more prevalent in older companies with more complex manufacturing processes and operations.

It was found that as a company increased in size as measured by gross sales, it was more likely to adopt MRP. Only 18.4% of companies with less than S$ 10 million (Singapore dollars) used MRP while 83.3% of companies with sales between S$200 and S$500 million had adopted MRP. About half (49.2%) of the MRP systems resided on minicomputers while microcomputers and mainframes each accounted for 20.3%

of the hardware platforms. A majority of the companies (71.1%) sourced their MRP software from vendors. Only 13.6% of the companies developed the entire software in-house.

The extent to which companies had implemented MRP II was measured by the degree to which modules had been computerized. The most highly computerized modules were bill of materials (BOM), inventory stock control, and materials requirements planning (MRP). Sixteen modules were evaluated on the degree of computerization using a six-point Likert scale. ('0' for 'not at all', '1' for '1-20%', to '5' for '81-100 %'). The understanding of the term "MRP II" was also evaluated using the participants' choice of definitions of the term MRP. Rather than identifying MRP II as a general system for computerizing any business function, or a computerized planning and control system for production only, 67.2% of the survey participants identified MRP II as a "primarily computerized materials/production planning and control system integrated with other business areas to achieve a total business system." Information pertaining to the total hardware and software investment in MRP was collected and summarized. The results suggested that there are two major groups of users.

"The first group comprises of smaller users who had spent between S$100,000 and S$300,000 (US $141K to $423K) while the other group of larger users had spent more than S$500,000 (US $705K)." The smaller systems belonged to small and medium enterprises while the larger systems are owned by multi-national corporations and larger enterprises. "The additional system investment is more evenly spread among the different types of enterprises, indicating that the smaller companies were prepared to further invest large amounts in their MRP systems." Major MRP benefits and reasons for implementation were ranked on a 5 point Likert scale. Benefits such as better delivery, better responses to changes, and better scheduling generally matched reasons for implementation. Reasons were primarily operational in nature.

It appears that companies intend to apply MRP II as a tool for improving operational efficiency rather than as a means for increasing competitiveness.

Sum and Yang noted that top management in Singapore plays a major role in introducing MRP to their companies. The study showed that 67.8% of the Singapore companies cited top management as the MRP II initiator while only 18% of the US companies cited top management as their MRP II initiator. Lack of MRP expertise, training, and education were identified as major problems facing MRP implementers. Surprisingly, they found that cost was not a major barrier to MRP implementation. The authors suggest, "Case studies could be carried out to better understand the complexities of the implementation process and to study how companies cope with organizational changes that accompany MRP adoption [10].

CHAPTER 4
RESEARCH METHODOLOGIES

4.1 Methods of Data Collection

The methods employed to achieve the objectives of the research are:

1. Literature survey ;
2. Visit to companies and gather all the available data and Conduct interviews;
3. Proper consultation will be conducted with concerned expertise;
4. Survey of literature and previous research works on similar topics; and
5. User friendly based application software will be developed.

4.2 Data Collection (Survey Questionnaires)

The questionnaire constitutes a central part of the approach to define the business strategy required to make sure a company focuses on creating value for customers and suppliers, integrates all critical business processes and reduces or even eliminates lateral hand-offs or complex chain of business steps. The whole idea of this approach is to rethink and redesign business processes and recognize and realize the potential of new business processes and recognize and realize the potential of new technology.

The purpose of the interviewed and circulated questionnaire is:

- First, the questionnaire result is used as one input data to the implementation model of ERP.
- Secondly the questionnaire is a way of creating awareness in Material requirement planning, manufacturing recourse planning, enterprise resource planning. Furthermore, it can be used to assess the level of awareness on the mentioned fields.

The questionnaire consists of 50 questions. It was distributed to 75 Gafat Engineering Factory staffs', who are representative employees of each plant as shown in table 6-1 below and some external customers. Out of the 75 questionnaires, 60 were filled and returned. This means 80 % respondent rate.

4.2.1 Nature of the Circulated Questionnaires

The questionnaire is prepared for both the employees. Interview was held with some external customers.

The questionnaire distributed for employees has three sections whose main targets are described below.

Section One: Question 1-12 is mainly concerned with finding out the general attitude and awareness of the employees towards Material Requirement planning, Manufacturing resource planning, Enterprise resource planning, quality concepts and the company's background such as, company profile, organizational structure, motto, mission, objectives, location, customer supplier relationship, and existing cost analysis.

Section Two: Question 13-40 is mainly concerned with assessing the material requirement planning, general inventory systems and other production related parameters.

Section Three: Question 41-50 is mainly concerned with the manufacturing system like major process, types of products produced, production flow chart, production capacity, annual consumption of materials, and product costing parameters.

4.2.2 Categories of respondents

The study considered a sample size of 75 candidates from 5 relevant departments in GEF for questionnaire. Out of 75 questionnaires distributed to the employees, 60 of the respondents properly completed and returned the questionnaires. This gives a response rate of 80% Table 5.1 summarizes this data.

Table 4.1: Categories of Respondents

Department	Questionnaire			
	Distributed		Returned	
	(No.)	Percentage (%)	(No.)	Percentage (%)
Quality Management	5	6.67	5	100
Logistics Department	15	20.0	13	86.67
Production And Engineering	35	46.67	33	94.23
Human Recourse	10	13.33	8	80.0
Research and Development	10	13.33	7	70

4.2.3 Respondents position

In order to collect reliable information the respondents were selected from the different position, for which they are responsible by considering out their duties in their respective department. Table 6.2 shows the respondents who filled the questionnaire from each department with regard to their position. According to the data presented in the table most of the respondents of the questionnaire are experts, senior experts and team leaders.

Table 4.2: Respondents position

Departments		Positions					
		Head	Team Leader	Senior Expert	Expert	Associate Expert	Total
Quality Management		-	2	1	1	1	5
Logistics Department		-	3	3	4	5	15
Production And Engineering		3	8	7	9	8	35
Human Recourse		1	3	2	2	2	10
Research and Development		1	2	3	2	2	10
Total	No.	5	18	16	18	18	75
	Percentage (%)	6.67	24	21.33	24	24	100

4.2.4 Summarized Responses

Prior to questionnaire distribution the questionnaire is assessed by heads of the different departments, senior experts, team leaders, and associate experts of GEF. This is helpful to point out the core problem.

Thus based on the questionnaire survey, the main problem in the factory is the production delay and its immediate consequence of high manufacturing cost. The same result is obtained when a discussion is held with the heads, experts and team leaders. The past data records of the factory also depicts the same reason with that of the questionnaire survey. The main causes for the problem and their frequency is shown in the next chapter. Based on the information that has been collected, it is tried to identify the core problem of the situation.

CHAPTER 5
DATA ANALYSIS AND INTERPRETATION

5.1 Problem Analysis in the Production of Et-97/1

GEF is a producer of different artilleries to satisfy the demand of the defense forces and other civilian products used for different purposes. Products are manufactured and sold as individually specified units. Component types are similar; however, each customer configures the product to its own needs, primarily using available options. Some products are completely custom designed and built to customer specifications. The product is shipped directly from the manufacturing plant to the customer.

The company has annual sales of approximately one hundred twenty million Birr. The company has six hundred employees, including about four hundred fifty non union employees on the shop floor. The manufacturing organization was very traditional, with a process plant layout consisting of components fabrication, subassemblies, and final assembly. A tremendous amount of data collection effort was expended initially to match company products with producing equipment in the process flow analysis.

A large amount of product flow complexity existed, with many different products running across any given machine.

The current plant setup and production processes resulted in long travel distances to produce a finished product.

The production of ET 97/1 rifle consists of a lot of process performed in different shops of the factory. The assembly of the different components of the rifle has 53 parts. Each component on the assembly line has passed through long and bulky processes in which there is at an average of 9 inspection check ups at each inspection point.

The production of the ET 97/1 rifle is liable to high manufacturing cost due to the different factors mentioned in chapter 4. As the core problem lays on the production planning this chapter deals with the main problems in the production area of ET 97/1 in shop1 only. That is the production of one component of the assembled part.

The first assembled component is the assembled receiver and is done on shop 1 in which it consists of a lot of parts to be assembled. As shown in the table. Among the different component parts the breach block has 72 production steps and 14 inspection points.

Each inspection points have at an average of 9 inspection instruments and repetition of measurement is done on each step.

Breach block is purchased in a block form and the required shape is given in the plant through 72 processes via the available machines and jigs and fixtures. Each machine is arranged in the respective processes to be performed in the breach block. Most of the machines are performing more number of activities.
The process flow of the breach block is shown in table 5.1

Table 5.1 process flow of assembled receiver

Parts to Be Sub Assembled

No	Description of Sub Assembly	Sub Assembly Code	Assembled In Shop	Parts to be Assembled	Part Code	Manuf. in Shop	Remark
1	Assembled Receiver	Ps11-1	Shop 1	- Receiver body	11-1A	4	
				- Receiver rear lug	21-3K	1	
				- Right guide	11-4	4	
				- Left guide	11-5	4	
				- Trigger guard	11-6	4	
				- Grip Screw Frame	11-8	1	
				- Bolt Locking Lug	11-9	1	
				- Bolt Locking Lug Pin	11-16	4	
				- Trigger guard base	11-20	4	
				- Butt stock Fixing	11-44	3	
				- Butt Stock Fixing Plate rivet	11-65	3	
				- Magazine feed tray rivet	11-67	3	
				- Breech Block rivet	11-68	3	
				- Distance tube	11-69	3	
				- Distance axle	11-70	3	
				- Upper Pin	11-80	3	
				- Trigger Guard rivet	11-82	3	
				- Lower Pin	21-84	3	
				- Breech block	11-2	1	
				- Receiver body	11-1b	4	
				- Receiver rear lug	11-3d	1	
				- Assembled selector	Ps 11-3	1	

5.2 Cause and Effect Diagram and Pareto Analysis

Once the core problem has been identified, the cause of the core problem and the effect caused by the core problem are stated from the organized information. Thus the next process is forming a diagram showing the cause and effect relationship in the form of a problem tree. This is done by restating all negative condition of the problem into positive condition that is desirable and realistically achievable.

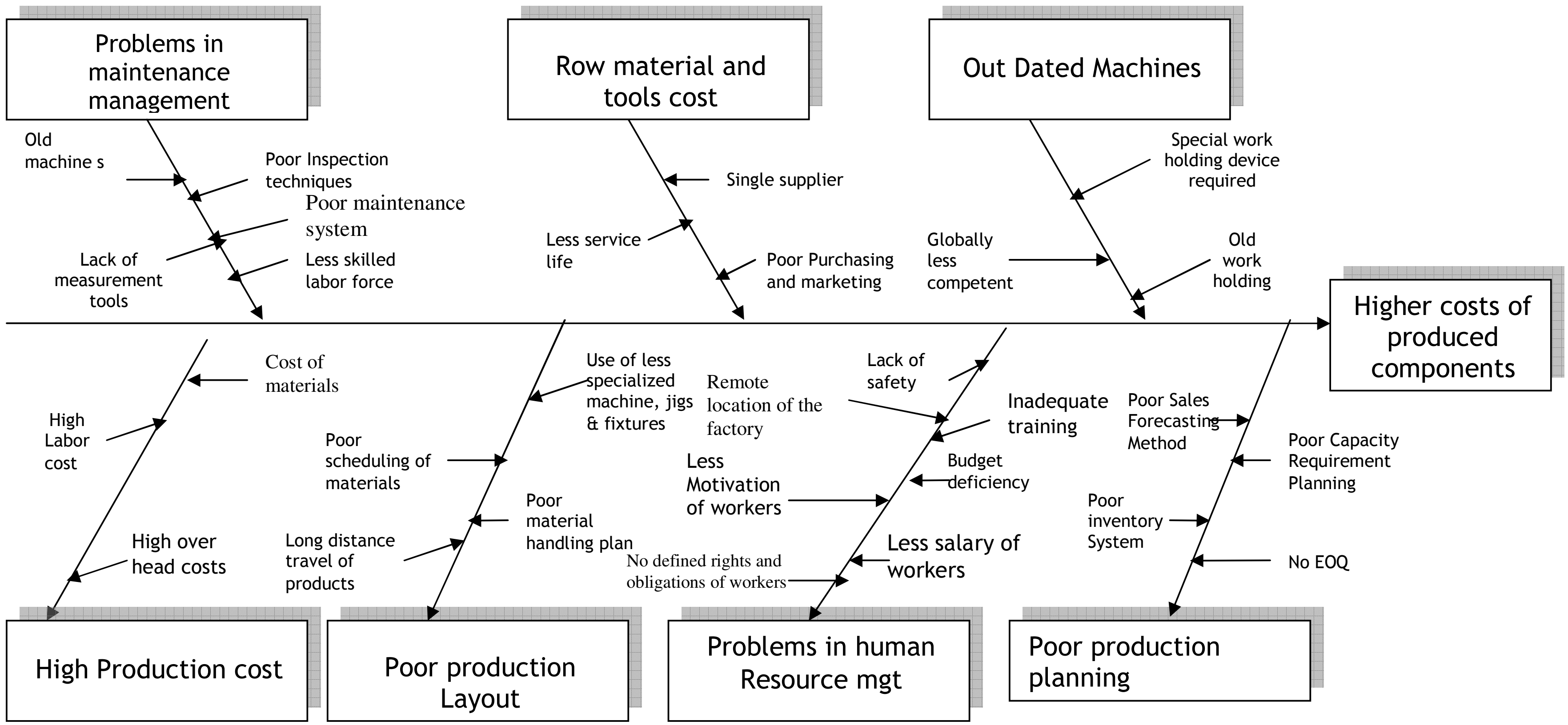


Fig. 5.1 Cause and effect Diagram

The questionnaire based upon the specific criteria has been provided to assess the whole structure of current business. The next and the most important step of analysis is to study the performance gaps and to identify the underlying factors which explain the causes of the gap and provide the necessary fit. With accurate information and systematic analysis it will become easy for the whole organization to reach the ultimate goal of "Transformed Organization".

Table 5.2: Percentage of Respondents for the Causes of Production delay and manufacturing cost

Department	Number of Respondents	Causes for production delay	%age of cause
Quality Management	5	Problems in human resource mgt.	20.5%
		Poor Production Layout	29.5%
		Rework and Scrap	9.75%
		Outdated machines	10.25%
		Poor production layout	12.0%
		Supply of raw materials and tools	12.67%
		High Production Costs	5.33%
Logistics Department	15	Problems in human resource mgt.	13.25%
		Poor Production Layout	31.75%
		Rework and Scrap	12.0%
		Outdated machines	17.0%
		Poor production layout	11.67%
		Supply of raw materials and tools	9.33%
		High Production Costs	6.0%
Production And Engineering	35	Problems in human resource mgt.	15.50%
		Poor Production Layout	21.33%

		Rework and Scrap	15.67%
		Outdated machines	15.25%
		Poor production layout	12.25%
		Supply of raw materials and tools	10.25%
		High Production Costs	9.75%
Human Recourse	10	Problems in human resource mgt.	12.33%
		Poor Production Layout	25.0%
		Rework and Scrap	13.67%
		Outdated machines	9.25%
		Poor production layout	13.50%
		Supply of raw materials and tools	15.25%
		High Production Costs	11.0%
Research and Development	10	Problems in human resource mgt.	13.0%
		Poor Production Layout	25.33%
		Rework and Scrap	18.67%
		Outdated machines	13.0%
		Poor production layout	12.0%
		Supply of raw materials and tools	10.0%
		High Production Costs	8.0%

Table 5.3: Percentage of the causes for production delay

Reasons for the main problem	Percentage(average)	Cumulative percentage
Poor production planning	26.582	26.58
Problems In human Resource management.	14.916	41.49
Rework and Scrap	13.752	55.25
Poor production layout	12.95	68.20
Outdated Machines	12.284	80.48
Raw materials and tool cost	11.50	91.98
High production costs	8.016	100.0

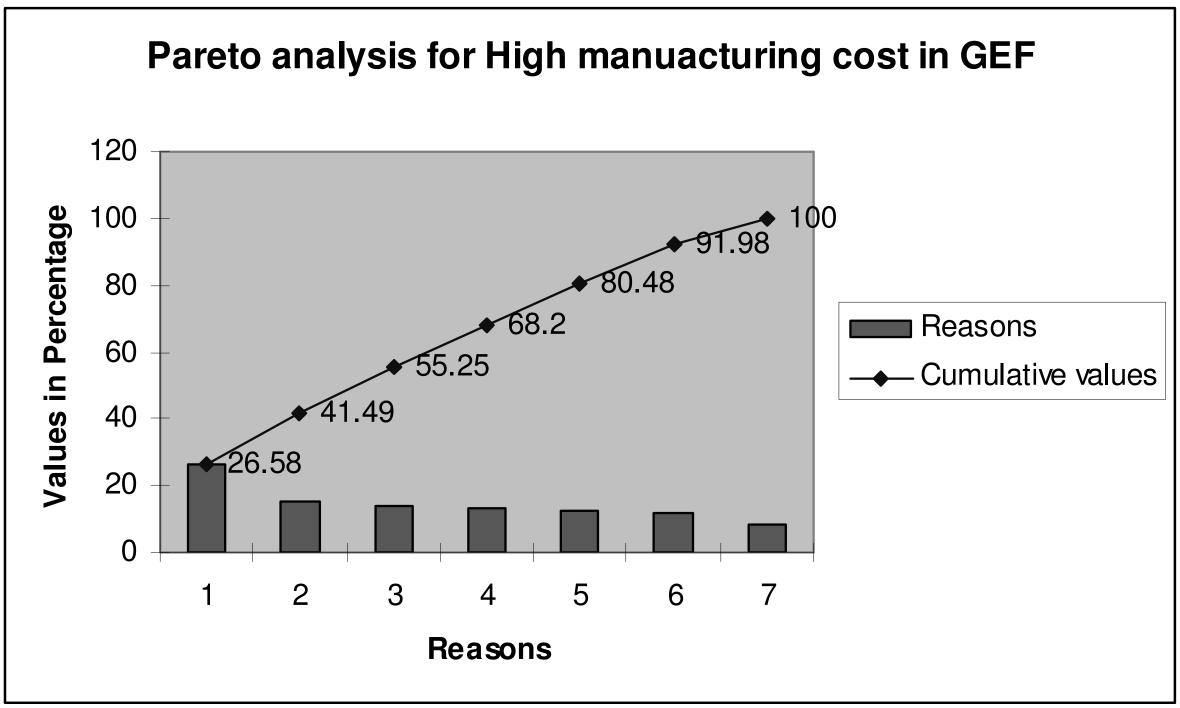


Fig 5.2 Pareto Analysis for the Production Delay and High manufacturing cost

5.2.1 Interpretation of the Pareto curve

A useful first step is to draw a vertical line from the 20- 30 percent area of the horizontal axis. This has been done in the figure and shows that:

- 28.6 percent of the reasons are responsible for 41.49 percent of the cost of the produced component. The reasons are:
    - Poor production Planning (26.58 %) and
    - Problems In human Resource management (20.40%)

These are often called the 'A' elements or the "vital few" which have been high lighted for a special attention it is clear that, if the objective is to reduce costs, then the production planning problems must be tackled as a priority. Similarly concentration on the problem of human resources will have the biggest effect on minimizing the cost of the produced components and it enables the factory to be competent in the global market.

It is conventional to further arbitrarily divide the remaining 70-80 percent of elements in to two classifications the 'B' and 'C' elements, the so called "trivial many".

In summary, the pre ERP characteristics in shop one of GEF included the following:

- The plant layout and personnel resources were organized and managed functionally. Materials traveled excessive distances and Material handling systems were labor intensive.
- The maintenance and quality system was audit based with no statistical quality control.
- Key raw materials came from single supplier. Work-in-process inventory storage used forty percent of production floor space.
- Inventory
- Logistics
- Bulky inspections on each inspection points
- Repetition of similar activities on different steps which can be finished on one machine.
- High setup times due to more number of process
- Operator negligence
- More number of reject

CHAPTER 6

ERP MODEL IMPLEMENTATION AND EVALUATION OF SELECTED MODELS IN GAFAT ENGINEERING FACTORY

6.1 Selection of Implementation Models

Is Enterprise Resource Planning the best step to take now to make more competitive? If so, what is the best way to implement: company-wide or Quick-Slice? The analysis will serve as the basis for putting together a short-term action plan to bridge the time period until the detailed project schedule is developed.

The Three Knobs

In project management, there are three primary variables: the amount of work to be done; the amount of time available and the amount of resources available to accomplish the work. Think of these as three Knobs, which can be adjusted (as shown in Figure6.1).

It's possible to hold any two of these knobs constant by varying the third. For example, let's assume the following set of conditions:

1. The workload is considered to be a constant, a given. There is a certain amount of work that simply has to be done to implement ERP.
2. The time can also be considered a constant, and, in this example, let's say it's fixed at about 18 months.
3. The variable then becomes the resource knob. By adjusting it, by providing resources at the appropriate level, the company can accomplish the necessary amount of work in the defined time. Developing a proper cost-benefit analysis can put the resource issue into clearer focus.

But, what if a company can't increase the resource knob? Sometimes, it's simply not possible. May be there's not enough money, or the organization is stretched so thin already that consuming large blocks of employee time on an implementation just isn’t in the cards.

Within the Proven Path, provisions are made for:

Work, Time, and Resources

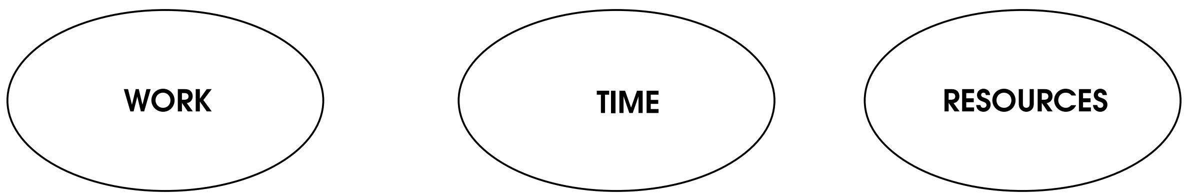


Fig. 6.1 Work Time and Resource Knob

- **Company-wide implementation**: total company project; all ERP functions implemented; time frame one to two years.
- **Quick-Slice ERP implantation**: confined to one or several Pareto high-impact product lines; most, but not all, ERP functions implemented; time frame three to five months.

With Quick-Slice ERP, the resources are considered a constant, because they are limited. Further, the time is considered fixed and is a very short, aggressive period. Thus the variable becomes the amount of work to be done. The principle of urgency applies here since only a portion of the products/company will be cutting over to ERP, it should be done quickly. This is because the company will need to move aggressively to the next step, which may be to do another Quick-Slice implementation on the next product family or perhaps to convert to a company-wide implementation.

Resource constraints are only one reason why companies elect to begin implementation on a Quick-Slice basis [1].

Based on the above fact from the questionnaire delivered the company have only a crowded time schedule and can not allot much of its resources to ERP implementation. Besides this the following are the main factors.

- There is not enough money i.e. No budgets are allotted to ERP implementation.
- The human resource is totally allotted to production and other tasks of the factory.

Thus it's better to implement ERP using Quick slice Method. The question is on which department will be ERP functions implemented first.

From the previous chapter we have come through the problems, which may be accountable for the high costs of the components produced with in the factory I.e. poor production planning which includes poor inventory system, poor sales forecasting methods, etc., and the human resource management. In addition to this for the rework and scrap and other causes of high manufacturing cost of the factory poor maintenance system of the factory can be mentioned as a vital cause.

Gafat Engineering Factory is a 'job ordered company that manufactures its products after getting an order from Ministry of National Defense and other external customers. As it is tried to be explain before, the factory is facing a great challenge to satisfy the requirements of its customer. When we see the existing situation of the factory, frankly speaking, it is not guaranteed to continue as an effective and efficient factory in the future. This is because survival of this industry is strictly dependent on its productivity and competitiveness at the market. The competition may be in national or international level.
Especially the Armament technology is growing in a faster rate and production of different riffles is becoming simple and simple. This in turn results a *dynamic* change in national defense demand. To cope with such dynamic changes, the factory has to identify the main problems facing in its day-to-day activity. It is believed that setting Proper Production Planning and Control system leads the factory to an organized set of activity to solve its production problems. Thus to

stay in the market and satisfy its customer needs, like any factory does, the factory is expected to apply a sound production planning and controlling system. Production planning includes allocation of resources, routings of each of the factory product, due date setting and dispatching order to the shop. For the annual production plan to be maintained there should be relevant and constant controlling mechanism of the production progress.

Since the types of products manufactured are different, high in variety and high in volume, the type of layout available in Gafat Engineering Factory is mixed type (process and product determined lay out).

Planning and controlling is must be integrated functions. It is ineffective to control the factory resources, if there is no plan against which the factory could compare its progress and it is insufficient to plan production if there is no control of the factory resources. Based on the forecasted demand, aggregate production planning, master production schedule, material requirement planning and capacity requirement planning the factory production technical planning methods department decides which product to be made, how many of each and when they should be completed, by scheduling the production and the existing resources. Based on the data collected from the production floor, the department controls the progress of the job. Production control is concerned with determining whether the production activity is running according to the plan and if not it attempts to take corrective actions to address the difference.

6.2 Evaluation of the Problems Identified

Based upon the understanding of the factory's historical characteristics, several key design considerations emerged as most important to the success of ERP. These include:

- Redesigning the production planning and control system and shop floor controlling and monitoring activities.
- Redesigning the Product Supply System process flow into product families to reduce the excessive travel distances. This involved heavy group technology

analysis to understand product structure modularity and product/equipment relationships.

- Reducing changeover times in the fabrication area to eliminate the need for large batch sizes and to eliminate the grouping of similar manufacturing orders.
- Improving reliability and process capability was heavily emphasized because no data were available in these areas, the need to establish performance baselines were critical.

To complete the conceptual design, the following components should be constructed.

6.2.1 Evaluation of the production planning and control

Activities with in the scope of production planning includes:

- Demand forecasting
- Aggregate production planning
- Master production planning
- Material requirement planning
- Capacity requirement planning
- Process planning

Production planning in GEF is based on a push system with the following elements;

- The master scheduler used forecasts, an inventory status report, and customer orders to determine manufacturing orders. Manufacturing engineers used the manufacturing orders to decide lower-level manufacturing orders. Orders are frequently grouped in large batches to minimize setup costs.
- The sales forecast used in GEF is traditional and large amount of materials are get stocked based on the need of various clients for different products i.e. based on earlier demands, Materials are stocked before any orders have been placed. As it is discussed with the factory employees most of the time this system has a draw back in that if any order is not placed by the anticipated companies the factory has incurred a lot of costs in placing orders and stock holding cost.

Proposed production planning and control method

ERP functions are shown as a matrix. The matrix is divided horizontally into planning and execution activities, and further divided vertically into demand, supply, and capacity elements. The planning elements of ERP are all vital to the success of any manufacturing strategy.

Production control is the updating and revising procedure where, according to the requirements of implementation, the labor assignments, the machine assignments, the job priorities, the line speeds, the production routes etc. It is basically a correcting mechanism, which goes on through out the implementation process of the already drawn up production plan and schedule. To have a control over the production, a system called Shop Floor Monitoring and Controlling system is used.

The production control means that products shall be produced in the best and cheapest method. It will be of required quantity and it shall be produced at the required time. If there is some deviation from the planning, the production control will lead to adjustment, modifications and refining the plans. In short the production control maintains the progress of the work as per the plan.

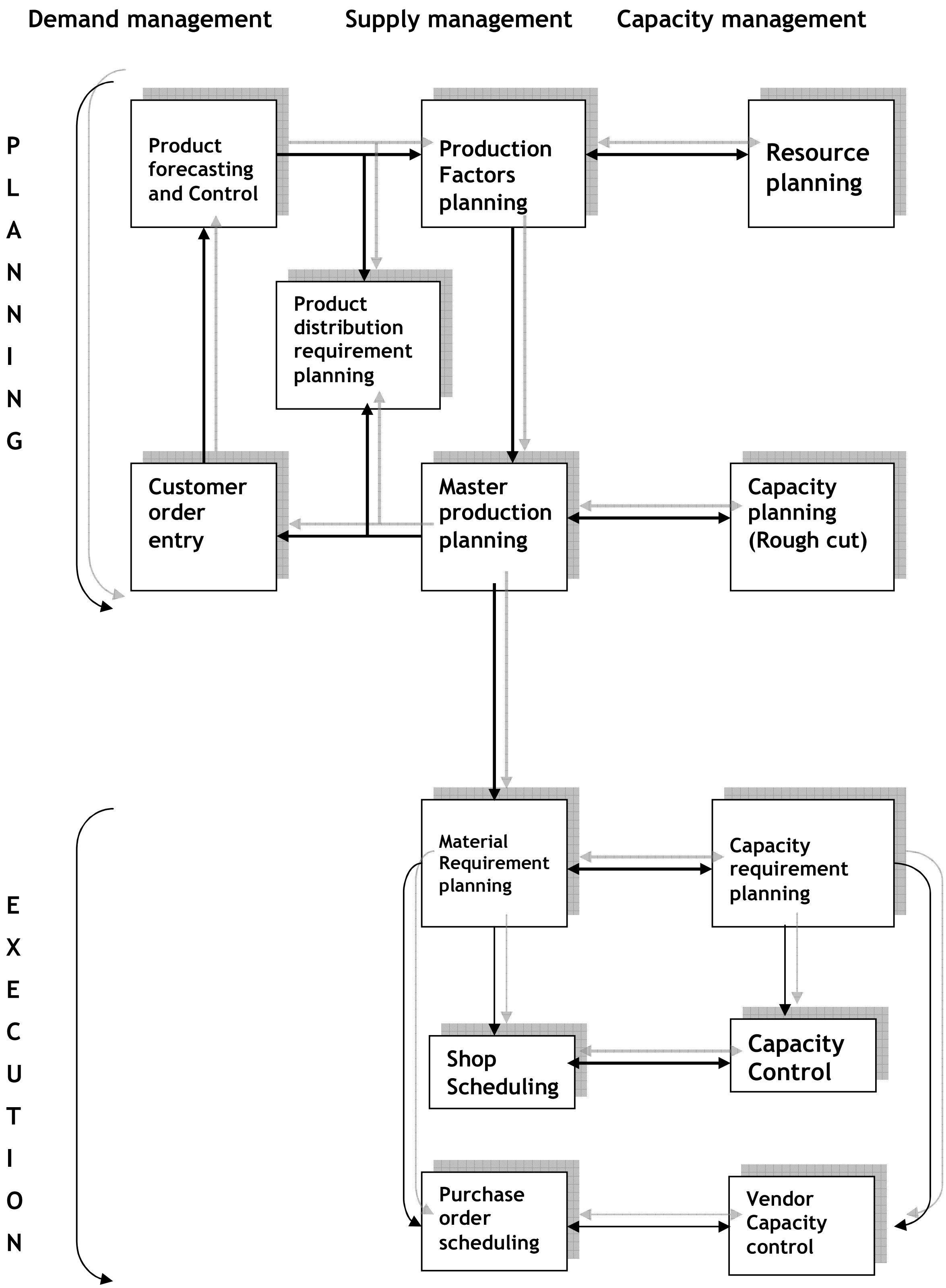


Fig.6.2 ERP planning and control

Shop floor control is an essential part of the overall production planning and control tasks of a company, responsible for operational control of the manufacturing related activities. The shop floor control feedback involves evaluating the movement of the job through the shop. The overall system that provides information on released orders to the floor and their progress to the shop is normally the SFMCS.

In addition to the activities of the production control and shop floor monitoring and controlling techniques the factory should have a sound inventory system, which is integrated and computerized. This is discussed on chapter 7 in detail on the software development.

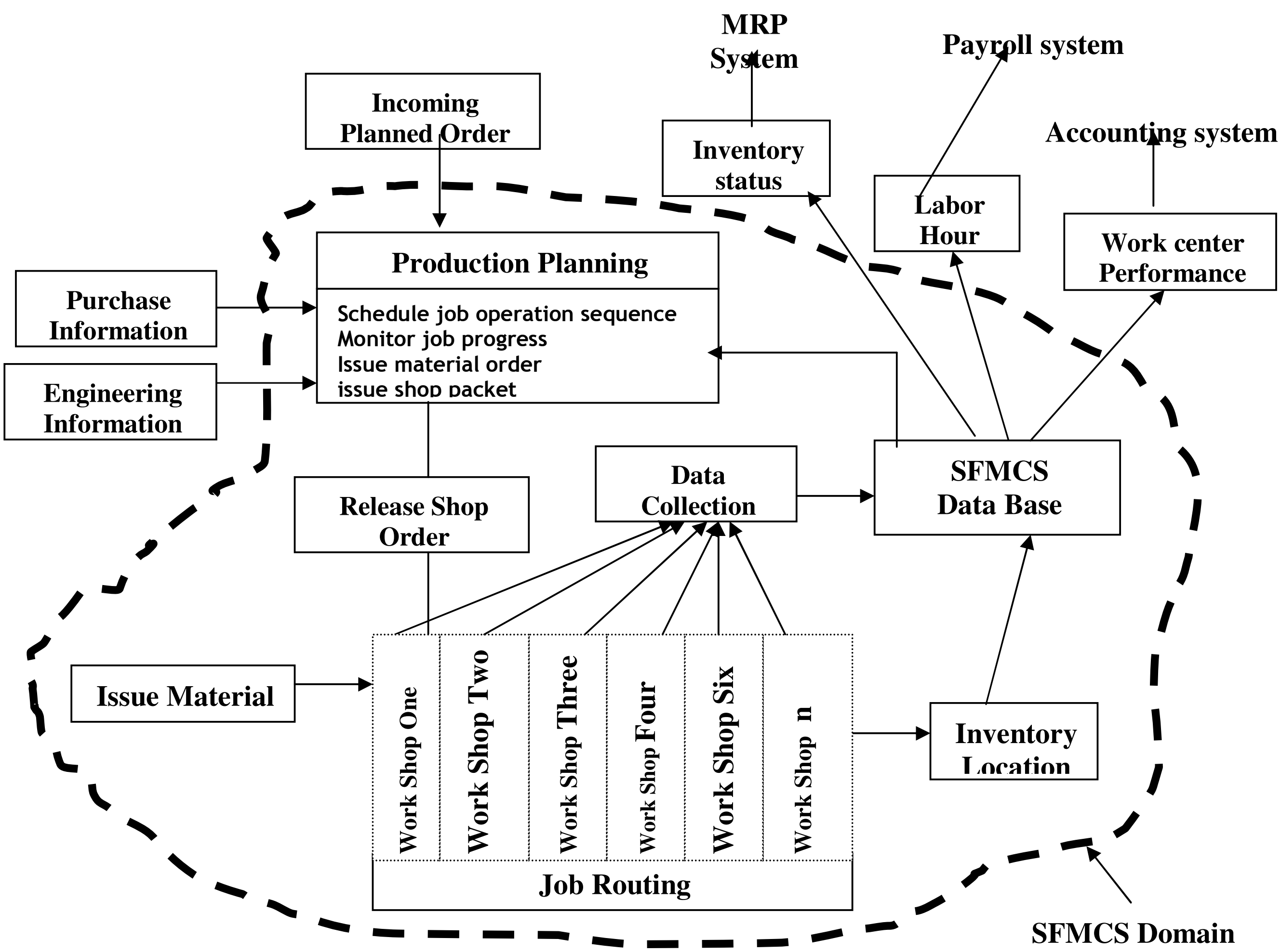


Fig. 6.3 Overview of Factory Shop Floor Monitoring And Controlling System (SFMCS)

6.2.2 Evaluation of the Maintenance Management System

Since cost of the machineries in the factory are old in age and not equipped with maintenance equipments there exists repetitive machineries break dawn. To justify its effect on the production process, there are no mechanisms to register machineries breakdown time. In addition to this there is no annual preventive maintenance plan.

The quality control system of the factory is following traditional means to inspect products while it is processed. Even if there are too many inspection points on the process flow, large number of rejection has occurred. Thus the factory has to use statistical quality control tool in order to minimize the number of rejections. The number of rejection per year for a sample number of 24 is tabulated below.

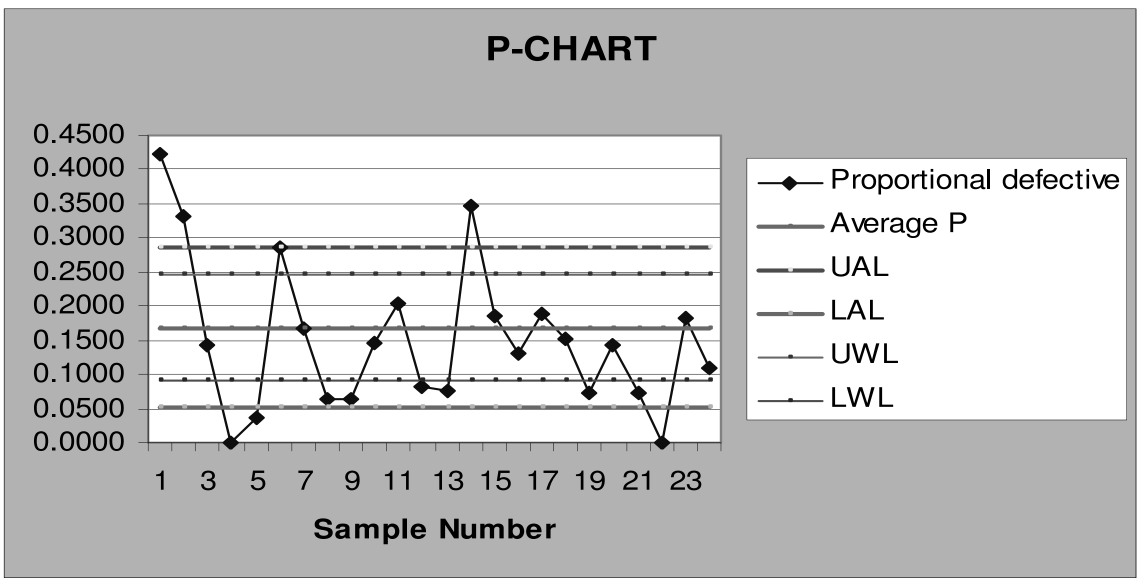


Fig. 6.4 Control chart for number of defectives in the production of ET 97/1

Integrating Maintenance Management System in to ERP

The most important elements of the proposed maintenance model includes

- Maintenance load
- Maintenance Resources
- Maintenance planning and scheduling

- Work orders executing
- Quality control
- Performance measurement

Besides the model considers three types of maintenance

1. Preventive maintenance : a work that must be carried out on a plan periodic schedule
2. Emergency or breakdown work that must be done immediately; and
3. Diagnostic predictive maintenance or condition based maintenance wok that must be planed as son as possible triggered by deterioration indicated by a monitored parameter.

Thus one way or another maintenance load is created, must be planned, scheduled and executed within a certain time span while complying with specific quality standards.

The work orders generated as a result of maintenance job requests are scheduled and executed by utilizing necessary maintenance resources according to prescribed maintenance policies. These policies can be acquired either from maintenance historic data files or from manufacturer's manual of the maintained item.

The maintenance resources considered in the proposed model include:

- Work shops;
- Man power;
- Machines;
- Equipments and tools; and
- Material, spare parts and consumables.

The maintenance management system as shown in figure 6.5, must cope with the maintenance load. The nature of the maintenance load is partly deterministic (planned maintenance), but also stochastic (unplanned maintenance). Each time a maintenance load is created; maintenance is planned and scheduled. At this point the procedure can return the previous step if the scheduling time period is not complying with the requested execution time span. A scheduled work order is executed and, when completed, if some of these tests are not satisfying; a request for a repetition of the maintenance job may be imposed. A successful quality control is followed by performance measurement and cost analysis. Finally, all data are recorded in the database and, as a result, the historic data file of the maintained item is updated and new future periodic maintenance dates are calculated.

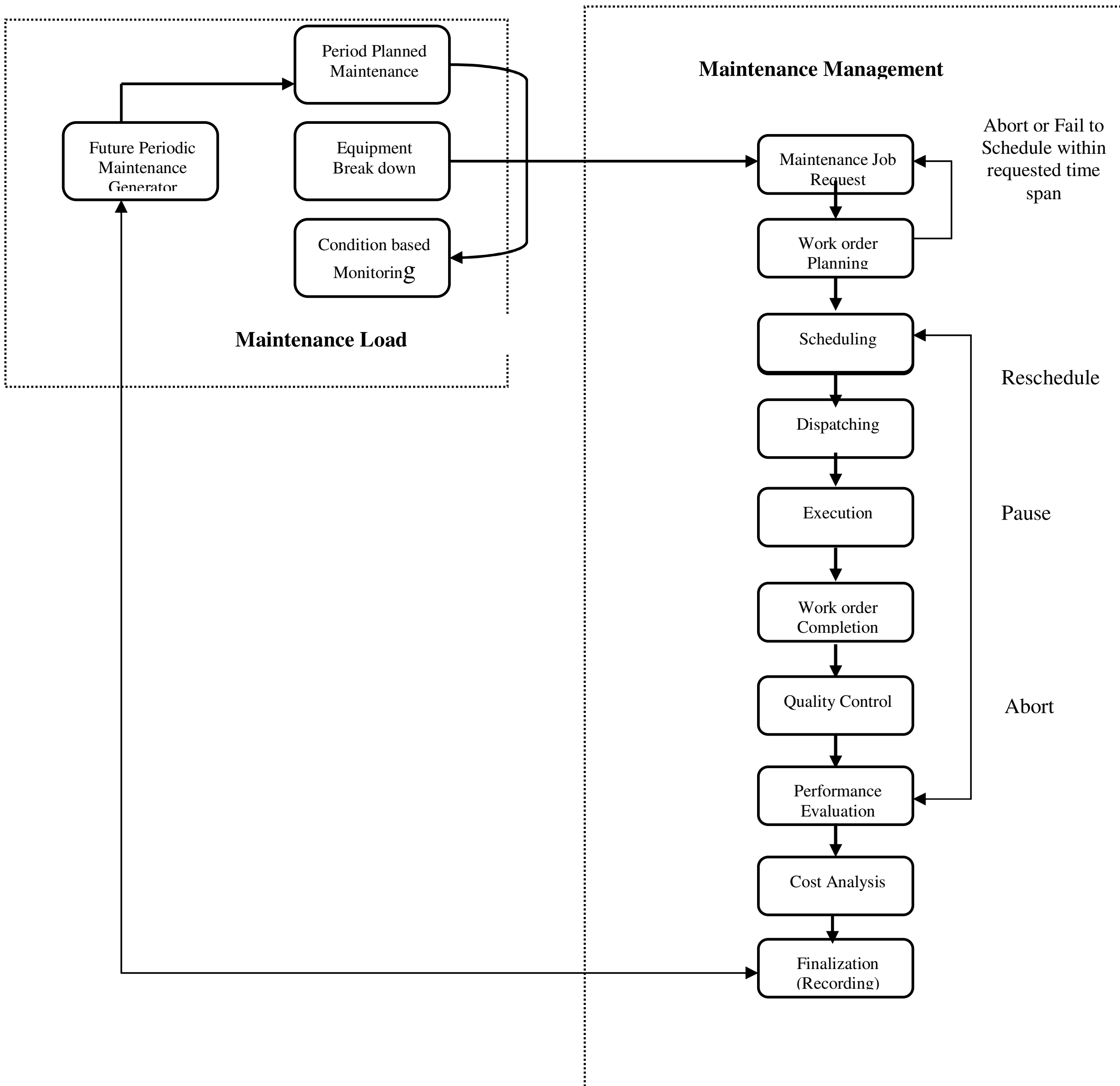


Fig. 6.5 Maintenance management System

6.3 Cost and benefit of implementing ERP

The costs of implementing an ERP project can be described as follow

1. **Computer system**

Include in this category the following costs

- New computer hardware necessary for ERP or ES.
- ES software for a combined ERP/ES
- Systems people and others to: --

- configure and enhance the ES software
- Install the software, test it and debug it
- Interface the purchased software with existing system that will remain in place after ERP and ES are implemented
- Assist in user training
- Develop Documentation
- Provide system maintenance

- Software maintenance costs

2. **Data**

Include here the costs involved to get and maintain necessary data

- Inventory record accuracy
- Bill of material accuracy, structure and completeness

3. **People**

Include here costs for:

- The project team Education, including travel and loading
- Professional guidance etc.

The benefits can be described as:

- Increased sales
- Increased direct labor productivity
- Reduced purchase cost
- Reduced inventories
- Reduced quality costs
- Increased productivity of the indirect wk force

The following operating costs are obtained during the research work in GEF. The costs related to computer system, data and People used in this paper are based on cost information found from ERP implementers guide on the internet and based on the factory's past record data and from discussions held with some of the workers of the factory.

Annual sales = 25,000,000

Number of employees = 600

Manufacturing process = Fabrication and assembly

Annual direct labor cost = 10,000,000

Annual Purchase Volume (production material) = 12,000,000

Raw Material and Work in progress (estimated) = 10,000,000

Finished goods (estimated) = 15,000,000

Pre tax net profit = 10% of sales

The costs are divided in to one time (acquisition) and recurring (Annual operating) cost

Table 6.1: costs incurred for computer system

Costs (Computer System)	**One time cost(Birr)**	**Recurring cost(Birr)**	**Comments**
Hardware	3,500,000	-	Costs primarily for work stations, computers etc. (50 computers are assumed to be used)
Software	1,000,000	30000	Costs accounted for the total software.
System and programming	300000	20000	Adapting the software to the company and training in its use.

Table 6.2: costs Incurred for Data

Costs (Data)	One time(Birr)	Recurring(Birr)	Comments
Inventory record Accuracy	50,000	18,000	Includes new Equipments and added cycle counters
Bill of material accuracy and Structure	100,000	-	Bills will need to be structured in to the modular format

Table 6.3: costs incurred for people

Costs (Data)	One time(Birr)	Recurring(Birr)	Comments
Project Team	300,000	100000	5 equivalent full time people including costs for education time and teaching the new ERP software interactions to the org. (Past training data and internet source)
Professional Guidance	150,000	50,000	Professional guidance during installation

Subtotal (one time) (Birr) = 5,400,000

Subtotal (Recurring) (Birr) = 218,000

Total Cost (Birr) **= 5,618,000**

Contingency (15% of the sub total cost) = 842700

Total Cost incurred (for ERP implementation) = 4775300

Table 6.4: Benefits Gained from ERP implementation

Benefits	**Current (Birr)**	**improvement (Assumed and internet source) (%)**	**Annual benefit (Birr)**	**Comments**
Sales	25,000,000	7%	1,750,000	Improvement due to improved product availability.
Direct labor productivity	10,000,000	10%	1,000,000	Reduction in idle time, over time, layoffs, and other items caused by the lack of planning and information flow.
Purchase cost	12,000,000	5%	600,000	Better planning and information will reduce total purchase cost
Raw material and work in progress	10,000,000	10%	1,000,000	Better inventory management
Finished goods	15,000,000	10%	1,500,000	Better inventory management
Premium freight (3% of purchase cost)	360,000	50%	180,000	Produce and ship on time.

Total (Birr) = 6030000

Contingency (10%) (Birr) =- 603000

Net annual benefit (Birr) =**5427000**

Thus pay back period = $\frac{4775300}{5,427,000}$ **=0 .87years**

CHAPTER 7

INTEGRATING CONCEPTUAL COMPONENTS OF ERP

7.1 Conceptual Components of ERP

The ERP model consists of four components that are implemented through a methodology. Figure 7.1 illustrates the integration between the components. A clear mapping results, as can be seen in Table I, when this conceptual model is compared to the 4Ps model.

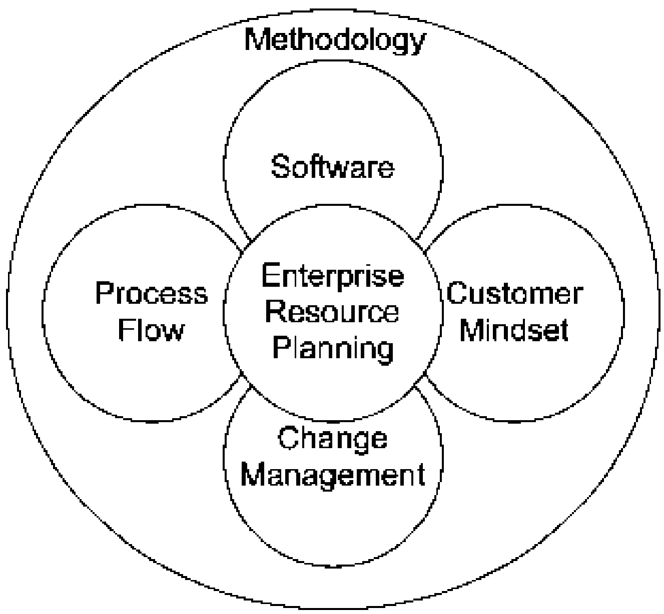


Fig.7.1 Conceptual components of ERP

Table 7.1 the 4ps and ERP conceptual Model

The 4Ps	ERP conceptual model
People	Customer mind set
Product	Software
Process	Change management
Performance	Process flow

7.1.1 The software component

The software component of the ERP model is the component that is most visible to the users and is therefore seen as the ERP product. It consists of several generic modules, some of which are listed below:

(1) Inventory Management The inventory management system the main component of the ERP System. This part is used to facilitate the inventory system of the factory. Items are recorded in proper manner their respective groups. Adding a new item, editing and deleting of an existing items, receiving and issuing of items is possible and enable fast and reliable system of recording the assets of the company.

(2) Human resources (HR). HR forms an integral part of an ERP system. HR administration automates personnel management processes, including payroll, recruitment etc.

(3) Supply chain management (SCM). SCM is the oversight of materials, information and finances as they move in a process from supplier to manufacturer to wholesaler to retailer to consumer.

(4) Supplier relationship management (SRM). To maximize profitability, companies must be able to select the right suppliers quickly, establish strategic relationships and effectively collaborate with them as they help meet business goals.

(5) Customer relationship management (CRM). CRM is a term for methodologies, software and usually internet capabilities that help an enterprise manage customer relationships in an organized and efficient manner.

7.1.2 Process flow

The second component in the conceptual model is the process flow within an ERP system.
Process flow deals with the way in which the information flows among the different modules within an ERP system.

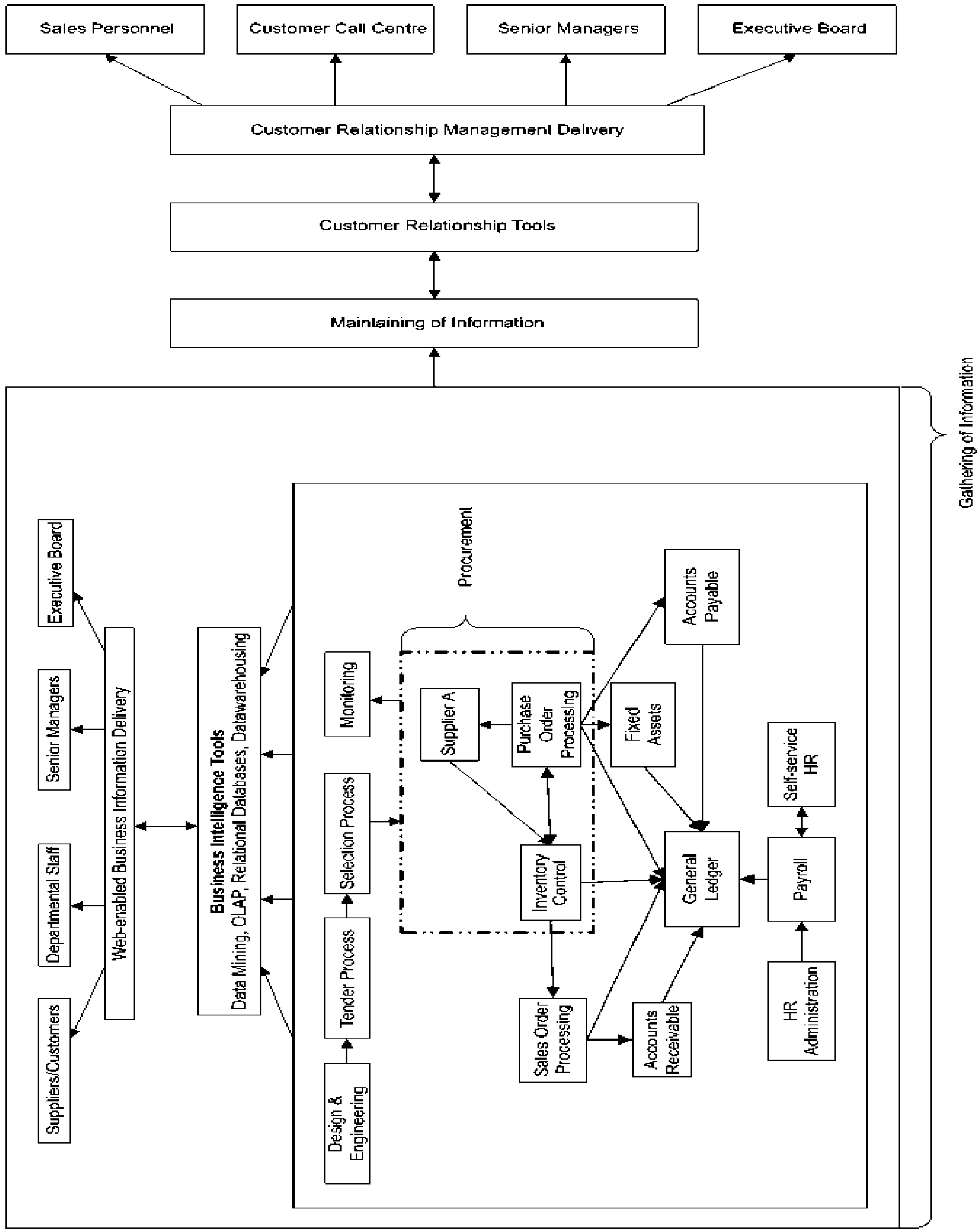


Fig. 7.2 Master Process Flow

This forms a very important part of understanding ERP systems. Figure7.2 illustrates the master process flow, showing how information flows within and between the different modules.

Before an ERP system can be implemented in an organization, the business processes must be modeled and, if need be, reengineered to allow smooth integration. The following are some examples to illustrate the process flow within each of the software components:

Finance: An organization places an order using the purchase order process. The stock or goods purchased through the purchase order process are delivered to the organization and are allocated as stock in the inventory. If a purchase is a capital expense, such as vehicles or buildings, the item will be transferred to fixed assets. The stock items in the inventory can be sold to a customer. The process is the sales order process. The inventory levels are adjusted as stock flows in and out. A sales invoice is generated and accompanies the goods to the customer. This invoice will be the proof that the customer received the delivered goods and owes the company money.

The above-mentioned process also forms part of the SCM component. The organization needs to pay its creditors for the goods it received and the organization must also make sure that it collects its debt from its debtors. All the entries of the modules described above will be made in the general ledger.

HR: HR administration involves the organization's internal activities. Information gathered from HR administration is populated into the payroll system itself. This information, as well as that gathered from the self-service HR module, influences the payroll. Information such as a new employee's salary package will be pulled from the HR administration module. Changes made by the employee in the self-service HR module are also reflected in the payroll module. Interaction between the payroll and the self-service HR module is a continuous process.

SCM: The stock levels in the inventory control trigger the generation of a purchase order. The stock levels are determined through demand planning. An order for the

required stock is placed with the supplier. This order placement can be a physical order or an e-commerce transaction between the organization and the supplier.
The supplier delivers the required stock to the organization and uses supply and transportation planning to optimize delivery to the organization. The stock from the supplier will be delivered at a predetermined price, as negotiated in the SRM component. The delivery time and duration will also be governed by the SRM component.

SRM: The SRM process begins with a design and engineering phase. This phase establishes the minimum requirements and specifications of a product. It also defines the criteria the supplier must fulfill. These criteria form the basis for the tendering process. Different suppliers will tender and submit documentation based on the criteria. A selection will be made and a preferred supplier chosen.

A contract is drafted between the parties. The procurement process is determined and forms part of the bigger SCM process. Ongoing management of the supplier and its services will continue and adjustments will be made to accommodate changes and shortfalls.

CRM: The first and most important process within CRM is to gather all relevant information for a specific customer. This process is tedious and cumbersome and involves sources such as spreadsheets and users' personal information management utilities. Business decisions will be based on this information.

Once all the relevant information has been gathered, it needs to be maintained.
This is crucial, as no organization can afford to make decisions based on old and wrong information. A central database is instituted where all the information is stored and maintained through a chosen CRM tool.

The CRM tool organizes the information in a structured way so that the information is easily accessible. The information can be viewed using either web interface or a client-server application. The information related to a specific customer will be viewed differently by each user, for example the customer call centre will want to view the problem history of a specific customer, whereas the salespeople will want to see all products sold to a customer.

BI: A vast amount of data are stored within the organization and can be found within the ERP system itself or within planning and forecasting, which forms part of SCM. The main purpose of BI is to accumulate the data and process it into useful information. The data are accumulated through different BI tools, such as data mining and data warehousing.

The information is stored in a presentable manner and the relevant people access it using an interface that is easy to use, such as a web-based or graphical interface. The information can be viewed from the internet or within the company.

7.1.3 Customer mindset

The third proposed component of the ERP model is the customer's mindset. Resistance kills many ERP projects. A proposed ERP system may hold great promise, but often fails to consider how the users are likely to view this so-called improvement.

ERP systems remove the old tried-and-true ways of working which users understand and are comfortable with, even though some of these existing, cobbled-together legacy systems are not all that good. When users are asked to give up what they know and what they can rely on, they will resist. For any ERP project to succeed, the users must buy into the new ERP system. A paradigm shift or customer mindset change must be achieved. This has to be done at three levels.

(1) User Influence: Training plays a major role in the operation of the ERP system after implementation. One of the major advantages of an ERP system is increased productivity. This can only be acquired once the user is trained sufficiently on the use of the ERP system. Users should not be expected to be able to perform immediately at the same level of productivity as on the old legacy system.

(2) Team Influence: A typical ERP project involves internal people from a number of departments within an organization, as well as many external people in the form of consultants and vendors. A primary reason for unsuccessful ERP implementations is the inability of this disparate group to come together in a focused, team-oriented manner. All too often the team membership polarizes into "us-versus-them" factions and the project degenerates into mass finger pointing. A successful ERP project will require that the functional and technical leadership and teams develop a strong partnership and a shared commitment to the success of the ERP implementation. Without this joint commitment to work together, any attempt to implement an ERP system will result in failure. Consultants play a major role and key partnerships at every level will be required to maintain the cohesiveness of the team. When possible, the consultants should be incorporated directly into the team. This requires major trust on the part of the organization.

(3) Organizational Influence: The users will be expected to work twice as hard during the implementation of the system. They still need to do their normal operational work to make sure the business continues to run smoothly and they need to give inputs to the different project teams of which they are a part. This causes the users to become overworked, tired and stressed. It must be pointed out to the user's right at the start what the issues will be during implementation, and the rewards must be clearly stated. It will be necessary to remind the users regularly of the benefits of installing the ERP system

7.1.4 Change management

Change management plays a major role in the successful implementation of an ERP system and is the fourth component in the ERP model. Change needs to be managed at several levels.

- **User Attitude**

Resistance to change is one of the major issues that all ERP projects will face. User attitude change management focuses on managing the users' expectations and on converting the non-believers to believers and supporters of the system. What the organization needs are people to understand what it is all about, to like the new system, to take part in making it a success and to have confidence in the project team.

- **Project Changes**

All ERP projects are subject to scope change at some time during the lifecycle. The key to successful ERP implementation is to manage the change of scope process effectively.

The Project Management Body of Knowledge (PMBOK) defines scope change control as:

  - Influencing the factors which create scope changes to ensure that changes are beneficial;
  - Determining that a scope change has occurred; and
  - Managing the actual changes when and if they occur.

- **System Changes**

This module in the change management component involves the review of current version management. Most organizations have implemented some form of version management processes to preserve the integrity of custom software developed within an organization. At the same time, organizations have established a formal promotion protocol to manage the testing and release of custom-developed software.

When ERP applications are introduced, a number of new change management issues are encountered that are associated with maintaining and reconciling custom and packaged applications.

Generally speaking, version management helps an organization to manage effectively version control and security issues that are typical to a software development and maintenance project.

An effective change management strategy will improve an organization's change analysis capabilities and provide more fluid and efficient change implementation/migration processes.

CHAPTER 8

SOFTWARE DEVELOPMENT

8.1 Software Packages

Today there are a lot of software packages to support enterprise resource planning. Many companies failed to be successful because the complete software doesn't match with their businesses. Thus even if there are a lot of software packages it is believed that based on the result of the problem analysis depicted on earlier chapters to develop a friendly user software using Visual basic 6.0.
The software package has two main parts the production planning and human Resource planning. The production planning covers mostly the inventory system and purchasing activities within the organization. The inventory system has three divisions, i.e. the consumable items, fixed asset and the EOQ (Economic Order Quantity).

8.2 Basic components of the software

From the Pareto analysis in chapter 5 the vital few i.e. the reasons that causes majority of the problem i.e.41.49 % are the production planning and the problems in human resource management. Thus even if the ERP software covers different aspects of the factory systems like the manufacturing data base, product design data base, and business data base in this thesis only the manufacturing database specifically inventory system and the human resource management are covered.

8.2.1 Production planning

On this part of the software the basic issues like inventory system and determination of the economic order quantity is clearly shown.

Consumable Items

The consumable items include components purchased and stored in different departments. These components include spare parts, Raw materials, tools, auxiliaries, stationary, Construction materials, petroleum, Sanitary, Medicals, food and Beverages, Weapons and finished products.

Earlier the inventory systems of the components are poor in which materials are issued and received manually which is tedious and it is liable to loss of materials due to improper registration and negligence.

Thus the software is capable of showing the different items to be issued, received, to add new or existing items, to edit existing items, to delete existing items to control returned items and so on.

The software is also adjusted in such away that to show the ware houses where the components are stored either by search directly or browsing from its group. The details of the forms are shown on appendix 2.

Fixed Assets

Fixed asset of the factory includes plant and machinery, furniture and fixtures, different equipment, vehicles, building and so on. Similarly the existing fixed assets are also registered. Whenever inventory processes are required we can perform any inventory process as it is shown in appendix 2.

Economic Order Quantity

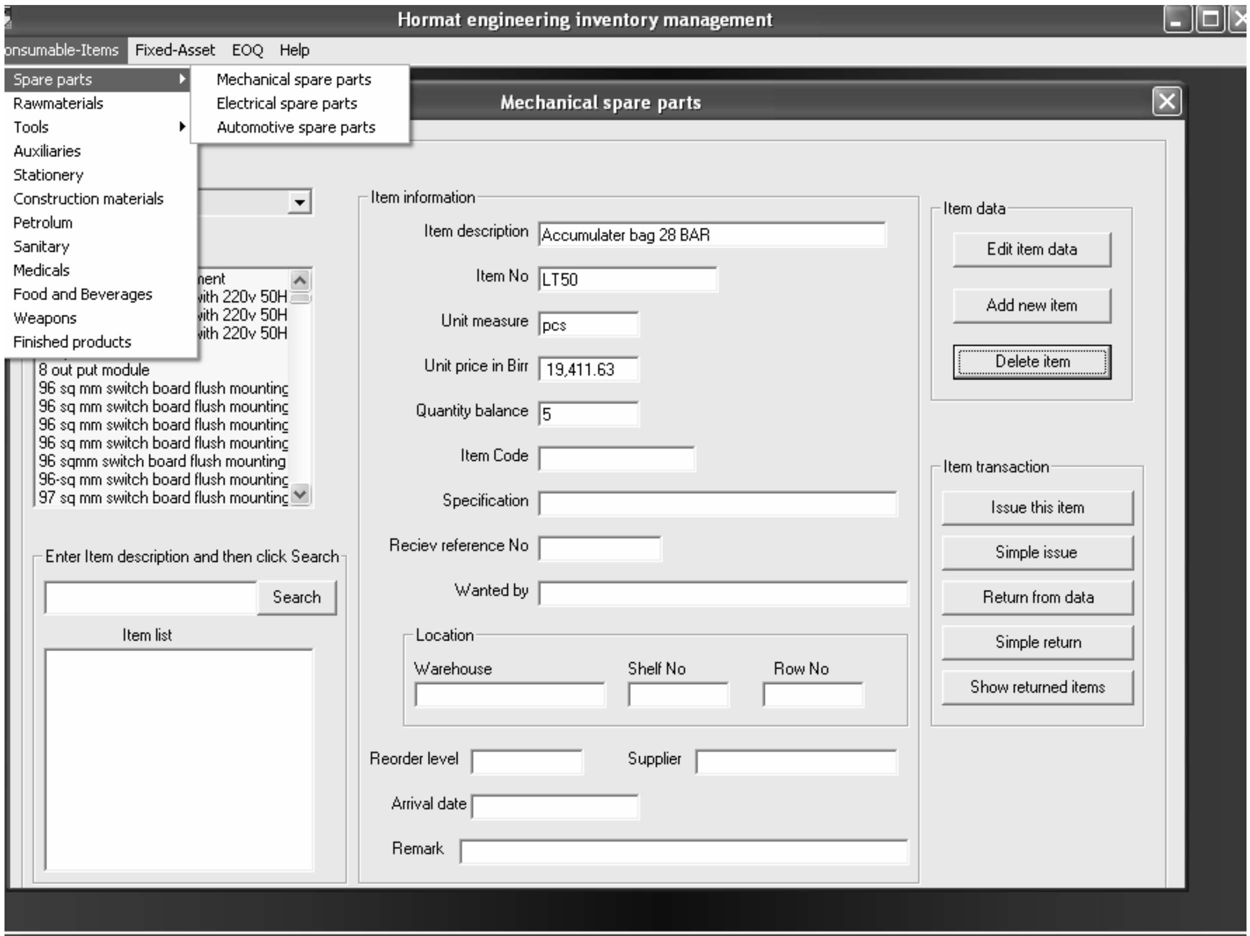
This part of the inventory system is used to show some calculations of EOQ with shortage and with out shortage. The software shows some calculations to find the economic order quantity based on given parameters.

8.2.2 Human resource management

The human resource management is simple software shows the total human resources available and is showing individual data about the employees. We can retrieve any employee data and we can easily access any information about him/her.

8.3 The software

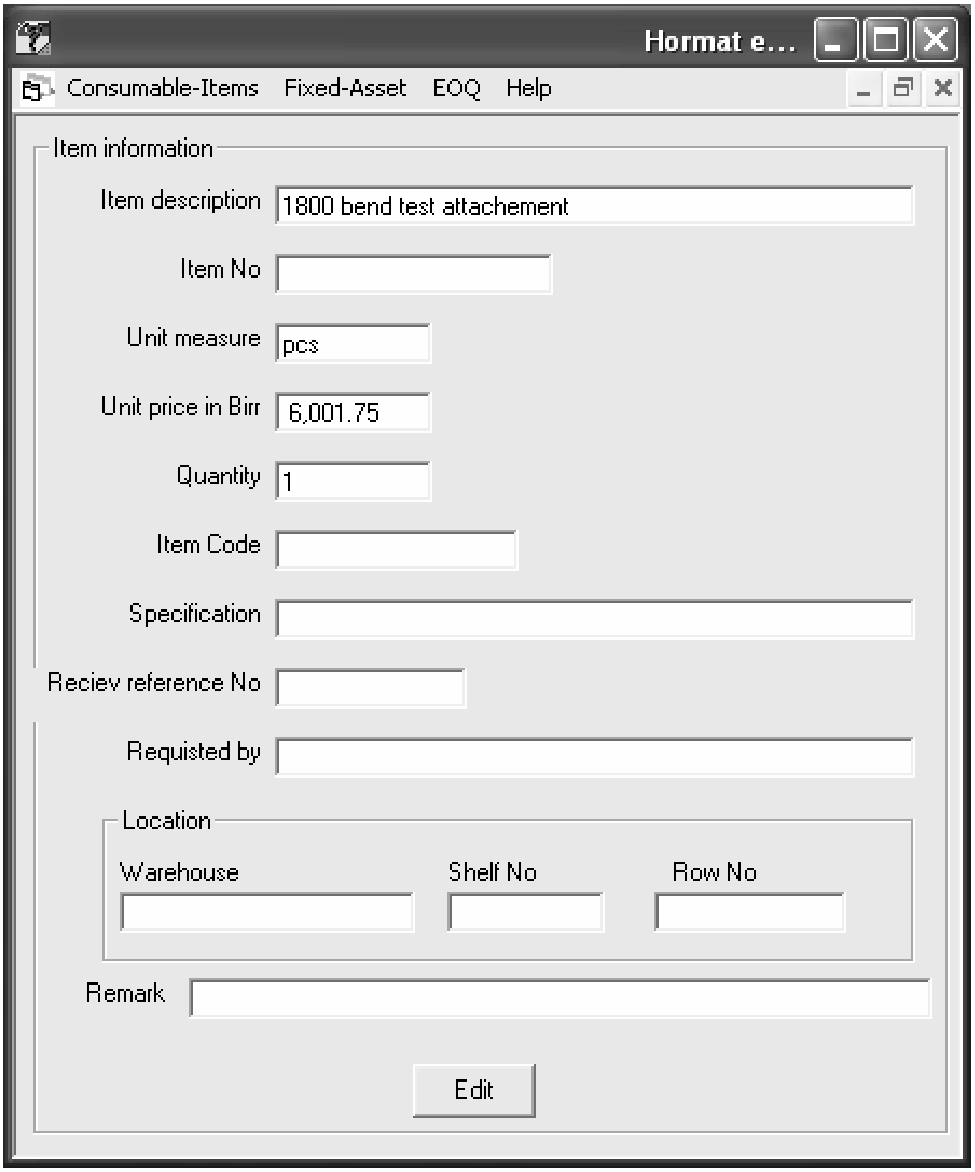
8.3.1 Consumable items



The above part of the software shows the list of the consumable items among which the spare part item has further classified as mechanical spare parts, electrical spare parts and automotive spare parts.

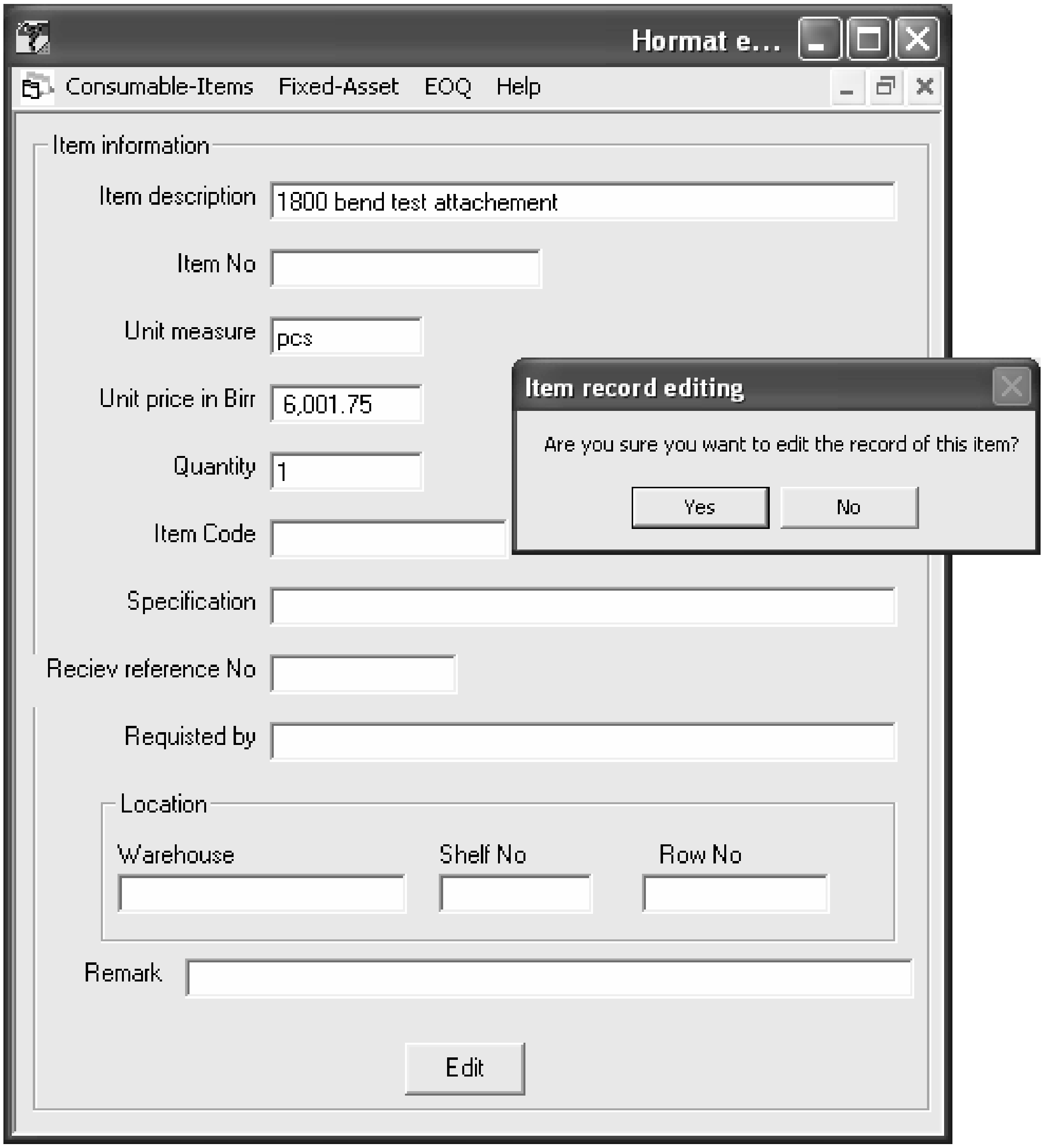
The form shown is similar for all the the catagories, the only difference is the data ecch category holds.

In this forms the inventory representative can add a new item, edit the existing items, delete an exisiting item, issue an existing item, issue items which are not in the store but to be issued from where they are and see different items returned, by just clicking the respective command buttons.

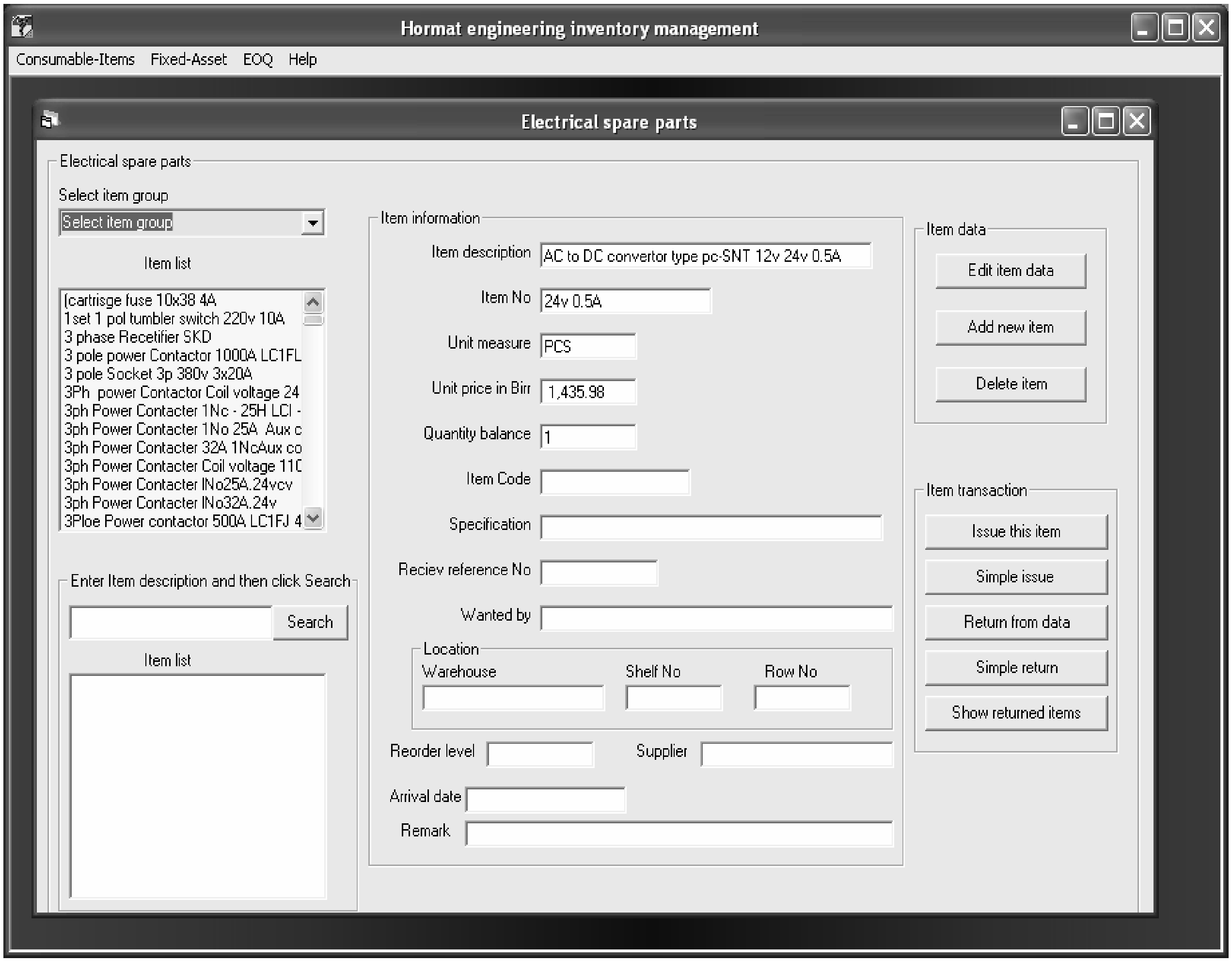

Hormat e...
Consumable-Items
Fixed-Asset
EOQ
Help
Item information
Item description
1800 bend test attachement
Item No
Unit measure
pcs
Unit price in Birr
6,001.75
Quantity
1
Item Code
Specification
Reciev reference No
Requisted by
Location
Warehouse
Shelf No
Row No
Remark
Edit

This part o f the software (above) is used to edit the existing data based on requirement.

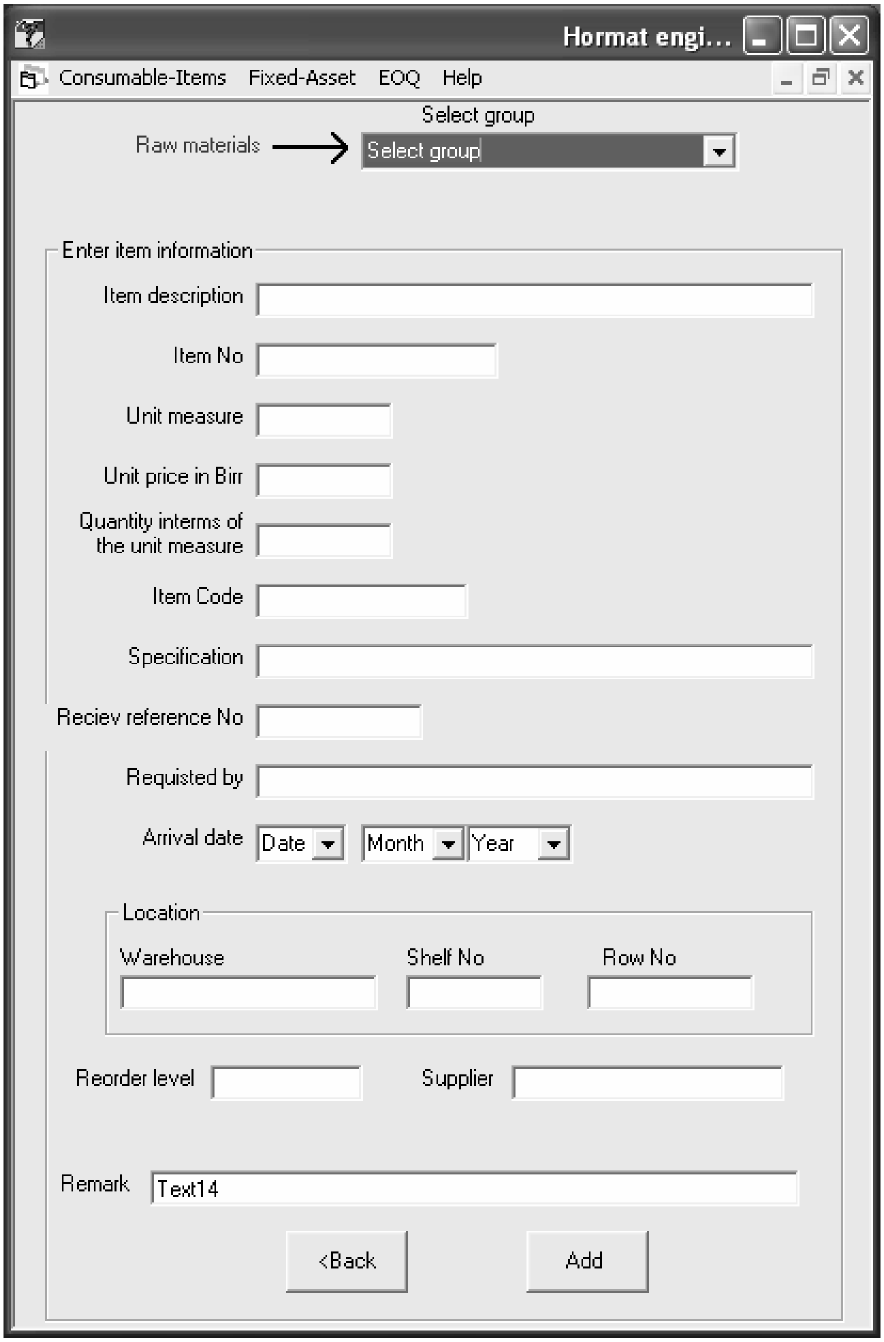
The software has also a mechanism by which it assures weather the data is to be really edited or not before complete edition is done as shown below.



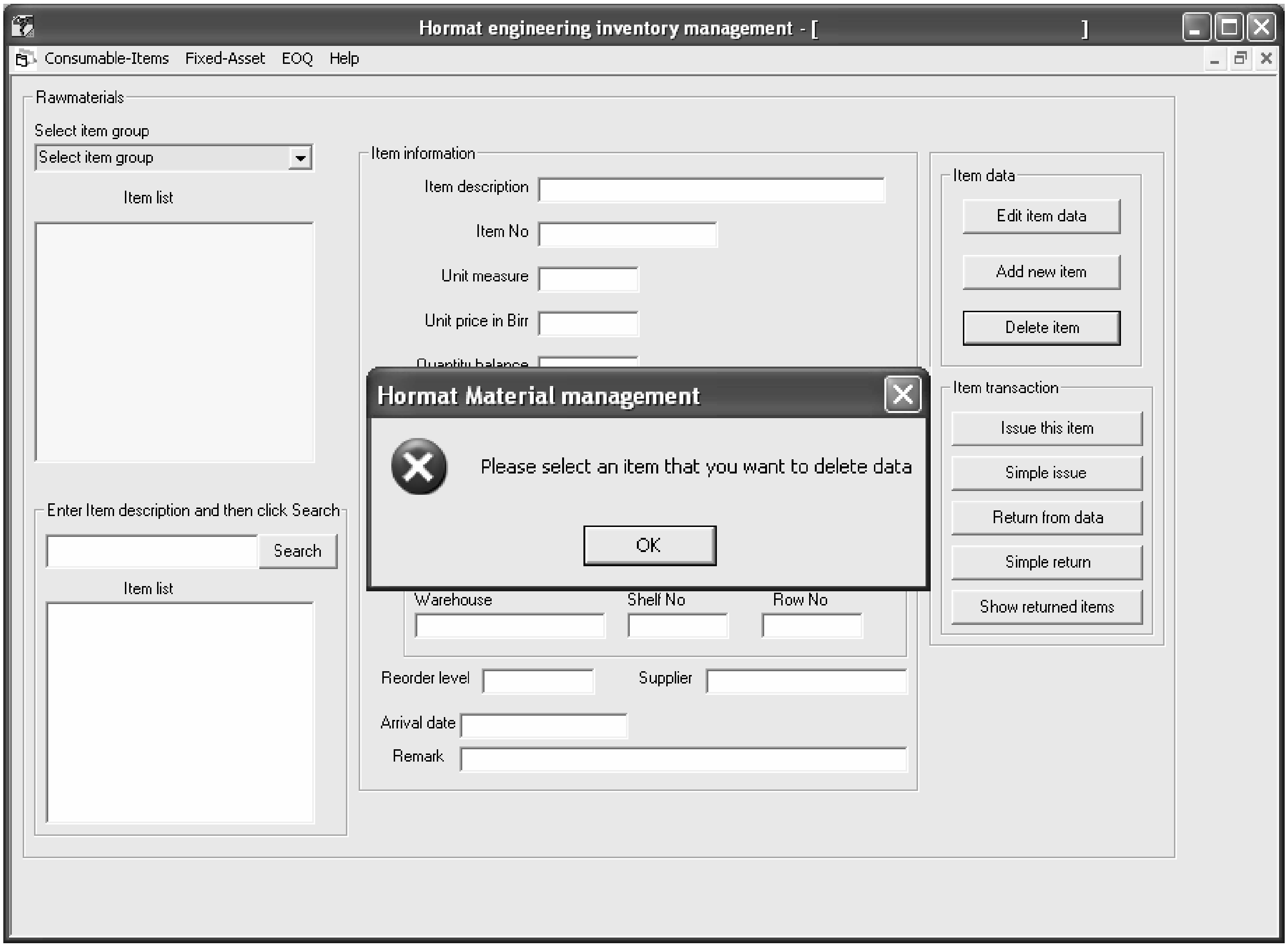
This part of the software (below) is showing the electrical spare part.



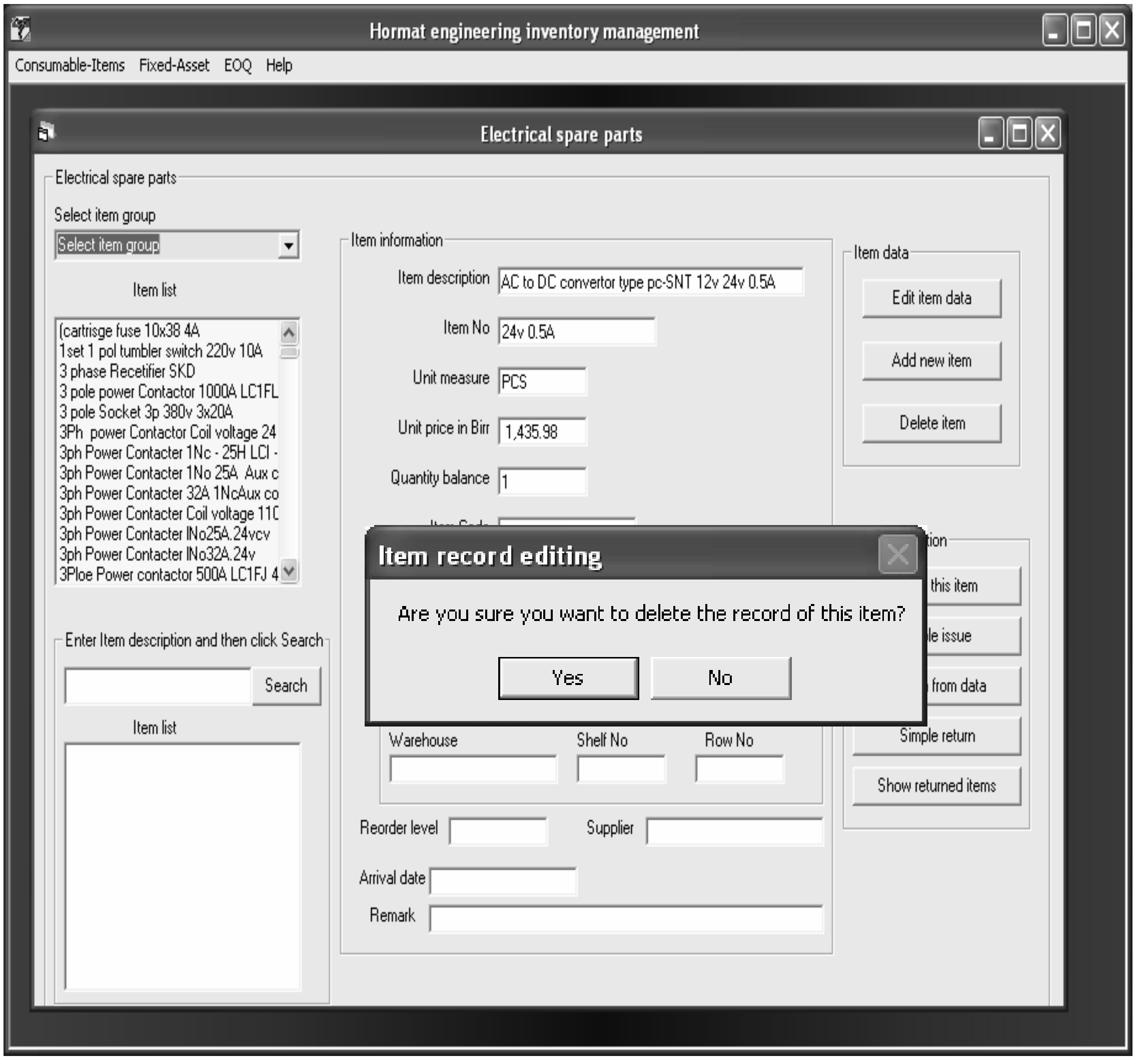
The form shown below is used to add new items in to an existing inventory. Once the item is added to the database the earlier amount is updated. The form has an option to select a group, which we want to update.



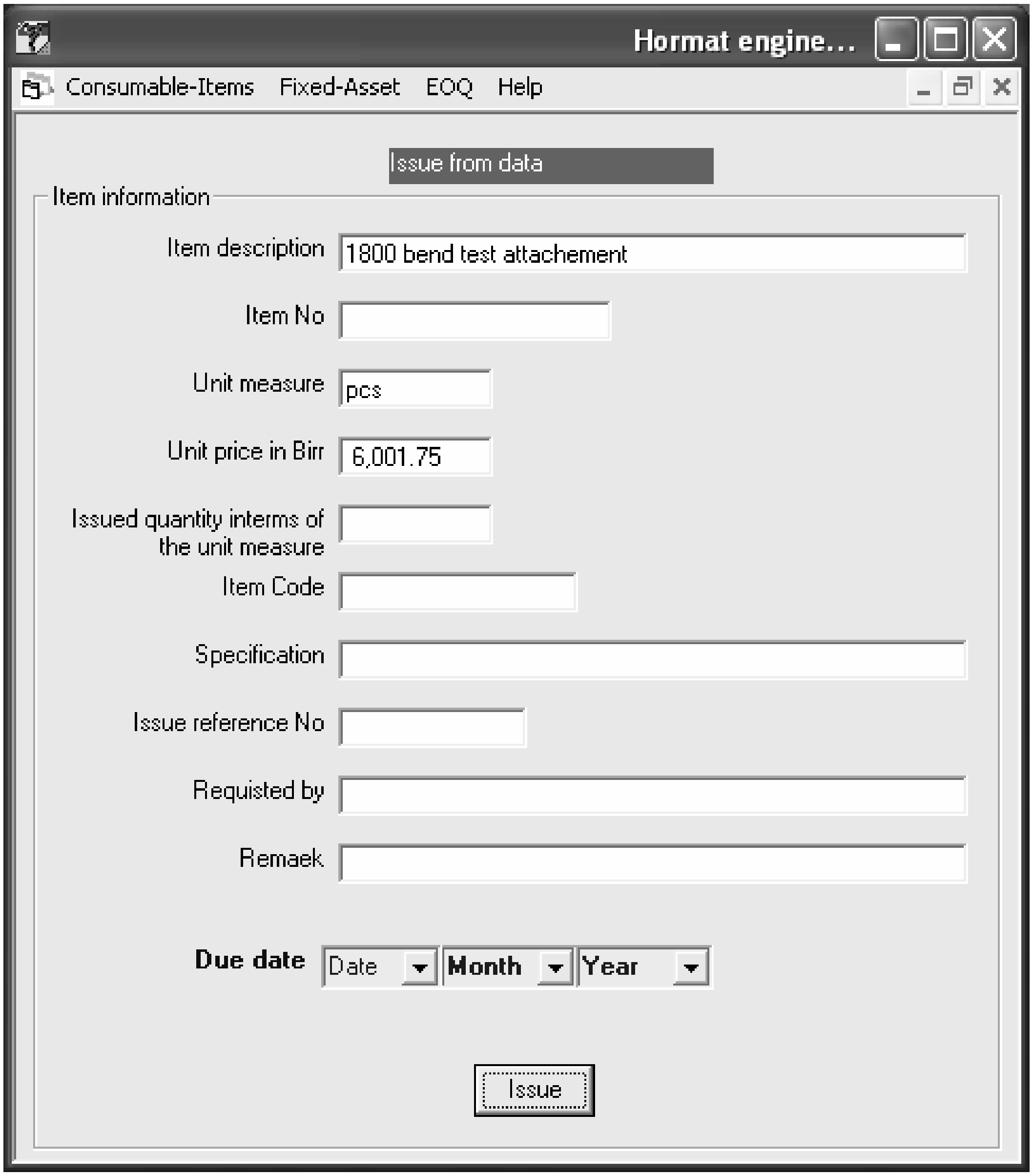
The form shown below shows a message to select the item to be deleted.



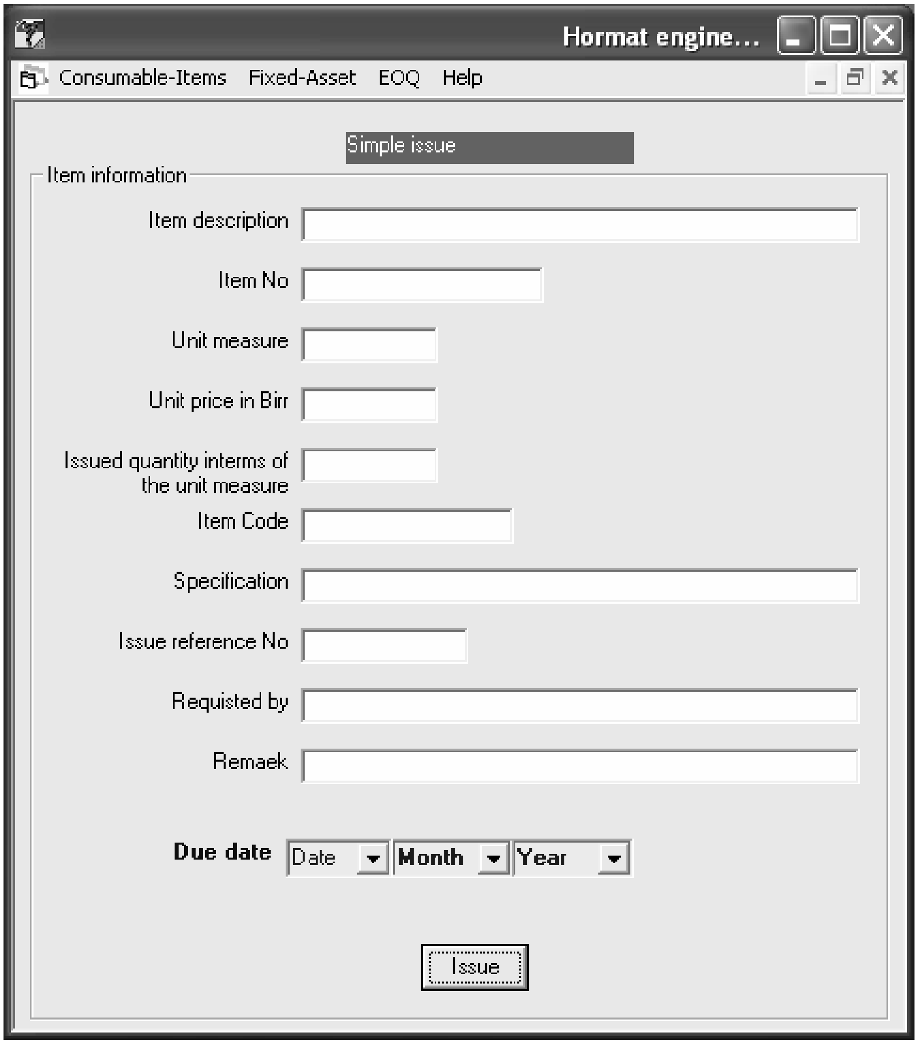
The form shown below shows a message box, which gives a caution weather to delete an item, or not when the delete command button is pressed.



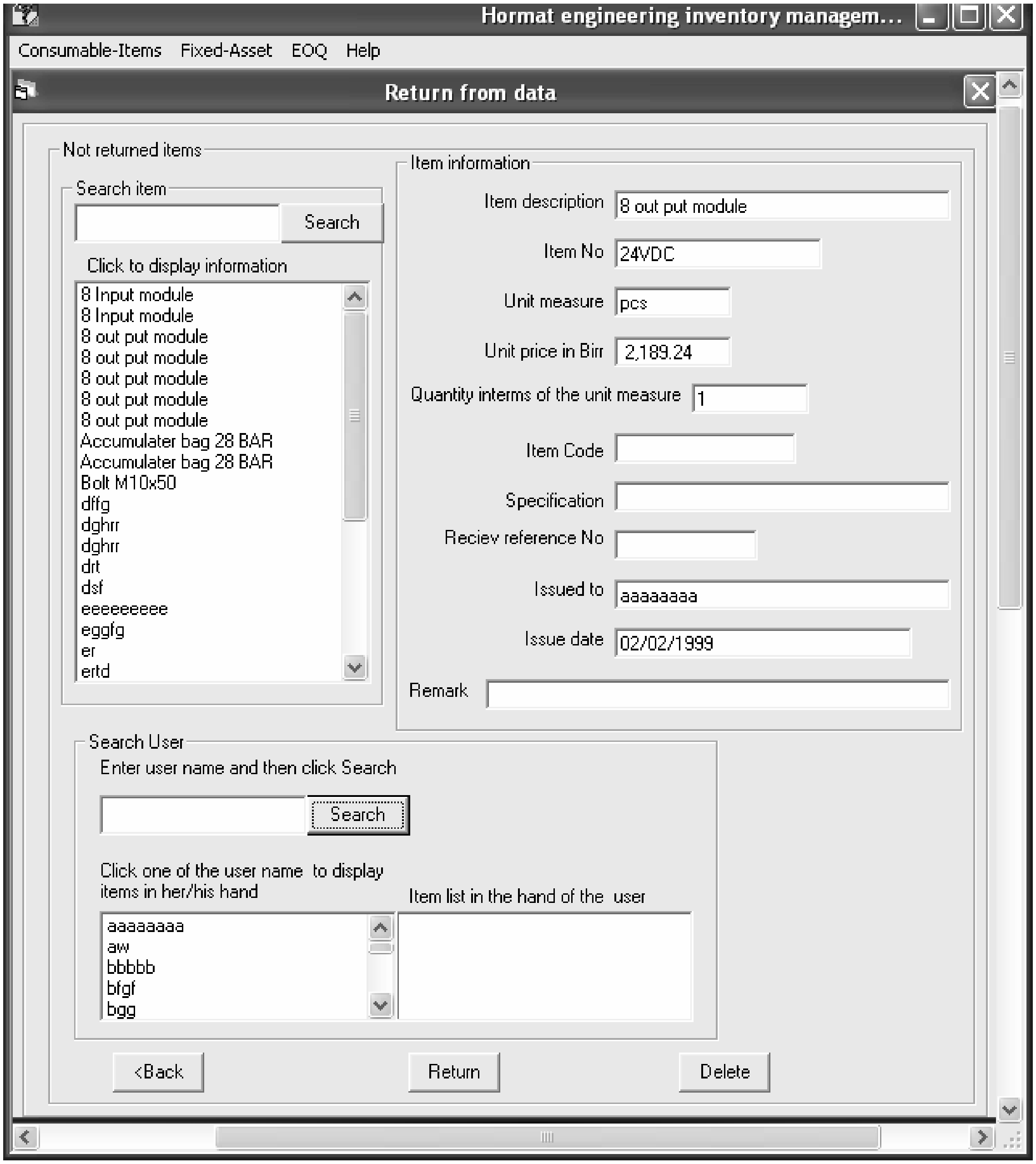
The form shown below is used to show issue an item from an existing inventory. Like the adding of new items, the issue of items is also update the existing inventory.



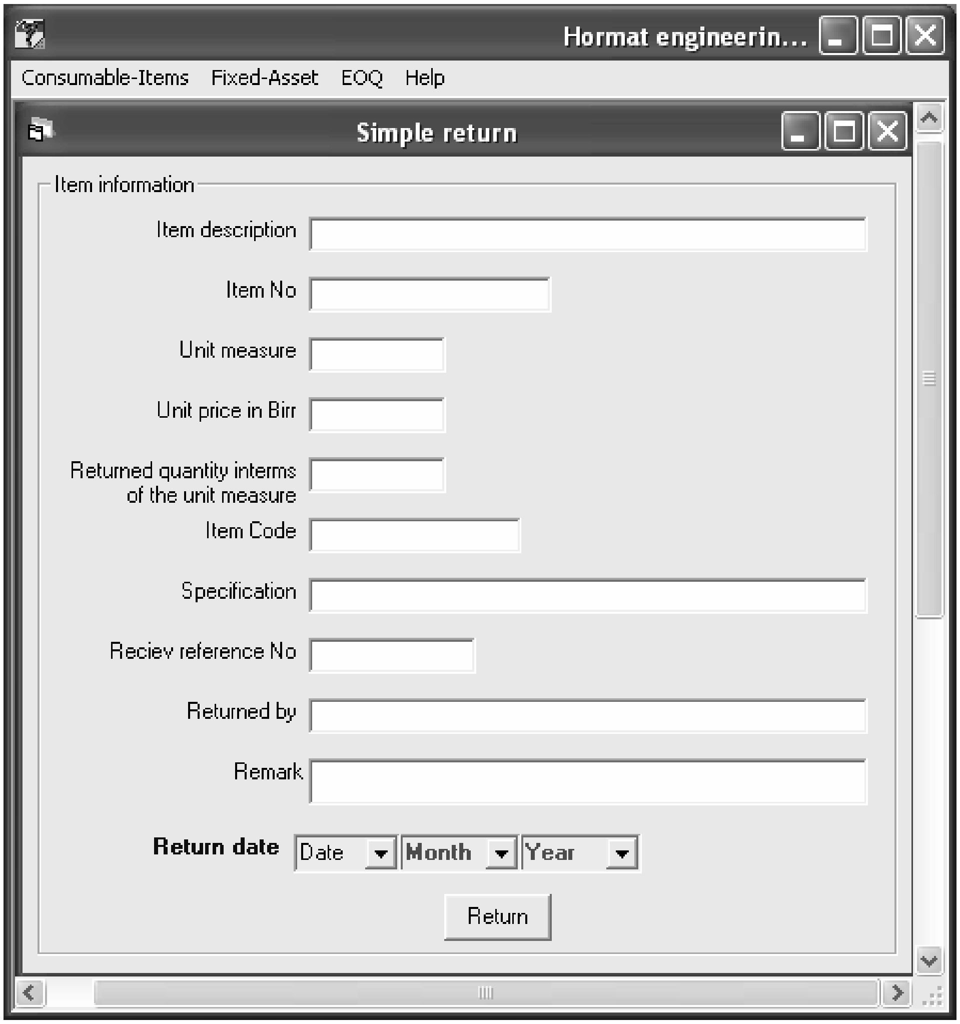
If it is required to issue materials, which are not available in the store, it is possible to issue from the place where the item is available via simple issue as shown below.



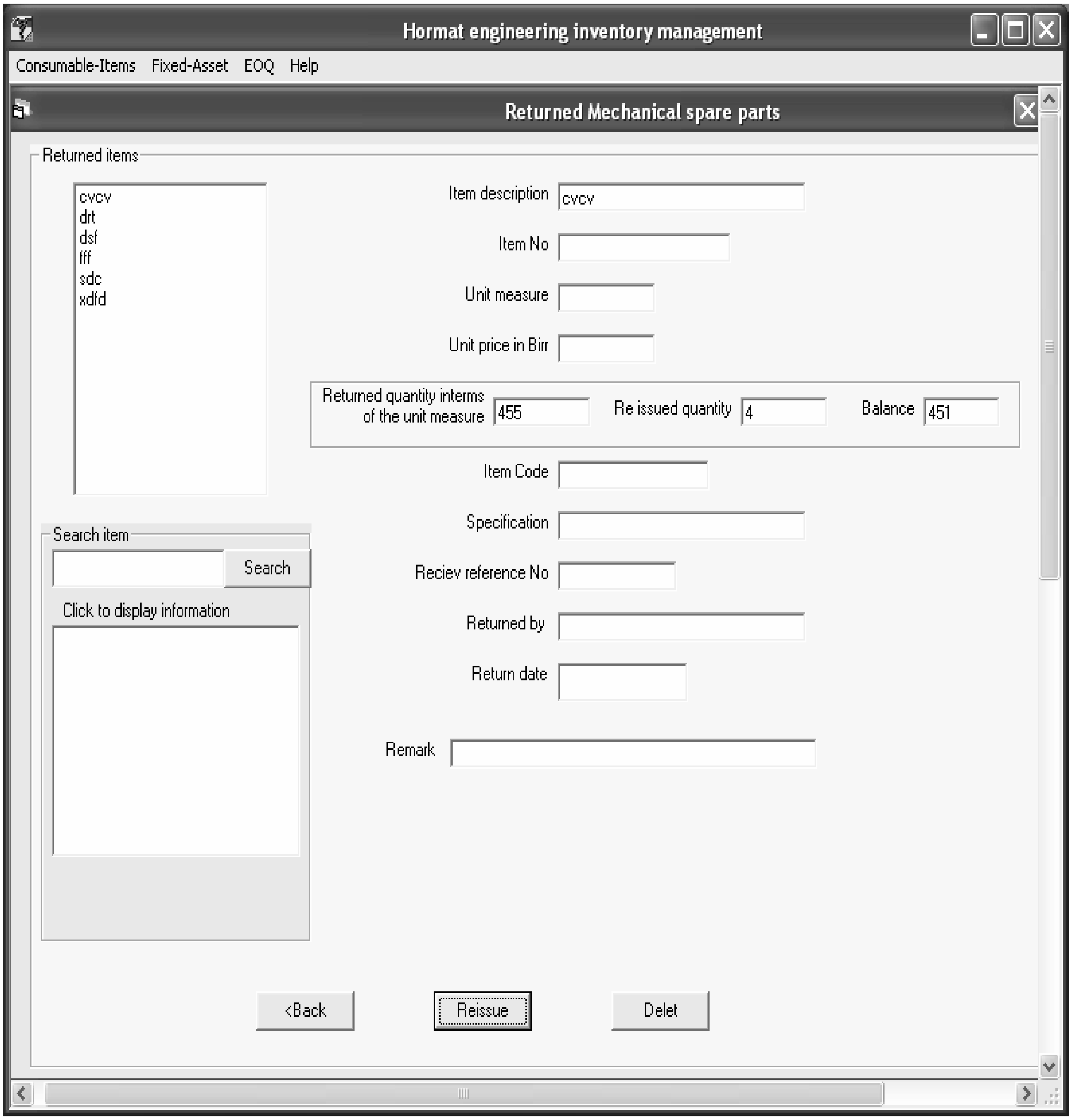
The next form shows the return from data i.e. the inventory representative can retrieve the items taken by an individual and at the same time it shows items still available on his hand.



Those materials issued from individual's hand with out entering the inventory should be registered as returned item and this can be shown as follow.

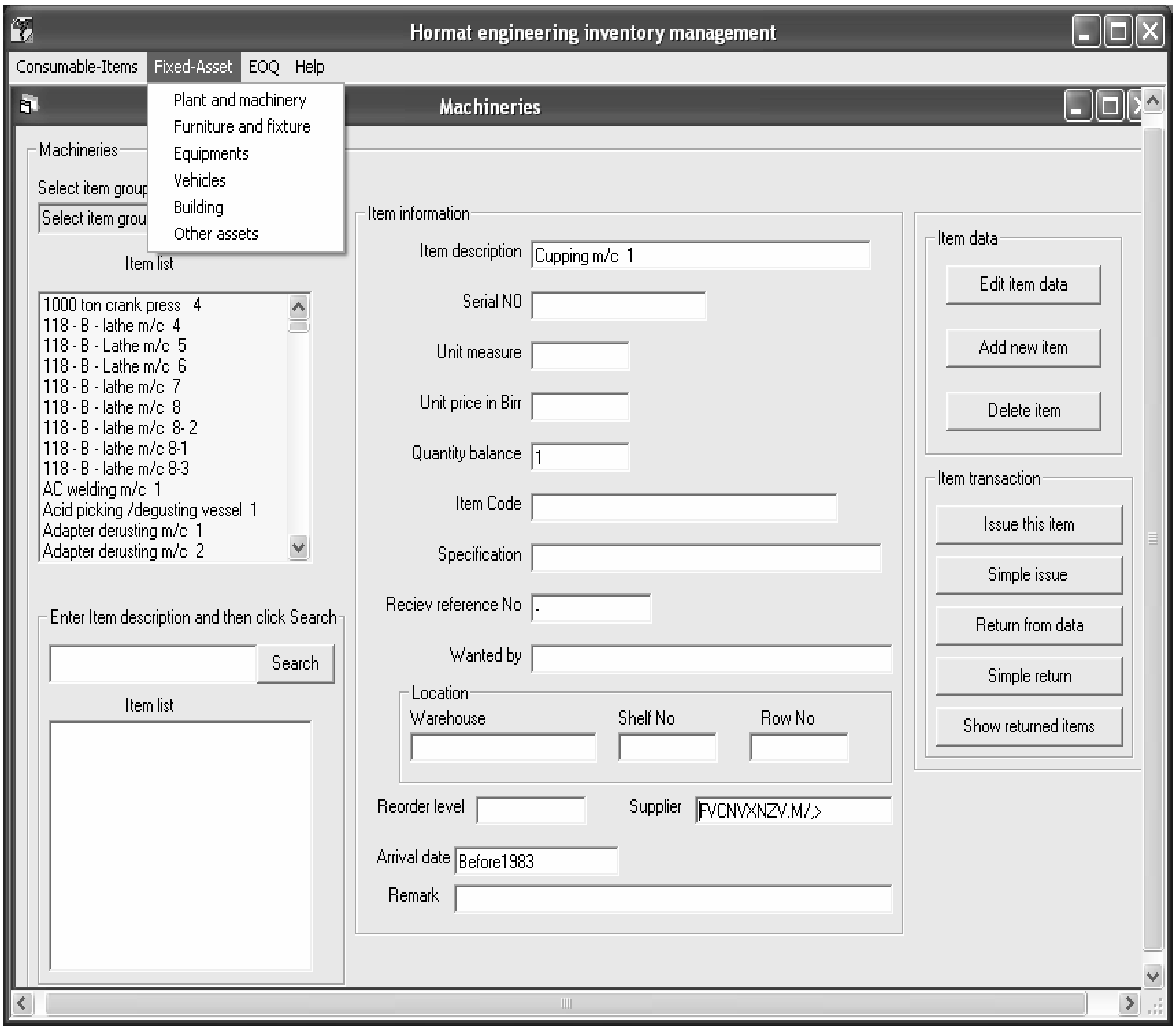


The next form shows the returned items. It also shows items that are re issued and therefore possible to delete it from the returned item data.


Hormat engineering inventory management
Consumable-Items Fixed-Asset EOQ Help
Returned Mechanical spare parts
Returned items
cvcv
drt
dsf
fff
sdc
xdfd
Item description
cvcv
Item No
Unit measure
Unit price in Birr
Returned quantity interms of the unit measure
455
Re issued quantity
4
Balance
451
Item Code
Specification
Reciev reference No
Returned by
Return date
Remark
Search item
Search
Click to display information
<Back
Reissue
Delet

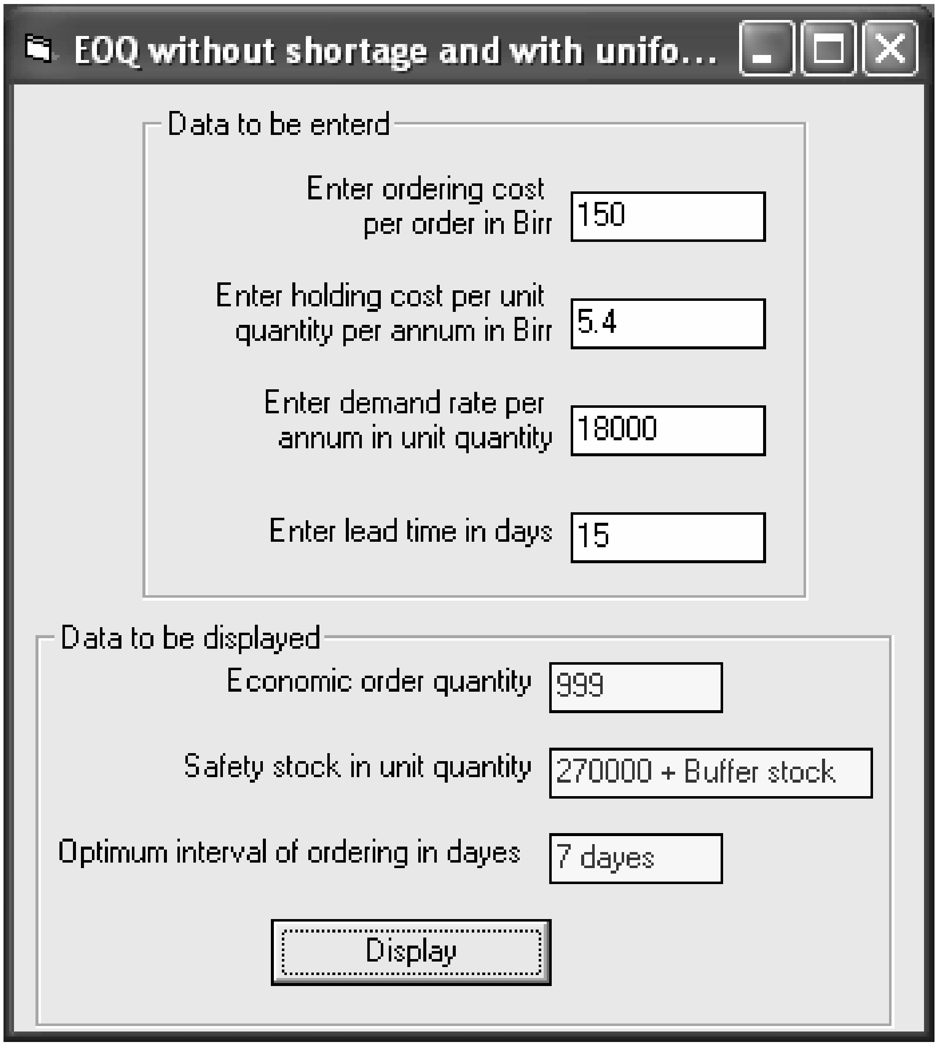
8.3.2 The Fixed Asset

The form shown below shows fixed asset machinery. The rest parameters are the same with that of the consumable items i.e. to edit, to add, to delete etc. of an item. Similarly as shown in the form we do have similar forms for the items listed in the menu like furniture, vehicles etc.

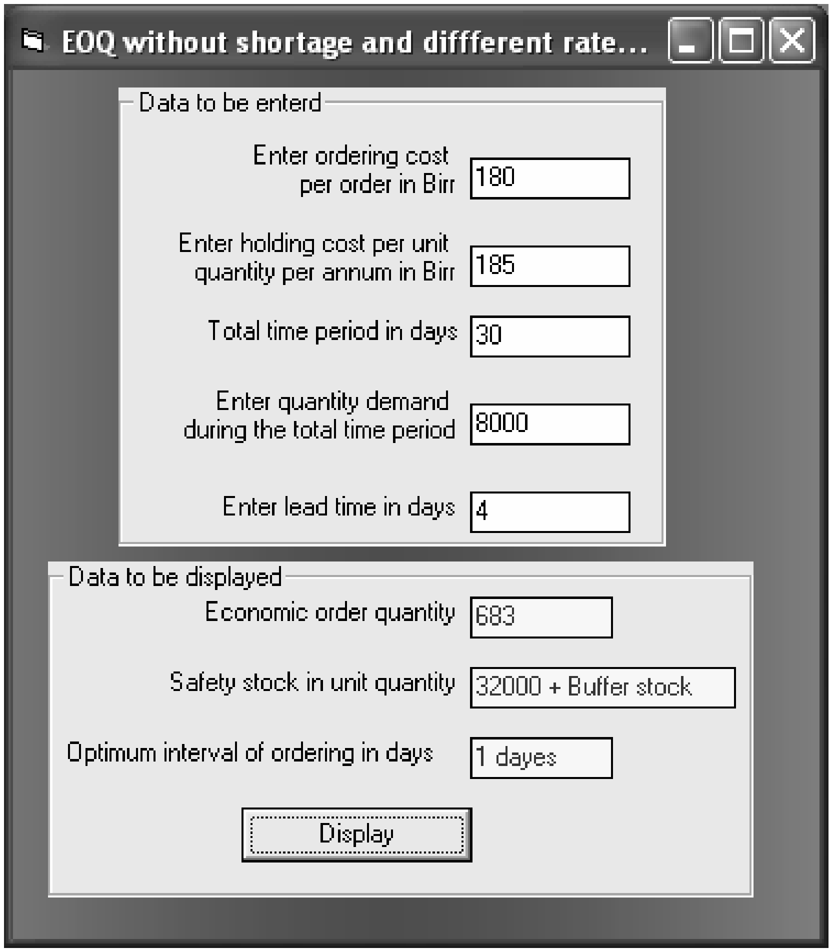


8.3.3 The EOQ

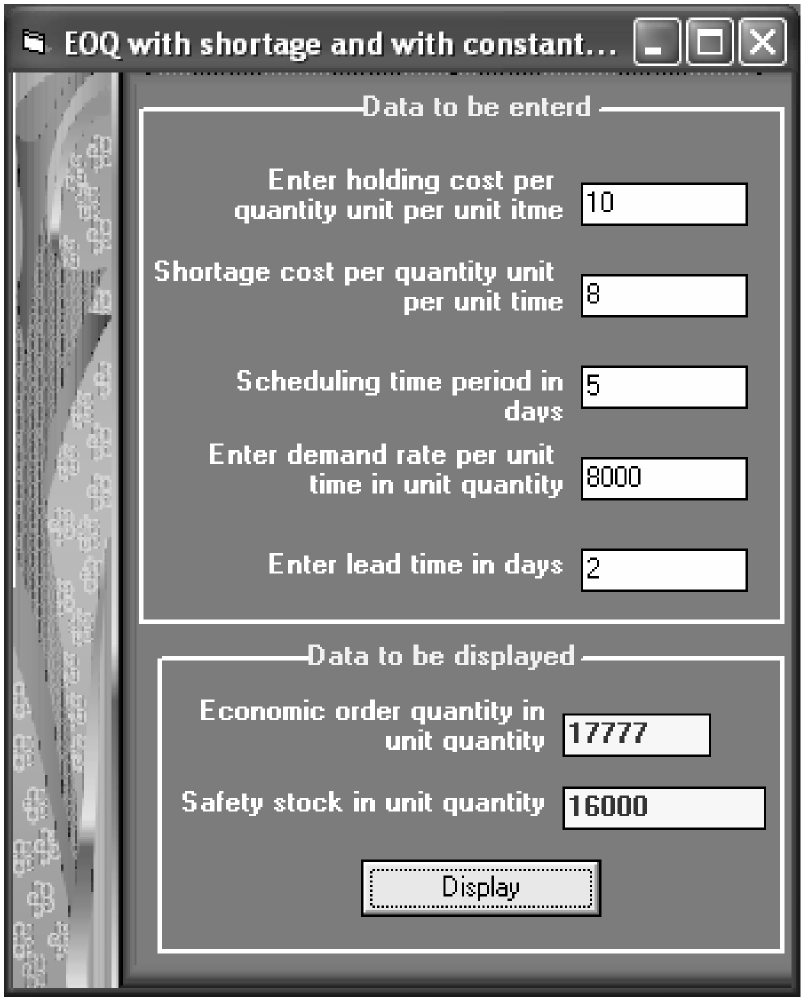
The form shown below is used to calculate EOQ with out shortage and uniform demand rate.



Similarly the form shown below is used to calculate EOQ with out shortage and non uniform demand rate in different cycles.

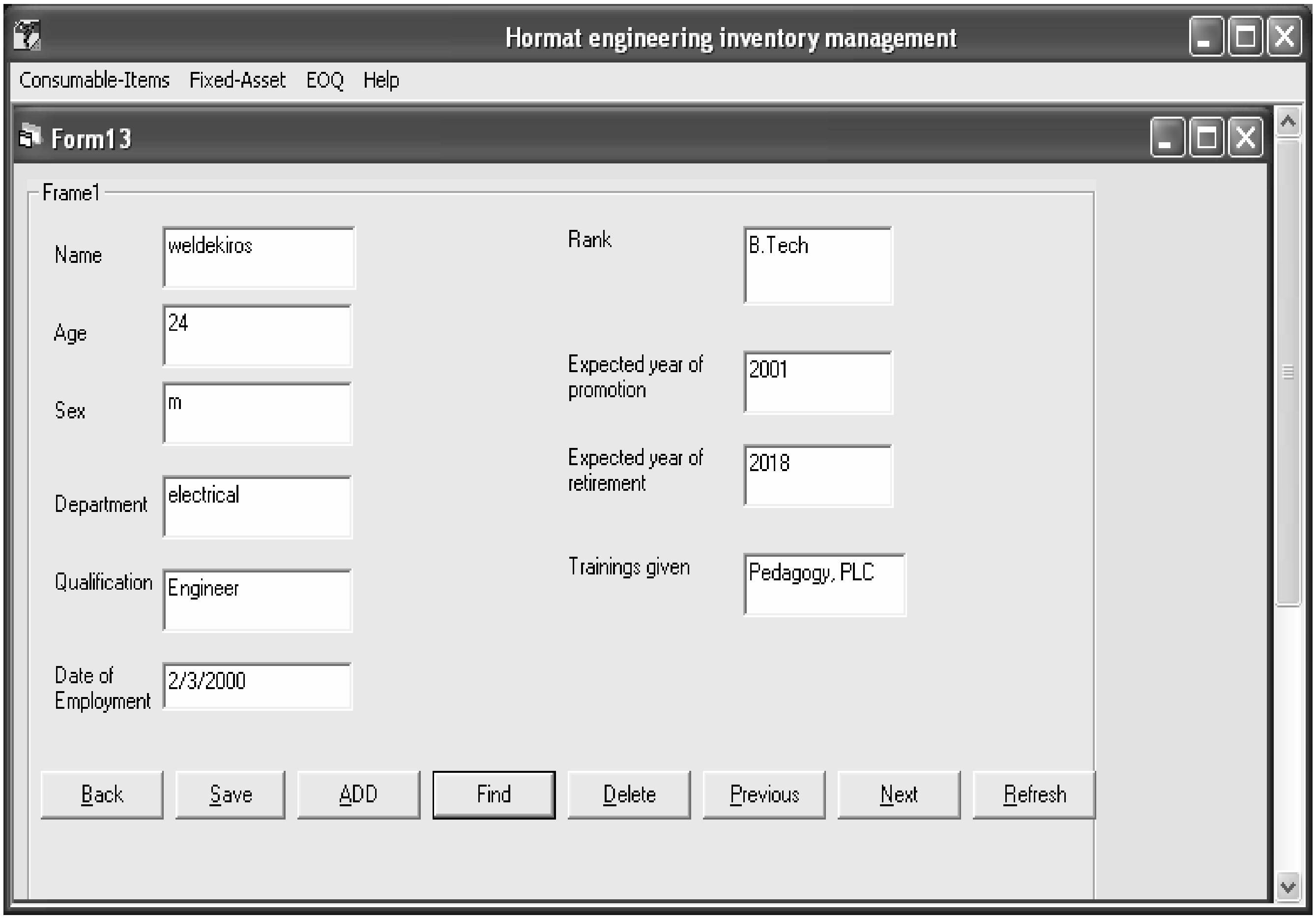


The next form is used to calculate the EOQ with shortage and constant rate of demand.



8.3.4 Human resource management

This part of the software shows every data of an employee, which can be shown on the interface by retrieving it from the database.


Hormat engineering inventory management
Consumable-Items
Fixed-Asset
EOQ
Help
Form13
Frame1
Name
weldekiros
Age
24
Sex
m
Department
electrical
Qualification
Engineer
Date of Employment
2/3/2000
Rank
B.Tech
Expected year of promotion
2001
Expected year of retirement
2018
Trainings given
Pedagogy, PLC
Back
Save
ADD
Find
Delete
Previous
Next
Refresh

Chapter 9
Conclusion, Recommendation and Future Work

9.1 Conclusion

To be truly competitive, manufacturing companies must deliver products on time, quickly, and economically. The set of business processes known as Enterprise Resource Planning (ERP) has proven to be an essential tool in achieving these objectives. Their capabilities offer a means for effectively managing the required resources: materials, labor, equipment, tooling, engineering specifications, space, and money. For each of these resources, ERP can identify what's required, when it's needed, and how much is needed. Having matched sets of resources at the right time and the right place is essential for an economical, rapid response to customer demands.

GEF is a 'job ordered company' that manufactures its products after getting an order from Ministry of National Defense and other external customers. As it explained before, the factory is facing a great challenge to satisfy the requirements of its customers. The survival of this industry is strictly dependent on its productivity and competitiveness at the market. The competition may be in national or international level.

From the detailed analysis the following conclusions are derived:

- The main problems observed are the problems in production planning like demand forecasting, inventory system and on managing the Human Resource.
- There is no strong production as well as performance measurement; evaluation and progress follow-up mechanism. The skill, capacity and training need of each individual operator is not determined.
- Since most of the machineries in the factory are old and not equipped with maintenance equipments there exists repetitive machineries break dawn more over, there are no mechanisms to register machineries breakdown time and there is no preventive maintenance plan.

- A report prepared by varies sections and departments do not consider the factory's overall activities in detail. There is no feed back mechanism about what kinds of corrective action to be taken.
- There is no clear information exchange between varies departments of the factory about the progress of job. For example the quality control test results is not prepared in such a manner that it could explain test request receiving time, result delivering date and time, causes of reject, amount of re-workable materials and possible remedial solution that have to be made by the concerning section.
- The total cost of each product is not known because direct and indirect cost of material, labor and other expense to produce varies product is not determined.
- There is no effective utilization of resources (manpower, machineries, raw materials, time)
- The current actual Production capacity of the shops and the factory is unknown.
- From the detailed analysis the main problems have been observed in production planning which includes Poor inventory system, poor capacity requirement, Planning, and poor sales and forecasting and human resource Management.
- On the other hand the factory has followed poor maintenance management system in which it is pointed out that no preventive maintenance system has existed.

9.2 Recommendation

Today the Armament technology is growing in a faster rate and production of different riffles is becoming simple and simple. This in turn results a dynamic change in national defense demand. To cope with such dynamic changes, the factory has to identify the main problems facing in its day-to-day activity.

The following recommendations are made based on the study that has been conducted.

- If the factory has implemented ERP system then it can achieve benefit of 5427000 birr with in a pay back period of 1.035 year.
- It is believed that setting Proper Production Planning and Control system leads the factory to an organized set of activity to solve its production problems. Thus to stay in the market and satisfy its customer needs, the factory is expected to apply a sound production planning and controlling system. Production planning includes allocation of resources, routings of each of the factory product, due date setting and dispatching order to the shop. For the annual production plan to be maintained there should be relevant and constant controlling mechanism of the production progress.
- To make the system well functional, the factory shall implement ERP system as faster as possible.
- The required qualified manpower for directly related sections with production technical planning and control section like material requirement section, costing section should be assigned by qualified personnel as soon as possible. Other wise the system could not bring meaningful significance for this factory.
- Materials and office equipments like computers should be fulfilled to support the system effectively.
- Various departments of the factory must prepare data exchanging formats and provide convenient information, which can provide detailed information.
- The quality assurance department must prepare a formal inspection certificates that can be provided to Production technical Planning and control (PTPC) department at each stages of the production inspections. The department also must give fast and accurate inspection services in each production line and must use statistical methods to trap any errors which have occurred in production.
- The marketing and supplies management department must organize its stores in such a manner that they could give detail information about each material inventory balance whenever requested by any department.
- The technique and maintenance department must prepare preventive, overall, and predictive maintenance programs so that the occurrence of breakdown maintenance could decreases there by the production down times shall be

minimized. More over the department has better used computer data base of the maintenance management system to have effective preventive, break down and predictive maintenance system.

- Motivation should be introduced to minimize turn over, tardiness and absenteeism of workers in GEF. Moreover there should be participatory or democratic management system to motivate and initiate creativity and to let enjoy the factory by its resources.

9.3 Limitation of the Study and Future Work

The study has focused on production planning which mainly focuses on developing software on inventory management system, evaluating production planning and control system, maintenance management system and the human resource management system based on the Pareto analysis driven in chapter 5 and selected ERP implementation model i.e. Quick slice. Thus future works should be done on the rest of the problems identified based on priorities given.

9.4 Post ERP Implementation

There are two major objectives involved in operating ERP after fully implemented:

- Don't let it slip or deteriorate.
- Make it better and better.

How should a company address these issues? How can they not let it slip? 'What's involved in making it better and better?

Five important elements are involved:

- Understanding.
- Organization.
- Measurements.
- Education.
- Lean Manufacturing/Just-in-Time.

- **Understanding**

In this context, understanding means lack of arrogance. Operating at a Class A level is much the same. A company needs to understand that:

• Today's success is no guarantee of tomorrows.

• People are the key.

• The name of the game is to win, to be better than the compete

- **Organization**

Don't disband the ERP project team and the executive steering committee. Keep these groups going.

- **Measurements**

Measuring the effectiveness of ERP performance requires both operational and financial measurements.

- **Operational Measurements**

This part should be reviewed by the ERP operating committee formally, as a group. For any answer that's lower than excellent, this group should focus on:

- What's going wrong?
- What's the best way to fix the problem?
- Does the problem exist only within one department? If so, that department manager should be charged with correcting the problem. On the other hand, if the problem crosses departmental boundaries, should the company activate a spin-off task force?
- How quickly can it be fixed?
- What's the best way to fix the problem?

- **Financial Measurements**

At least once a year, the ERP operating committee should take a check on "how we're doing" financially with the ERP. Actual results should be compared to the benefits projected in the cost justification.

Just as with the operational measurements, straightforward approach should be used here: Is the company getting at least the benefits expected? If not, why not? Start fixing what's wrong,

- **Education**

Failure to establish an airtight ongoing education program is a major threat to the long-term successful operation of ERP. Ongoing education is essential because:
New people enter the company plus, current employees move into different jobs within the company, with different and perhaps expanded responsibilities. Failure to educate these new job incumbents spells trouble. It means that sooner or later the company will lose that critical mass of ERP knowledgeable people. The company then will be unable to operate ERP as effectively as before.

- **Lean Manufacturing**

Lean Manufacturing (formerly called Just-in-Time) is arguably the best thing that ever happened to ERP. Because Lean Manufacturing, done properly, will not allow the factory to neglect ERP processes.
Lean Manufacturing does more than keep ERP from slipping. It also helps it to get better and better. How so? By simplifying and streamlining the real world.

- As setup times drop, so do order quantities and, hence, inventories.
- As quality improves, safety stock can be decreased and scrap factors minimized.
- As flow replaces job shop, queues go down and so do lead times.

As these real world improvements are expressed into ERP, it work better and better. As the real world gets simpler, data integral becomes easier and planning becomes simpler.

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