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Development of material requirements planning system (Case study in Coldair factory)

تطوير نظام تخطيط لمتطلبات المواد

(دراسة حالة مصنع كولداير)

A project submitted in partial fulfillment for the requirements of the degree of B.SC (Honor) in Mechanical Engineering

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الآية

قال تعالى في محكم تنزيله :

{ مَّثَلُ الَّذِينَ يُنفِقُونَ أَمْوَالَهُمْ فِي سَبِيلِ اللّهِ كَمَثَلِ حَبَّةٍ أَنبَتَتْ سَبْعَ سَنَابِلَ فِي كُلِّ سُنبُلَةٍ مِّئَةُ حَبَّةٍ وَاللّهُ يُضَاعِفُ لِمَن يَشَاءُ وَاللّهُ وَاسِعٌ عَلِيمٌ {261} الَّذِينَ يُنفِقُونَ أَمْوَالَهُمْ فِي سَبِيلِ اللّهِ ثُمَّ لاَ يُتْبِعُونَ مَا أَنفَقُواْ مَنّاً وَلاَ أَذًى لَّهُمْ أَجْرُهُمْ عِندَ رَبِّهِمْ وَلاَ خَوْفٌ عَلَيْهِمْ وَلاَ هُمْ يَحْزَنُونَ {262} قَوْلٌ مَّعْرُوفٌ وَمَغْفِرَةٌ خَيْرٌ مِّن صَدَقَةٍ يَتْبَعُهَا أَذًى وَاللّهُ غَنِيٌّ حَلِيمٌ {263} يَا أَيُّهَا الَّذِينَ آمَنُواْ لاَ تُبْطِلُواْ صَدَقَاتِكُم بِالْمَنِّ وَالأذَى كَالَّذِي يُنفِقُ مَالَهُ رِئَاء النَّاسِ وَلاَ يُؤْمِنُ بِاللّهِ وَالْيَوْمِ الآخِرِ فَمَثَلُهُ كَمَثَلِ صَفْوَانٍ عَلَيْهِ تُرَابٌ فَأَصَابَهُ وَابِلٌ فَتَرَكَهُ صَلْداً لاَّ يَقْدِرُونَ عَلَى شَيْءٍ مِّمَّا كَسَبُواْ وَاللّهُ لاَ يَهْدِي الْقَوْمَ الْكَافِرِينَ {264}.

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Dedications

This project is dedicated to our beloved parents, our brothers, sisters, and our friends we adore them for their effortless support every single moment till we reached this day. Without their love, patient and support, this project would not have been become possible and real

Acknowledgement

We would like to thank everyone that have been supporting us through our academic life, especially those whom helped us to understand the engineering concepts, we are thankful for our supervisor ustaz. Wedaa-Allah Al-amin, because he was beside us in every step throughout the research, and for his effort of giving us the best techniques and resources to solve the different problems.

Abstract

This project aims to develop an inventory management system based on the material requirements planning, the system helps in facilitating the process of inventory management and ensure the availability of materials for production, and make sure inventory is on the same line with demand. The software system is made by using Microsoft Excel and Microsoft access, Excel is the base of the system, the necessary calculation for the system to function are done by using it, such as the required quantities for the items of the product, and the dates of orders. Access helps us in making necessary output reports in the appropriate image. A field visit to Coldair's factory inventory sector is made to collect the necessary data for the system to run. And to assess the status of the plant and finds out its requirements to help us develop the appropriate system for the factory. As a result the Material Requirements Planning system software is designed to fit the plant requirements, the results obtained by the system are the dates of deliveries, the quantities of each item needed for production, the dates of orders and the quantity required for inventory. The system facilitates the process of managing the inventory necessary for production.

الملخص

يهدف هذا المشروع لتطوير نظام لإدارة متطلبات المخازن قائم على اسلوب التخطيط لمتطلبات المواد. يساعد النظام في تسهيل عملية ادارة المخزون و ضمان توفر المواد اللازمة للانتاج عند الطلب و ان يكون المخزون متوافقا مع الطلب. النظام صمم باستخدام مايكروسوفت إكسل و مايكروسوفت أكسس. إكسل هو اساس النظام وهو ضروري للقيام بالحسابات اللازمة كالكميات المطلوبة للسلع المنتجة و تواريخ الطلب. بينما أكسس يساعدنا في تصميم تقارير الانتاج اللازمة في الصورة المناسبة. تمت زيارة ميدانية إلى مصنع كولدير لجمع البيانات اللازمة لإنشاء النظام. ولتقييم حالة المصنع ومعرفة متطلباته لمساعدتنا في تطوير النظام المناسب للمصنع. بالناتج تم تصميم برنامج نظام التخطيط لمتطلبات المواد. النتائج المتحصل عليها من النظام هي تواريخ وصول المواد وكميتها و التواريخ التي يتم الطلب فيها و الكمية المطلوبة. البرنامج يناسب متطلبات المصنع ويسهل عملية ادارة المخزون الضروري للانتاج.

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CHAPTER ONE

INTRODUCTION

Chapter One
Introduction

1.1 Introduction:

The industrial sector has witnessed great development in the last two decades, with this great development the process of managing the necessary materials for production has become more complicated than ever.

Nowadays dealing with raw materials, work in process, components of parts and subassemblies in manufacturing facilities is complicated and followed by several issues such as quantities of production, inventory costs and the required time to meet the demands. Therefore MRP is the appropriate tool for planning and control of manufacturing inventories. Material requirements planning (MRP) is a production planning, scheduling, and inventory control system used to manage manufacturing processes. Most MRP systems are software-based, while it is possible to conduct MRP by hand as well.

1.1.1 Historical background:

Prior to MRP and before computers dominated industry, Reorder point (ROP)/reorder-quantity (ROQ) type methods like EOQ (economic order quantity) had been used in manufacturing and inventory management. In 1964, as a response to the Toyota manufacturing program, joseph Orlicky

developed Material requirements planning (MRP). The first company to use MRP was Black & Decker in 1964, with Dick Alban as project leader. Orlikcy's book Material Requirements Planning has the subtitle The New Way of life in Production and Inventory Management (1975). By 1975, MRP was implemented in 700 companies. This number had grown to about 8000 by 1981.

In 1983 Oliver Wight developed MRP into manufacturing resource planning (MRP II). In the 1980s, Joe Orlicky's MRP evolved into Oliver Wight's manufacturing resource planning (MRP II) which brings master scheduling, rough-cut capacity planning, capacity requirements planning, S&OP in 1983 and other concepts to classical MRP. By 1989, about one third of the software industry was MRP II software sold to American industry ($1.2 billion worth of software).

1.2 problem statement:

MRP software is too expensive for small companies. Some Companies spend an average of $375,000 on MRP systems.

1.3 Project significance:

To make MRP systems available for small scale companies with low cost.

1.4 project objective:

To develop a MRP system by using Microsoft Excel and Microsoft Access. So it becomes available for small scale companies.

1.5 Project scope:

This study was implemented in Coldair Company inventory sector. The software system is demonstrated by using the (18 DD no frost refrigerator (single door)).The tools used for the project are Microsoft Excel and Microsoft Access.

CHAPTER TWO

LITERATURE REVIEW

Chapter Two

Literature Review

2.1 Introduction:

This chapter demonstrates the basic information of the material requirements planning system, and review some of the case studies of (MRP).

Material requirements planning (MRP) is a production planning, scheduling, and inventory control system used to manage manufacturing processes. Most MRP systems are software-based, while it is possible to conduct MRP by hand as well. [1]

2.2 An MRP system is intended to simultaneously meet three objectives:

1. Ensure materials are available for production and products are available for delivery to costumers.
2. Maintain the lowest possible material and product levels in store.
3. Plan manufacturing activities, delivery schedules and purchasing activities. [1]

2.3 MRP system basic inputs:

The three major inputs of an MRP system:

1. The master production schedule.

2. The product structure records or the Bill of Materials (BOM).

3. The inventory status records.

Without these basic inputs the MRP system cannot function.

2.4 MRP system basic outputs:

There are two outputs and a variety of messages/reports:

Output 1:

The “Recommended production” schedule which lays out a delayed schedule of the required minimum start and completion dates with quantities, for each step of the Routing and Bill of Material required to satisfy the demand from the master production schedule (MPS).

Output 2:

The “Recommended Purchasing” schedule. This lays out both the dates that the purchased items should be received into the facility and the dates that the

purchase orders or blanket order release should occur to match the production schedules. [1]

2.5 Messages and reports:

- Purchase orders: An order to a supplier to provide materials
- Reschedule notices: These recommend cancelling, increasing, delaying or speeding up existing orders.[1]

2.6 The Bill of Materials (BOM):

The product structure records or the bill of materials is a list of the raw materials, sub-assemblies, intermediate assemblies, sub-components, parts and the quantities of each of them needed to manufacture an “end product”.

Each different product made by a given manufacturer will have its own separate bill of materials. The bill of materials is arranged in a hierarchy, so that managers can see which materials are needed to complete each level of production. MRP uses the bill of materials to determine the quantity of each component needed to produce a certain number of finished products. [2]

2.7 The Master Production Schedule (MPS):

The master schedule outlines the anticipated production activities of the plant. Developed using both internal forecasts and external orders, it states the quantity of each product that will be manufactured and the time frame in which they will be needed. The master schedule separates the planning horizon into time “buckets”, which are usually calendar weeks. The schedule must cover a time frame long enough to produce the final product. This total production time is equal to the sum of the lead times of all the related fabrication and assembly operations. It is important to note that master schedules are often generated according to demand and without regard to the capacity. And MRP system cannot tell in advance if a schedule is not feasible, so managers may have to run several possibilities through the system before they find one that works. [3]

2.8 Dependent demand vs Independent demand

Independent demand is demand originating outside the plant or production system, while dependent demand is demand for components. The bill of materials (BOM) specifies the relationship between the end product (independent demand) and the components (dependent demand). MRP take as input the information contained in the BOM. [4]

2.9 Lead Times:

The time that elapses from when the purchase order is issued until the moment when the material is physically present ready for the operation. [5]

2.9.1 Benefits of lead time reduction:

1. Reduces customer order lead time.

2. improves on-time delivery.

3. Increase customer satisfaction levels.

4. Reduces inventory.

5. Increases flexibility

6. Reduces impacts of changes to consumer orders or cancellation of orders.

7. Identifies bottleneck and constraints.

2.10 Lot sizing:

Lot sizes are the part quantities issued in the planned order receipt and the planned order release sections of an MRP schedule. [6]

2.10.1 Lot-Sizing Techniques:

1. **Lot-for-lot:**

It generates orders in quantities equal to the net requirements in each period, with no extra in hand inventory.

2. Economic order quantity (EOQ):

A type of fixed order quantity that determines the amount of an item to be purchased or made at one time.

3. Least unit cost:

A dynamic lot sizing technique that adds ordering cost and inventory carrying cost for each trial lot size divides by the number of units in the lot size then picking the lot size with the lowest unit cost.

4. Least total cost (LTC):

Dynamic lot sizing technique that calculates the order quantity by comparing the carrying cost and the ordering costs for various lot size and selects the lot where these costs are most nearly equal. [7]

2.11 Safety stock:

Quantity of stock planned to be in inventory to protect against fluctuations in demand and/or supply, adequate safety stock levels permit business operations to proceed according to their plans. Safety stock is held when there is uncertainty in demand, supply, or manufacturing yield; it serves as an insurance against

stock outs, the main goal of safety stocks is to absorb the variability of the customer demand. [8]

2.12 Problems facing MRP implementation:

1. Lack of top management commitment.
2. Failure to recognize that MRP is only a software tool.
3. Insufficient user training and education.
4. Lack of technical expertise.
5. MRP requires a high degree of accuracy for operation.

2.13 MRP processing:

Using information culled from the bill of materials, master schedule and the inventory records file, an MRP system determines the net requirements for raw materials, component parts, and subassemblies for each period on the planning horizon. MRP processing first determines gross material requirements, then subtracts out the inventory on hand and adds back in the safety stock in order to compute the net requirements. [9]

2.14 Benefits and drawbacks of MRP:

MRP systems offer a number of potential benefits to manufacturing firms. Some of the main benefits include helping production managers to minimize inventory

levels and the associated carrying costs, track material requirements, determine the most economical lot sizes for orders, compute quantities needed as safety stock, allocate production time among various products, and plan for future capacity needs. The information generated by MRP systems is useful in other areas as well. There is a large range of people in a manufacturing company that may find the use of information provided by an MRP system very helpful. Production planners are obvious users of MRP, as are production managers, who must balance workloads across departments and make decisions about scheduling work. Plant foremen, responsible for issuing work orders and maintaining production schedules, also rely heavily on MRP output. Other users include customer service representatives, who need to be able to provide projected delivery dates, purchasing managers, and inventory managers.

MRP systems also have several potential drawbacks. First, MRP relies upon accurate input information. If a small business has not maintained good inventory records or has not updated its bills of materials with all relevant changes, it may encounter serious problems with the outputs of its MRP system. The problems could range from missing parts and excessive order quantities to schedule delays and missed delivery dates. At a minimum, an MRP system must have an accurate master production schedule, good lead time estimates, and current inventory records in order to function effectively and produce useful information.

Another potential drawback associated with MRP is that the systems can be difficult, time consuming and costly to implement. Many businesses encounter resistance from employees when they try to implement MRP. For example, employees who once got by with sloppy record keeping may resent the discipline MRP requires. Or departments that became accustomed to hoarding parts in case of inventory shortages might find it difficult to trust the system and let go of that habit.

The key to making MRP implementation work is to provide training and education for all affected employees. It is important early on to identify the key personnel whose power base will be affected by a new MRP system. These people must be among the first to be convinced of the merits of the new system so that they may buy into the plan. Key personnel must be convinced that they personally will be better served by the new system than by any alternate system. One way to improve employee acceptance of MRP systems is to adjust reward systems to reflect production and inventory management goals.

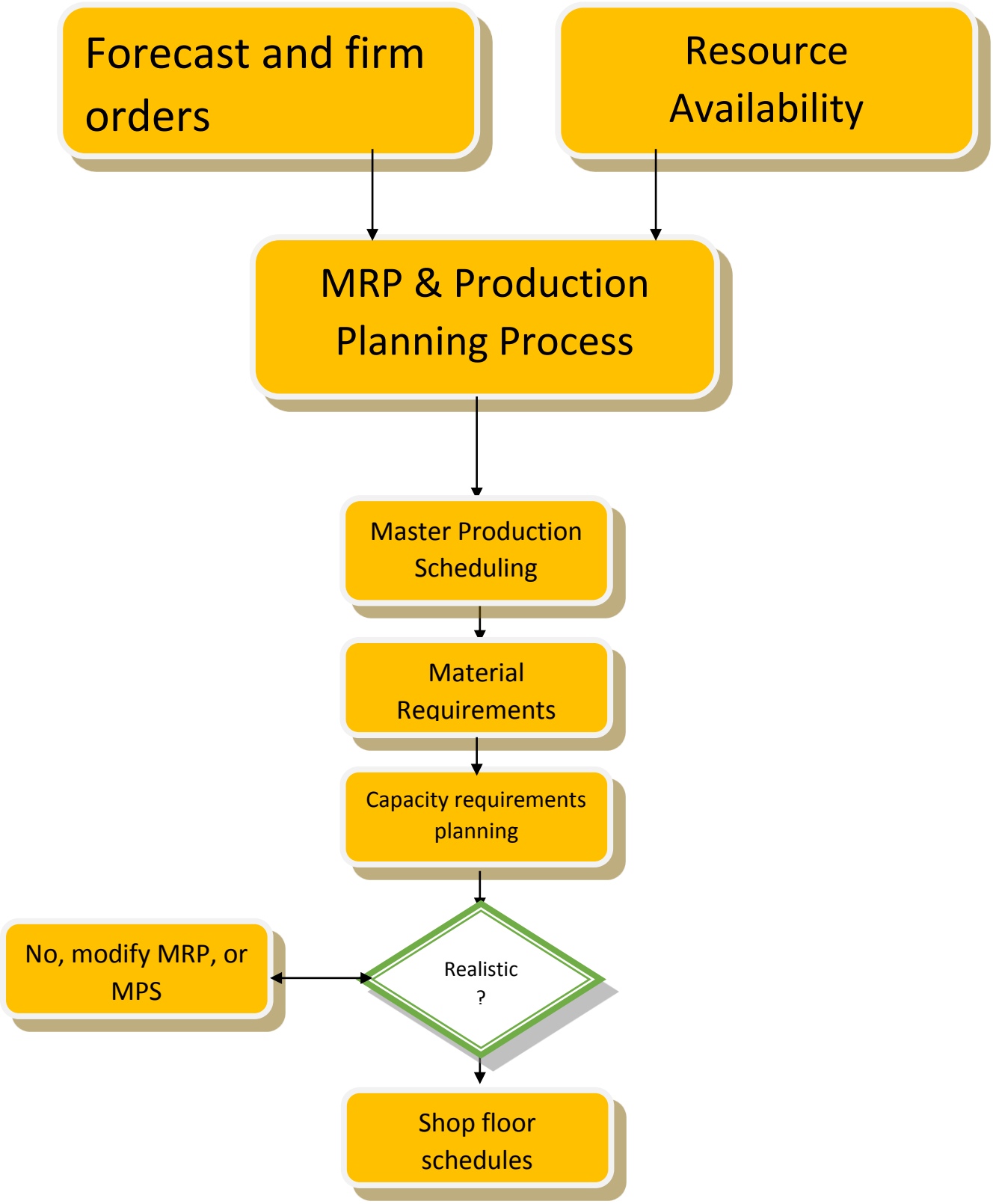

Figure (2.1: the MRP and production planning process.)

2.15 The case studies:

2.15.1 Study of the MRP Implementation Process:

This paper reports on a large-scale survey of Companies involved in MRP implementation. Survey Responses are used to develop a profile of Problems typically encountered during the implementation process. Discriminate analysis is used to determine which of those problems, and additional factors, appear to affect the success or failure of MRP implementation. Finally, comparisons are made between the problems encountered during implementation and problems which were found to significantly discriminate between successful and unsuccessful MRP implementers. There are many key benefits encountered Inventory control improved by 31%, production control improved by 16%, management improved by 14 %, customer service improved by 13%, cost control improved by 13%, company growth improved by 13%.

Although there are many benefits encountered , there are major problems which faced the implementation process, education of personnel 23%, lack of management support 20%, Implementation approach (Lack of time, personnel) 15%, Problems of MRP system (Lack of technical expertise) 15%, Gaining acceptance 11%, Inventory control and record accuracy 9%, Forecasting demand 7%.

Comparing average problem scores reported by the companies to the results from discriminate analysis gives insight into how the implementation Process should be managed. Accurate capacity data and market forecasts support from marketing and company expertise on MRP have been shown to be important and common trouble spots in MRP implementation.

Preventive action and management during implementation in these areas are crucial for success. [10]

2.15.2 A Study of MRP Benefits and Costs

The impressive rise in the popularity of Material Requirements Planning (MRP) has generated an associated interest in the benefits and costs of MRP.

In the study we felt it was important to examine not only benefits of MRP, but costs as well. As a result, one of the questions in the survey requested the cost of MRP installation. The precise question was: How much would you estimate it cost to install MRP in your facility? An approximate estimate will be helpful. Include costs of software, hardware, people, etc. Current Cost? Total Eventual Cost? The purpose of this question was to gain some general information about costs. Obviously the cost data are not very detailed or precise. Companies reported they have spent an average of $\$375,000$ on MRP installation to date and this figure will rise to $\$618,000$ before the system is fully installed. There is

substantial variation in cost among companies. Notice, the standard deviation of cost exceeds the average. An analysis was conducted to explain the large variance in costs. The benefits that were gained are substantial and represent dramatic economic results for the companies who have installed MRP. For example, in the case of inventory turnover an average improvement of 34% in turnover was reported for MRP systems. Since the average company had $15 million invested in inventory, this improvement represented a $4 million reduction in inventory. Similar results have been achieved in other manufacturing performance measures.

We can conclude from the study that the average company installing MRP has achieved significant benefits. Furthermore, these companies can still expect greater benefits when their MRP systems are fully installed. [11]

2.15.3 Critical factors of MRP implementation in small and medium sized firms

The purpose of this study is to identify the elements of MRP implementation that are required to ensure successful implementation in small and medium sized manufacturers. A number of elements of implementation that are identified and subsequently grouped into a hierarchical structure consisting of eight boarder elements, The eight factors used for aggregation are shortly described in the

following , top management support, This variable is necessary to generate acceptance and increase participation, facilitate project management, foster adherence to formal planning and promote operational usage. Formal project planning to increase people's commitment. Data accuracy which is a widely recognized key element. Organisational arrangements. Education/training, the users must know the ''hows'' and "whys" of the MRP system, formal planning/control policies and procedures, software/hardware characteristics, employees individual characteristics. The next step consisted in devising a method to allow researchers to determine the extent to which MRP was successfully implemented. One possible approach that was first considered consisted in asking MRP users to rate the level of satisfaction, Significant benefits such as improved customer service, better production scheduling and reduced manufacturing costs can accrue from the successful implementation of material requirement planning (MRP). [12

CHAPTER THREE

METHODOLOGY

Chapter Three
Methodology

3.1 Introduction:

MRP represents an innovation in the manufacturing environment. Thus, its effective implementation requires explicit management actions. Steps need to be clearly identified and necessary measures be taken to ensure organizational responsiveness to the technique being implemented.

3.2 MRP COMPUTER PROGRAM:

We use Microsoft excel and Microsoft access for the project.

The MRP program works as follows:

1. A list of end items needed by time periods is specified by the master production schedule.
2. A description of the materials and parts needed to make each item is specified in the bill of materials file.
3. The number of units of each item and material currently on hand and on order are contained in the inventory file.
4. The MRP program “works” on the inventory file. In addition, it continuously refers to the bill of materials file to compute quantities of each item needed.

5. The number of units of each item required is then corrected for on hand amounts, and the net requirement is “offset” to allow for the lead time needed to obtain the material.

3.2.1 MRP program standard inputs:

1. Demand for Products:

Product demand for end items stems from two main reasons. The first is known customers who have placed specific orders, such as those generated by sales personnel, or from interdepartmental transactions. The second source is forecast demand. Demand from known customers and demand forecast are combined and become the input to the master production schedule.

2. Bill of Materials File:

The bill of Materials file contains the complete product description, listing materials, parts, and components but also the sequence in which the (18 DD no frost refrigerator (single door)) is created, the refrigerator consists of cooling cycle, steel, plastic, and accessories. The BOM file is often called the product structure file or product tree because it shows how a product is put together. It contains the information to identify each item and the quantity used of each item to make a single refrigerator.

3. Inventory Records File:

Inventory records file under a computerized system can be quite lengthy. Each item in inventory is carried as a separate file and the range of details carried about an item is almost limitless. The MRP program accesses the status segment of the file according to specific time periods. These files are accessed as needed during the program run.

3.2.2 Outputs and reports:

We have two outputs:

Recommended purchasing and recommended production

And two reports:

Primary Reports: Primary reports are the main or normal reports used for the inventory and production control.

Secondary Reports: Additional reports, which are optional under the MRP system.

3.3 Field of study:

We chose a field of study which requires an inventory management system in Sudan, after searching and comparing alternatives Coldair Company has been chosen to implement the MRP system. The project focuses on the inventory sector of the company. After meeting up with employees from the inventory

sector of the company we choose a product for the system which is the “18 DD no frost refrigerator (single door)”, we collect the necessary data for the system such as the bill of materials, the lead times, the production plan and the inventory status.

3.4 Assessment of the present situation:

Includes all activities associated with description and modeling of business practice with respect to inventory management, ordering of materials, and The Manufacturing plan.

3.5 Steps / Phases of the MRP system:

The material requirements planning portion of manufacturing activities interacts with the master schedule, bill of materials file, inventory records file, and the output reports.

3.5.1 Production Scheduling:

Formalization of production scheduling procedures. The production plan contained in the master production schedule is illustrated by entering the inputs data which are the demand quantities and the demand dates, to generate the order dates and the required quantities. The production plan of the MRP is the interface of the MRP system.

3.5.2 Design the BOM:

Design and implementation of the Bill of Materials into company's information system, the bill of materials must contain accurate data for the (18 DD no frost refrigerator (single door)), and the lead time required for each item, it must be designed in its own worksheet in Excel.

3.5.3 Design the MRP system processes:

Includes the design of the MRP system (often this may be based on adapting commercial software to company specifics), in this project we use Microsoft Excel as the base of the MRP system, the Excel contains worksheets including production plan sheet, bill of materials sheet, inventory status sheet and production statistics chart sheet, the necessary calculations for the system are done by Excel. The user provides the system with the necessary inputs to generate the desired outputs which are the quantity of items needs to be purchased and the dates of orders, we also use Microsoft Access as a tool to make purchasing reports and inventory status reports, using Access gives us a simplified overview of the requirements of each demand. The output reports contained in the Access are purchasing orders which contain the required quantities and order dates for each demand. And the inventory status reports which contain the available on hand in the inventory.

3.5.4 Test and evaluation

Assessment of the system before introducing it to the workplace. Often this activity feeds back to Design, we make necessary adjustments and setup the system for use.

Also its necessary to train workers to use the system, workers are required to have knowledge in both Microsoft Excel and Access .the worker who interacts with the system must also have basic knowledge of MRP systems. The inputs data of the system must be as accurate as possible, Thus a hundred percent accuracy cannot be obtained.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

Chapter Four

Results and Discussions

4.1 Introduction:

This chapter discusses the structure of the MRP system which consists of Microsoft Excel and Microsoft Access.

The MRP system of the project is based on Microsoft Excel, which the user use to process the inputs data to come up with desired outputs.

Microsoft Access is also used to create purchasing reports for the supplier based on the results obtained by using Excel. And also used to create inventory status reports.

A suitable field to implement the project is required, after searching and evaluate available options we selected Coldair factory.

4.2 COLDAIR FACTORY

Coldair factory is an industrial corporation specialized in producing cooling devices such as air conditioners, freezers and refrigerators.

It is one of the first companies competes at this line of industry in the market, and has been running for many years until now.

It is located in Khartoum-Bahri industrial area.

The factory is divided into major departments includes:

1. Head Management.
2. Procurement Department.
3. Sales and Merchandizing Department.
4. Production Department.
5. Quality Control Department.
6. Information Technology Department.
7. Human Resource Department.

The project data collected from Coldair factory are used to develop the MRP system, the data of the MRP system are divided to input data and output data.

One product is selected to demonstrate how the system operates, the (18 DD no frost refrigerator).

4.3 The inputs data:

The data that must be considered include:

1. The end item being created, in this case (the 18 DD no frost refrigerator)
2. How much is required at a time.
3. When the quantities are required to meet demand.
4. Inventory status records. Records of net materials available for use. Already in stock (on hand) and materials on orders from the supplier.

5. Bill of materials. Details of the materials, components and sub-assemblies required to make the refrigerator.

4.4 The Outputs:

There are two outputs and a variety of messages/reports:

Output 1:

Is the "Recommended production" schedule which lays out a delayed schedule of the required minimum start and completion dates with quantities, for each step of the Routing and Bill of Material required satisfying the demand from the master production schedule (MPS).

Output 2:

Is the "Recommended Purchasing" schedule. This lays out both the dates that the purchased items should be received into the facility and the dates that the purchase orders or blanket order release should occur to match the production schedules.

4.5 Messages and reports:

Purchase orders: An order to supplier to provide materials.

Reschedule notices: These recommend cancelling, increasing, delaying or speeding up existing orders.

4.6 The Excel structure:

4.6.1 The MRP system interface worksheet:

The interface of the MRP system in excel is the first window to show up when opening Excel, the user enters the inputs necessary for the system to operate based on the production plan of the company.

The inputs required for the system to operate are the demand quantity of refrigerators, the demand dates at which the items should be ready for production processes. And the projected on hand.

These inputs are used to generate the outputs needed, such as the supply order dates for each item, and the quantities of each item, the supply order dates are the dates in which an order for items is made, these dates are shown in the purchasing orders worksheet in excel.

The interface of excel is the base of the system, without it the system can’t operate, because it affects the purchasing orders sheet and the inventory status sheet and gives a detailed information for the production plan of the company.

D	E	F	G	H	I
coldair engineering limited company					
MRP system interface for the 18 DD no frost refrigerator (single door)					
no.	delivery date	demand	supply order	projected on-hand	on hand
				200	200
1	16-04-2016	90	0	110	200
2	16-05-2016	100	0	10	110
3	16-06-2016	140	130	0	140
4	16-07-2016	100	100	0	100
5	16-08-2016	100	100	0	100
6	16-09-2016	80	80	0	80
7	16-10-2016	50	50	0	50
8	16-11-2016	40	40	0	40
9	16-12-2016	50	50	0	50
10	16-01-2017	100	100	0	100
11	16-02-2017	250	250	0	250
12	16-03-2017	100	100	0	100
13	16-04-2017	200	200	0	200

Table (4.1: The MRP system interface worksheet)

The figure above represents the interface of the MRP system on Excel, the colored cells represent the inputs and the non-colored represent the outputs.

4.6.2 The Bill of materials worksheet:

MRP uses the bill of materials to determine the quantity of each component needed to produce a certain number of the product (18 DD no frost refrigerator), from this quantity the system subtracts the quantity of items that's already in inventory to determine the order requirements.

This project contains Coldair's bill of materials for the product (18 DD no frost refrigerator (single door)), the refrigerator consists of a cooling cycle, steel, plastics, and accessories. This product has a number of components that extend to 87 items which has the same lead time since it's supplied by the same

supplier located in the United Arab Emirates. Thus a change in lead times may occur due to supplier issues.

The bill of materials in the Excel worksheet is designed to contain the materials description, the quantity for each item per refrigerator, lead times and the price for each item of the refrigerator.

C	D	E	F	G

18 DD no frost refrigerator (single door) , list of materials per one unit

NO	discription	QTY	item price	lead time
1	refrigerator body	1	362.1	35
2	fridge air duct parts	1	36.21	35
3	freezer air duct parts	1	36.21	35
4	freezer door liner	1	26.21	35
5	fridge door liner	1	26.21	35
6	evaporator compnent	1	36.21	35
7	compressor	1	26.21	35
8	condenser	1	36.21	35
9	foaming base	2	26.21	35
10	front roller component	2	36.21	35
11	adjustable foot	2	36.21	35
12	right bottom axis	1	26.21	35
13	decorative box	1	36.21	35
14	top axis	1	36.21	35
15	freezer door upper frame	1	26.21	35

Table (4.2: the bill of materials worksheet)

The figure above represents the bill of materials contained in the Excel worksheet.

4.6.3 The inventory status worksheet:

The inventory record shows the amount of raw materials on hand at any given time, the inventory status changes based on the change in the (on hand) in the interface of the system, it helps us to keep track on the

items of the refrigerator and make sure the quantity of the inventory satisfies the production requirements. The inventory status sheet represents the items description based on the bill of materials and the quantities of items available for each refrigerator.

	A	B	C	D	E
1	item no.	components description	Qty per ref	16-04-2016	16-05-2016
2	1	refrigerator body	1	100	100
3	2	fridge air duct parts	1	100	100
4	3	freezer air duct parts	1	100	100
5	4	freezer door liner	1	100	100
6	5	fridge door liner	1	100	100
7	6	evaporator compnent	1	100	100
8	7	compressor	1	100	100
9	8	condenser	1	100	100
10	9	foaming base	2	200	200
11	10	front roller component	2	200	200
12	11	adjustable foot	2	200	200
13	12	right bottom axis	1	100	100
14	13	decorative box	1	100	100
15	14	top axis	1	100	100
16	15	freezer door upper frame	1	100	100
17	16	freezer door lower frame	2	200	200
18	17	freezer door sheet (silver)	1	100	100
19	18	embedded part of door shee	10	1000	1000
20	19	stop block	2	200	200
21	20	fridge door upper frame	1	100	100

Table (4.3: the inventory worksheet)

The figure above represents a sample from the inventory status record, for the three first demands, a list of quantity values for each item represents how many items available in the inventory and the dates on which they are available.

4.6.4 The purchase orders worksheet:

This window shows the outputs generated from the demand and the demand dates in the system interface, it shows the delivery dates for the items based on

their lead time, the dates of demands minus the lead times of each item generates the order dates. It also shows the quantity needs to be purchased for each item to satisfy the demand. It also represents the prices for each item ordered by the facility for production, the total price of each demand is in the bottom of the table.

Every order has its own date, price and quantity, this window is the base of the purchasing reports made by Microsoft Access, which the company use to purchase items from the supplier.

	A	B	C	G	H	I
1	NO	components discreption	Qty per ref	date of order #2	Qty of order#	price of order#
2	1	refrigerator body	1	11-04-2016	140	50694
3	2	fridge air duct parts	1	11-04-2016	140	5069.4
4	3	freezer air duct parts	1	11-04-2016	140	5069.4
5	4	freezer door liner	1	11-04-2016	140	3669.4
6	5	fridge door liner	1	11-04-2016	140	3669.4
7	6	evaporator compnent	1	11-04-2016	140	5069.4
8	7	compressor	1	11-04-2016	140	3669.4
9	8	condenser	1	11-04-2016	140	5069.4
10	9	foaming base	2	11-04-2016	280	7338.8
11	10	front roller component	2	11-04-2016	280	10138.8
12	11	adjustable foot	2	11-04-2016	280	10138.8
13	12	right bottom axis	1	11-04-2016	140	3669.4
14	13	decorative box	1	11-04-2016	140	5069.4
15	14	top axis	1	11-04-2016	140	5069.4
16	15	freezer door upper frame	1	11-04-2016	140	3669.4
17	16	freezer door lower frame	2	11-04-2016	280	10138.8
18	17	freezer door sheet (silver)	1	11-04-2016	140	3669.4
19	18	embedded part of door sheet	10	11-04-2016	1400	50694
20	19	stop block	2	11-04-2016	280	10138.8
21	20	fridge door upper frame	1	11-04-2016	140	5069.4

Table (4.4: the purchase orders worksheet)

The figure above represents the purchased quantity worksheet in excel.

We notice that the lead time is the same for all the items because we deal with only one supplier, who is located in the United Arab Emirates, but in

some cases the order dates may diver due to supplier issues, in this case the system mark the different dates of order, based on the change in the lead time of the item.

	A	B	C	D	E	F
1	NO	components discreption	Qty per ref	date of order #1	Qty of order#1	price of order#1
2	1	refrigerator body	1	12-03-2016	0	0
3	2	fridge air duct parts	1	12-03-2016	0	0
4	3	freezer air duct parts	1	12-03-2016	0	0
5	4	freezer door liner	1	12-03-2016	0	0
6	5	fridge door liner	1	12-03-2016	0	0
7	6	evaporator compnent	1	12-03-2016	0	0
8	7	compressor	1	07-03-2016	0	0
9	8	condenser	1	12-03-2016	0	0
10	9	foaming base	2	12-03-2016	0	0

Table (4.5: the purchase orders worksheet)

The figure above show a case in which the order date of an item may be different due to the change in the lead time of the item.

4.6.5 The production statistics worksheet:

This worksheet contains a chart that represents the production schedule based on the relation between the quantity of demands and the date of delivery, this chart is the production plan.

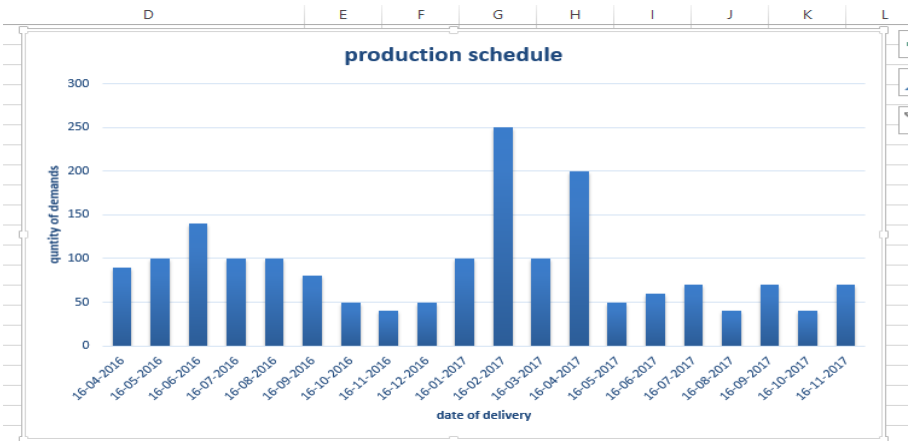

Figure (4.1: the production statistics chart)

4.6.6 The MRP system security:

The Excel worksheets of the MRP system contains sensitive information such as the production plan, the inventory status and the bill of materials of the product. Therefore a certain level of security is required so that only authorized people can view or modify the data in the Excel worksheets.

The system is designed to have three levels of security:

1. Password to only view the data in Excel in the read-only mode.
2. Password to open and modify the data in the worksheets.
3. Passwords to make changes to the work sheets each sheet apart.

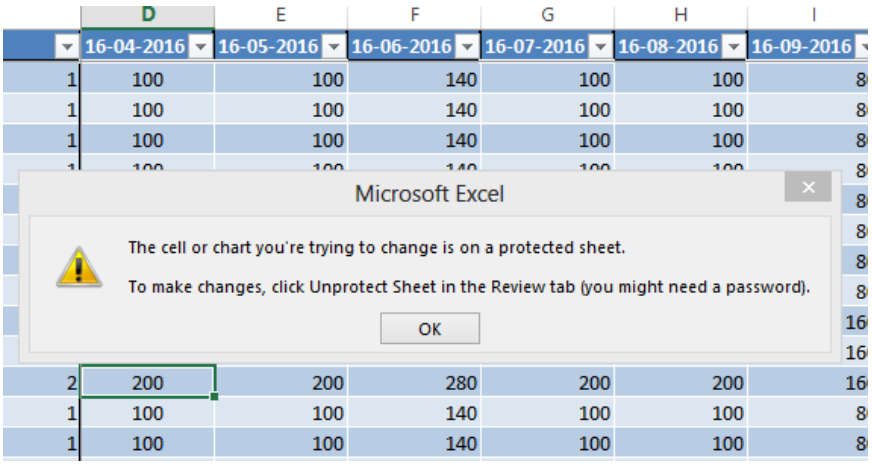

Figure (4.2: the password notification)

The figure above represents the (read-only) mode, password is required to change the contents of the worksheets.

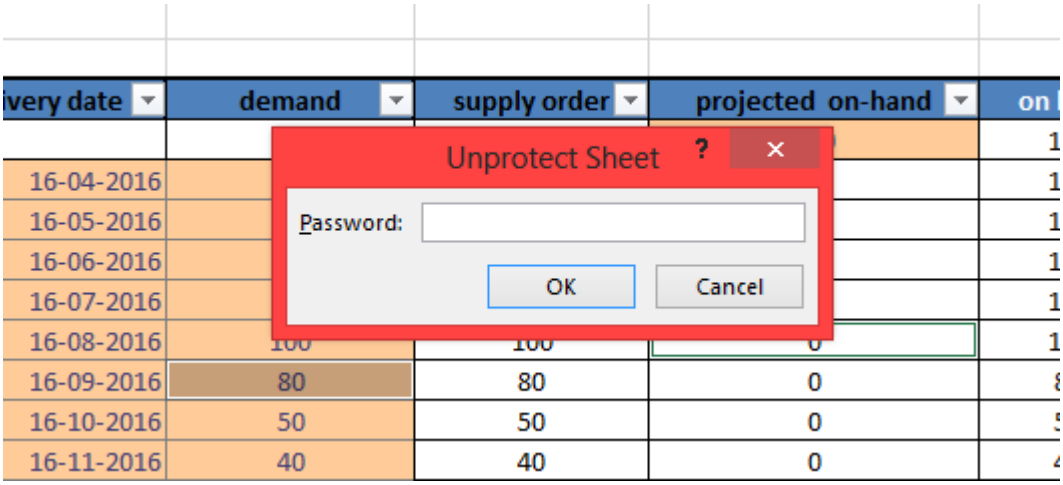

Figure (4.3: the password dialogue)

The figure above represents the dialogue of the password required to make changes in the cells of the worksheets.

4.7 Microsoft Access:

Access can transform the purchasing data and inventory data to the form of reports, a report that shows us the data for each demand, including the date of the purchasing orders, the quantity and the price. And shows us the inventory status record.

This method is more practical to show the purchasing data, rather than viewing all the data of the orders stacked side by side in Excel. Access can make reports for each order separate from the other orders. In the Access we have two tables, one for the purchasing orders, and the other table is for inventory status.

These tables are exported from the Excel and contain the necessary data to make the needed reports.

The program also contain two types of reports one for the purchasing orders and the other is for the inventory status, the data in the reports are based on the tables provided by the Excel.

The next pages view two reports examples for purchasing orders and inventory status report.

COLDAIR CO.
PO NO: PI2189
ISSUE DATE: 11/4/2016
TO: DUBAI MULTI COMMODITES CENTER
TELEPHONE 009714355750
FAX 0097144355837
ATTN: RAW MATERIALS FOR REFRIGERATORS>

PURCHASE ORDER CONFIRMATION

COLDAIR ENGINEERING CO.
P.O. BOX 804
BAHRI INDUSTRIAL AREA
KHARTOUM, SUDAN
TEL. :+ 00249185347429
FAX: +249185347427

NO	components discreption	Qty per ref	date of order #2	Qty of order#2	price of order#2
1	refrigerator body	1	11/04/2016	140	50694
2	fridge air duct parts	1	11/04/2016	140	5069.4
3	freezer air duct parts	1	11/04/2016	140	5069.4
4	freezer door liner	1	11/04/2016	140	3669.4
5	fridge door liner	1	11/04/2016	140	3669.4
6	evaporator compnent	1	11/04/2016	140	5069.4
7	compressor	1	11/04/2016	140	3669.4
8	condenser	1	11/04/2016	140	5069.4
9	foaming base	2	11/04/2016	280	7338.8
10	front roller component	2	11/04/2016	280	10138.8
11	adjustable foot	2	11/04/2016	280	10138.8
12	right bottom axis	1	11/04/2016	140	3669.4
13	decorative box	1	11/04/2016	140	5069.4
14	top axis	1	11/04/2016	140	5069.4
15	freezer door upper frame	1	11/04/2016	140	3669.4
16	freezer door lower frame	2	11/04/2016	280	10138.8
17	freezer door sheet (silver)	1	11/04/2016	140	3669.4
18	embedded part of door sheet	10	11/04/2016	1400	50694
19	stop block	2	11/04/2016	280	10138.8
20	fridge door upper frame	1	11/04/2016	140	5069.4
21	fridge door sheet (silver)	1	11/04/2016	140	5069.4
22	door lock and key	1	11/04/2016	140	5069.4
23	vc crisper block	1	11/04/2016	140	5069.4
24	crisper	1	11/04/2016	140	5069.4
25	fridge water tray	1	11/04/2016	140	5069.4
26	junction box	1	11/04/2016	140	5069.4
27	cover of junction box	1	11/04/2016	140	5069.4
28	defrosting tray	1	11/04/2016	140	5069.4
29	LED lamp	1	11/04/2016	140	5069.4
30	lamp cover	1	11/04/2016	140	5069.4

Page 1 of 3

Figure (4.4: purchasing order report)

The figure above represents a model for the purchasing report made by using Access.

COLDAIR CO.
PO NO.: PI2189
ISSUE DATE: 18/5/2016
TO: DUBAI MULTI COMMODITES CENTER
TELEPHONE 009714355750
FAX 0097144355837
ATTN: RAW MATERIAL FOR
REFRIGERATORS>

inventory status record

COLDAIR ENGINEERING CO.
P.O. BOX 804
BAHRI INDUSTRIAL AREA
KHARTOUM, SUDAN
TEL. :+ 00249185347429
FAX: +249185347427

no	components description	Qty	16-Apr	16-May	16-Jun	16-Jul	16-Aug	16-Sep	l6-Oct	16-Nov	16-Dec
1	refrigerator body	1	150	100	140	100	100	80	50	40	50
2	fridge air duct parts	1	150	100	140	100	100	80	50	40	50
3	freezer air duct parts	1	150	100	140	100	100	80	50	40	50
4	freezer door liner	1	150	100	140	100	100	80	50	40	50
5	fridge door liner	1	150	100	140	100	100	80	50	40	50
6	evaporator compnent	1	150	100	140	100	100	80	50	40	50
7	compressor	1	150	100	140	100	100	80	50	40	50
8	condenser	1	150	100	140	100	100	80	50	40	50
9	foaming base	2	300	200	280	200	200	160	100	80	100
10	front roller component	2	300	200	280	200	200	160	100	80	100
11	adjustable foot	2	300	200	280	200	200	160	100	80	100
12	right bottom axis	1	150	100	140	100	100	80	50	40	50
13	decorative box	1	150	100	140	100	100	80	50	40	50
14	top axis	1	150	100	140	100	100	80	50	40	50
15	freezer door upper fra	1	150	100	140	100	100	80	50	40	50
16	freezer door lower fra	2	300	200	280	200	200	160	100	80	100
17	freezer door sheet (silv	1	150	100	140	100	100	80	50	40	50
18	embedded part of doo	10	1500	1000	1400	1000	1000	800	500	400	500
19	stop block	2	300	200	280	200	200	160	100	80	100
20	fridge door upper fram	1	150	100	140	100	100	80	50	40	50
21	fridge door sheet (silve	1	150	100	140	100	100	80	50	40	50
22	door lock and key	1	150	100	140	100	100	80	50	40	50
23	vc crisper block	1	150	100	140	100	100	80	50	40	50
24	crisper	1	150	100	140	100	100	80	50	40	50
25	fridge water tray	1	150	100	140	100	100	80	50	40	50
26	junction box	1	150	100	140	100	100	80	50	40	50
27	cover of junction box	1	150	100	140	100	100	80	50	40	50
28	defrosting tray	1	150	100	140	100	100	80	50	40	50
29	LED lamp	1	150	100	140	100	100	80	50	40	50

Page 1 of 3

Figure (4.5: inventory status report)

The figure above represents the inventory status record report model, done by Using Access.

CHAPTER FIVE

CONCLUSIONS AND

RECOMMENDATIONS

Chapter Five

Conclusions and Recommendations

5.1 conclusion:

This project is an approach on how to develop a MRP system for small scale companies, by using Microsoft Excel for the necessary calculations of the system and Microsoft Access as a tool to create reports for purchasing orders.

We studied the company requirements and collected data about the inventory and the production information to come up with the ideal MRP software system, so production materials are managed in the appropriate way. The results obtained by the system are the dates of deliveries, the quantities of each item needed for production, the dates of orders and the quantity required for inventory.

5.2 Recommendations:

1. This MRP system is suitable for small scale industries but as the complexity of the facility increase, the more sophisticated programs are required.
2. The system operator should be trained to deal with the MRP system (Microsoft Excel and Microsoft Access knowledge).
3. To keep all the data of the system to perform forecasting techniques.

4. Managers should plan the MPS of next years before the longest lead time to ensure the availability of components.

5.3 limitations

1. Must ensure the data accuracy, thus it can’t be a hundred percent accurate.
2. The master production schedule should be planned early.
3. The worker might not be familiar with computers systems and needs training.

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