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Using the Successful Implementation Road of MRP to Developing Iraqi Manufacturing Industries

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Abstract: Production planning and control systems have always been an important tool for improving the effectiveness of manufacturing organizations, therefore, there has been steady evolution, innovations, view points and approaches in such systems. These systems may be crucial or may give new opportunities for companies struggling to meet higher customer expectations and overcome keen competition. This is applicable for the companies in developed as well as developing countries. Nowadays, there are three main approaches for production planning these are MRP-type systems, OPT and JIT. MRP-type systems which have engaged the interest of researchers and practitioners alike. These systems have been studied and widely adopted in industrial environments of most of Western countries, some of recently developed Far East countries and some of less developed countries. Iraqi industrial companies not adopted any of these advanced planning systems for many reasons which badly affected the ability of these companies to withstand and resist the wind of competition in the market and disability of its products to cross the border, thus, it was limited for local consumption. Generally, the studies which are concerned with adopting these systems in Iraqi industries are limited in few academic studies and their results often conflicts each other. Hence, the present study is carried out from the view of industrial engineering and operational research in order to satisfy the needs of Iraqi industrial companies for a scientific study in the subject of production planning and control to improve their performance. It is recommended to adopt MRP-type systems up to MRP II while there are no reasonable reasons found for adopting ERP systems in Iraqi manufacturing industries in the short and medium terms. The requirements for successful implementation of MRP-type systems are studied and identified.

Key words: Production planning and control, MRP, OPT, JIT, manufacturing, system

INTRODUCTION

General scope: Due to its importance, the area of production planning and control in manufacturing and service organizations provides an interesting and challenging career opportunity for people who study business and industrial engineering and for researchers and practitioners alike.

On the other hand, production planning and control specialists are in the core of the nervous system of any manufacturing organization. They participate in demand forecasting, planning the overall capacity of organization, determining how much inventory of parts and material to carry and when to acquire them and if parts are manufactured in house, they are responsible for when they are made and on what machines, so that, master production schedules or final assembly schedule are met to satisfy the demand of the organization. Therefore, informal planning procedures are not capable to carry out such complicated responsibilities and the need for formal and effective production planning and control systems appear.

Obviously, this is a challenging task which requires from production planning and control people to coordinate their effort with marketing, finance, engineering and personnel management. Sometimes conflicts arise among these functional areas, these conflicting objectives should be resolved in order to make production happen and products produced in the price and quality which are reasonable for competition and customers.

The world of manufacturing has been changing dramatically, since, 1960's. Global competition is reality and world class manufacturing companies have been created to engage in sales, manufacturing and purchasing activities in every corner of the world. On the other hand, the products have been complicated and manufactured in different designs and models to satisfy the needs and desires of the customers and to be able to compete with similar products. Hence, there have been many important changes in production planning and control systems.

No doubt, determining actual production requirements in such environments is a very difficult task,

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especially in manufacturing organizations having large number of finished goods that assembled from many thousands of subassemblies and piece parts. Some of the components may be purchased and others manufactured with many different operations and lead times which need to be considered.

Hereby, these organizations are turning more and more to the use of computer based production planning and control systems to aid them in planning, coordinating and controlling their production and inventory management activities in such dynamic and turbulent circumstances. "Material Requirements Planning" (MRP), combined with computer technology gave the first successful computerized production requirement system in the early 1960's.

It is a general knowledge that production planning techniques always needs a lot more due to the competition in businesses and the growing requirements of manufacturing systems. Hence, MRP systems are developed and extended by adding new modules to them with the time to be capable to cover these growing requirements, so, they breed new systems. These developed MRP systems are called "MRP-type systems".

Practically in 1980's MRP systems faced competitions from other production planning approaches, mainly the "Optimized Production Technology" (OPT) as well as the Japanese "Just-in-Time" (JIT) philosophy.

Obviously, improvements of production planning and control systems may be crucial for companies struggling to meet higher customer expectations and overcome keen competition in the global arena. Therefore, the companies change and will continue changing their practices in this area and seek to adopt and implement the most suitable and effective of these systems.

Production planning and control background: Wight (1981) stated that manufacturing due to its importance is "the goose that laid the golden egg". Production activities are the foundation of nation's economic system (Monks, 1987). Production systems transfer, human, material, energy, machines, facilities, information and technology into higher-valued products. The outputs of production systems are normally called "products". These products may be tangible goods, intangible services or combination. Goods are tangible items that can be touched or held. Production systems that produce goods are often referred to as "manufacturing systems" and the production of goods is called "manufacturing" manufacturing (Martinch, 2008).

Production management responsibilities include bringing the inputs together under an acceptable production plan that effectively utilizes the material, capacity and knowledge available in the production facility. Given a demand on the system, work is scheduled and controlled to produce desired products. Meanwhile, control must be exercised over inventory, quality and costs to ensure the ability of production system to compete. Manufacturing operations types are generally distinguished by the product range, product complexity and life time of the product being manufactured. The differences among the types of manufacturing processes have important implications on the choice of the production planning system. It is normal to distinguish four types of manufacturing processes namely; "job shop", "batch flow", "assembly line" and "continuous process" (Hopp and Spearman, 2001; Silver *et al*., 1998).

The manufacturing methods are typically specified in two documents. The first one is the "Bill of Materials" (BOM) which sets out the name and quantity of each part and subassembly that make up the finished items. The second is the "routing" which specifies the operations and machines involved in each process of the manufacturing of the product. These two documents are essential for production planning activities in any manufacturing organization.

Typically, the manufacturing organizations have three categories of managerial planning activities whose names "strategic", "tactical" and "operational" production planning (Silver *et al*., 1998; Vondermbose and White, 2004; Heizer and Render, 1996). Strategic planning is clearly of "long-range" scope planning decisions. It is a responsibility of top management, so, it is called "business planning". Tactical planning is a "medium-range" activity involving middle managements. Finally, operational planning which involves "short-range" actions and it is normally executed by lower levels of management (factory operations managers).

Long-range (business plans) are necessary to develop facilities and equipment, major suppliers and production processes and become constraints on the medium-range plan. Medium-range is "aggregate plans" concerning with employment, aggregate inventory, utilities, facility modifications and material-supply contracts. These aggregate plans impose constraints on the short-range production plans that follow. So, short-range is "Master Production Schedules" (MPS) for producing finished goods or end items which are used to derive production planning and control systems. These systems develop short-range production schedules of parts and assemblies, schedules of purchased materials, shop-floor schedules and workforce schedules (Gaither and Frazier, 2002; Stevnson and ven Ness 1999). In the late 19th and early 20th century, a number of innovations enabled a quantum leap in the scope and

complexity of manufacturing creating the need for much more "formal" methods of manufacturing operations management. Although, the idea of making product by the assembly of exchangeable parts has a long history, especially in the armaments industry (Hopp and Spearmen, 2001). It was only achievable at a high cost for complex precision items that required in assembling complex products such as automobiles.

However, with the time manufacturing systems have been more complicated and their requirements growing due to the competition in businesses, hence, there has been a steady development in production planning and control activities to fulfill the needs of manufacturing organizations.

Implementation MRP status studies: The surveys indicate that MRP systems are the most widely implemented production management techniques in the USA. Anderson *et al.* (1982) in their survey found that 64% from the responding were an MRP-type systems users and (Cheng, 1997) in his study found that the percentage increased to 82% which indicates that the users of MRP-type systems in 1997 are much higher than 1982 due to its effectiveness in supporting manufacturing activities.

Colde (1993) and Swan *et al.* (1999) and found that MRP systems are the most widely implemented in the UK., The similar results found in other western countries; Italy (Bartezzaghi *et al*., 1992; Swan *et al.*, 1999; Lowe and Sim, 1993).

The surveys in the countries in the Far East gave the same indication (Sum and Yang, 1993; Ang *et al*., 1994). In China, according to He *et al.* (2005) and Zhao *et al.* (2002). MRP-type systems have been implemented by an increasing number of Chinese firms. Zhang *et al.* (2003) stated that nearly 1000 companies in China have implemented different MRP-type systems. MRP-type systems are the most widely implemented in Egypt (Salaheldin and Francis, 1998; Kumar and Meade, 2002) indicated that AMR (Advanced Manufacturing Research) reported in 1995 that MRP systems completely dominated the manufacturing industry for nearly 15 years. It led to multi billion dollar software and services industry. More than 60,000 MRP-type systems were implemented world wide and over 4,000,000 manufacturing employees were educated on the theory and practices of MRP.

Aghazadeh (2003) stated that MRP systems have become the most effective and widely used inventory control systems across the world. Many operation managers have found the vast knowledge that MRP systems provide is absolutely necessary to effectively and competitively succeed in the current global economy. (Hopp and Spearman, 2004) indicated that 150 MRP system implementations were reported in 1971. By 1981 this number had grown to around 8000. When MRP systems evolved to MRP II in 1980's it grew in popularity. Hence, in 1984 alone, 16 companies sold $ 400 million in MRP II Software and by 1989, over $1.2 billion worth of MRP II Software was sold to American industry, constituting almost one third of the entire software market in the USA.

Bradely stated that "Business around the world are spending approximately $10 billion/year on Enterprise Resource Planning (ERP) systems and about the same amount of consultants to install there systems".

Generally, it is clear from the above surveys and studies that MRP-type systems have been extremely influential in the USA and western countries and later in the developing countries. JIT is the next most implemented technique in these surveys, OPT and other planning techniques are the least influential.

Studies of the requirements for successful implementation of MRP-type systems: Due to its importance, many studies and surveys have tried to understand the background of MRP systems success and failure. Such literature was first conducted in western countries conducted their studies in the USA. Some technical factors such as data accuracy (Wacker and Hills, 1977; Anderson *et al*., 1982; Cheng, 1997) high degree of computerization were reported to be closely related to the success of MRP and MRP II implementation. Many of these studies further suggested that certain human and organizational factors should be emphasized during systems implementation.

Since, the early 1990's MRP II researches had received considerable attention in developing countries in Asia (Sum and Yang, 1993) reported that the major problems of MRP II implementation in Singapore companies are; lack of company expertise in MRP II, lack of training and education and lack of communication between managers and employees. In addition to lack of data accuracy and top management support.

The most critical factors in MRP II implementation in China is the organizational factor, followed by the system factor and finally the technical factor as reported by He *et al.* (2005), Zhao *et al.* (2002) and Salaheldin and Francis (1998). Reported that the major MRP implementation problem in Egyptian manufacturing companies are; poor training and education on MRP and lack of company expertise in MRP, respectively.

Since, the late 1990's ERP implementation issues have been given much attention, thus, most of literature focused on the concept of the critical success factors of ERP implementation.

However, according to Nah *et al*. (2001) the research of critical success factors in ERP implementation is rare and fragmented and in their study they summarized the factors given by ten related articles that conducted by different researchers. As a result, the study gave eleven factors for ERP success; Other study carried by Reimers (2002) adapted from eight different articles shows 32 critical factors can be issued.

Practically, since, MRP II is the core of ERP, then the critical success factors of MRP II implementation have been already included in ERP implementation and then the failure rate of the later are much higher than that of MRP II.

MATERIALS AND METHODS

Material requirements planning: Until the 1960's many manufacturing organizations used ROP method. Thus, components were often ordered when not actually needed and so, this method tended to result in very high inventory levels. Later on, the competitive of the products became tougher as the world moved toward the "economic war" and businesses began to realize that their future depended on developing a much better response to customer needs, manufacturers faced the challenges of improving the quality and reduce the time and cost of their products.

The researchers in the field of planning realized the needs of manufacturing organizations for more efficient system for planning and control of stock to be able to compete in the market, thus MRP was developed and within twenty years MRP technique has been changing dramatically in a stepwise progression toward "Manufacturing Resource Planning" (MRP II). The main steps in the development of MRP were:

- A better ordering method
- Priority planning
- Closed-loop MRP
- Manufacturing Resource Planning MRP II

However, MRP II implementation is classified into four categories "ABCD classification" which has become widely used. Class "D" implementation is the lowest level of implementation and class "A" implementation means that MRP II is running the entire activities of the business.

In the 1990's, the new innovation "Enterprise Resource Planning (ERP) which can be considered as direct extension of MRP II was coined to describe the latest development in resource planning. Now a days, a new generation of ERP system, going under the name of (ERP II), is established (Andreu *et al*, 2003).

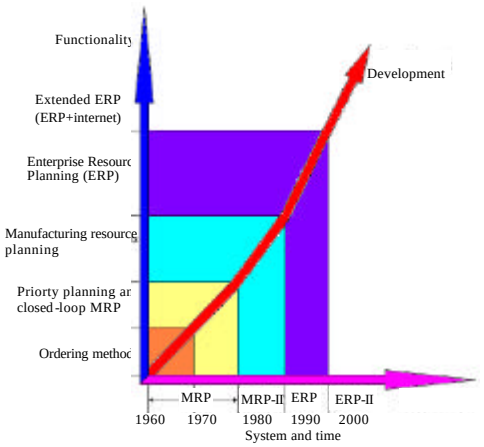

Fig. 1: Development of MRP-type systems and their functionality evolutions

During the 1980's MRP faced competitions from the other "Computer Aided Production Management" (CAPM) systems, mainly the "Optimized Production Technology" (OPT), as well as the Japanese "Just-In-Time" (JIT) philosophy. The development of MRP-type systems and their functionality evolutions can be illustrated as in Fig. 1.

The scope of iraqi companies: In spite of the dramatic development and changes of formal production planning and control systems and its wide applications in the developed countries, many manufacturing organizations in the developing countries didn't adopt such systems. Hence, the gap between production planning activities of these organizations and those of the developed countries increased more and more with the time and this has badly affected the ability of the products of these organizations to compete in the market.

However, production planning and control systems are still informal and/or incomplete process in many manufacturing organizations in the developing countries and in most of Iraqi manufacturing organizations. Whether they explicitly recognize it or not Iraqi companies established some kind of production plans. They do but that is not enough and they do not do it in the right way to carry out and fulfill this vital task.

In reality, Iraqi industrial companies are suffering from neglecting the technical and management approaches especially in production planning within its; long, medium and short ranges.

Generally, the planning procedures used in Iraqi companies extend between manually operated which is very slow and has no ability to cope with the actual dynamic circumstances and with the heavily depending on the planner capabilities. This leads to deal with reactionary or "fire fighting" mode and the wide use of the orders of "hot jobs" to solve the problems which arise during execution of such planning procedures. Hence, the disturbance in production planning is dominant, the productivity levels are low, production costs are high and investment utilization is low.

Although, some of Iraqi companies use to some extent computerized systems but these systems are designed in house and they are useful and used for storing some kinds of data and information but not for production planning activities. As a result, these planning procedures badly affected the ability of Iraqi companies to withstand and resist the wind of competition in the market and the disability of its products to cross the border thus, it was limited for local consumption.

Moreover, Iraqi industrial companies face nowadays a great challenge to improve their competitive position in the market in order to face the pressure which is resulted from entering of goods from different origins to the local market especially after the changes in the economic policies in the country which is converting to open door policy.

In order to survive in today's business world, Iraqi industrial companies need to control the components of the total costs and increase productivity, profitability and assets utilization. Since, production planning and control systems represent the nervous system of any production organization, then the main tool which these companies should use to achieve these goals is by improving the performance of their production planning and control activities through adopting the advanced formal planning systems.

Obviously, production planning and control systems are not like machines or equipments which can be purchased and used easily because for each one of these systems there are many requirements to implement successfully and the decision for which system to be adopted in a certain company or companies depends on the internal environment of this company or these companies as well as the external environment in which this/these company or companies exist. The company or companies also have different expectations of what changes in production planning and control system can lead to and what positive and negative effects can come up when the system is implemented.

No doubt, adopting an unsuitable production planning system or implementing it without preparing its requirements and not according to an effective plan will certainly lead to its failure and this could result in bad and harmful consequences and this may cause a permanent effect which could force the management to take a reaction decision of not adopting any new planning system any more in the future.

Researches conducted in IRAQ: The following researches attempt to make use of MRP systems in Iraqi industries: used MRP systems in Al-Qadissya general establishment. They found that MRP system is an effective technique to support planning for production and inventory in the company. But they all claimed that the requirements to implement the system were not available, especially the accurate BOM, Routing, Lead times and inventory records built a simple MRP system to support production and inventory planning of air coolers plant in Al-Hilal Company. He reached the same conclusion that the designed MRP system improved the ability of the company for planning and inventory control but the records and data which is required to ensure an effective use of the system were not available or not accurate. And this is "a major problem for the use of the system".

Al-Atroshy compared the three techniques of production planning and control MRP, JIT and OPT and concluded that JIT is impractical in Iraqi "engineering industries sector" environment because all of the requirements for its implementation were not available there while MRP and OPT were the suitable and practical techniques but she claimed that, OPT technique is the most effective technique to solve the problems raised due to the existing of bottlenecks in the production line of model 2003 TV in "Electronic Industries Company" EIC company where she did her research.

Al-Rawi attempted to apply a mix of MRP and JIT in "armaments industry sector". He concluded that the two systems complement each other and give the best results when MRP used for medium and long term planning and JIT for shop floor control. He also claimed that the main requirements for an effective use of MRP system were not available like accurate BOM, lead times and Inventory status.

Generally, all the previous studies were academic and did not take into consideration that MRP systems do not work effectively without preparing their requirements and explicit management actions to implement them.

Moreover, all above studies except the study of were based on the use of (MRP system of MAP 3000 Software). This is an old Software (Version 1984) and it has many limitations, drawbacks and shortcomings. Furthermore, it is a main frame system which limits its application compared with the PC-based systems which available nowadays in the software market.

In fact, all of these studies didn't give any plan or guide to the companies to help in implementing MRP systems and they are limited particularly in the use of (MAP 3000) Software.

RESULTS AND DISCUSSION

Implementation of MRP-type systems: Manufacturing companies in today's increasingly competitive marketplace are faced with many challenges; Improving quality, reducing costs and wastes and improving their competitive position.

Therefore, many manufacturers undertake the implementation of an MRP-type system to help them to maximize utilization of the resources of their companies, as a first step on the road of becoming truly competitive, remembering that this process is not an end in itself but should form the core of new business strategy for their manufacturing companies.

Generally, most of the companies that implement MRP-type systems successfully have realized significant benefits including, improvements in competitive position, customer service, production scheduling, finances, plant efficiency, reduced component shortages and lower manufacturing costs.

Practically, MRP-type systems is a structure as well as a tool for creating a predictable manufacturing environment and it defines "resources" in a broad sense, to include the people, technology and factory capacity in addition to the materials involved in manufacturing.

Obviously, the degree of success of implementing MRP-type systems in Iraqi industries depends mainly on the existing of many requirements. These must be studied in depth in order to achieve a successful implementation and get the maximum benefits of these systems in Iraqi industries environment. Therefore, the following aspects needs to be studied carefully, the factors affecting the success of implementing these systems how the degree of success of implementing of MRP-type systems can be measured, the database which is required for applying MRP-type systems and the crucial activities of typical implementation of these systems in order to reach and to have a scientific background for implementing MRP-type systems successfully. However, the first and the last of these aspects need to be studied more carefully and deeply. These two aspects are covered in details in the following sections.

Factors affecting the success of MRP-type systems implementation: Many researchers have tried to understand the background to MRP-type systems implementation success and failure. Generally, most of these studies are based on case studies or personal experience. The problem with case studies is that the failures are rarely documented because the authors are typically employees of (or consultants to) the companies described in the cases as such lessons drawn from these case studies may not be applicable in other cases. On the other hand, empirical studies on MRP systems practices have been limite (Sum and Yang, 1993).

Practically, the main factors affecting the degree of success of MRP-type systems implementation in Iraq industries are given as below. A breakdown in any one of these factors can cause the system to be ineffective and serious, compounded breakdowns led to its ultimate failure:

- Top management commitment
- Data accuracy
- Education and training
- Technical expertise
- User involvement
- Recognize that MRP II software is only a tool
- Selection of software package

Top management commitment: Commitment by top management is essential to the success of any MRP implementation. Implementing an MRP system is a major decision for any manufacturing organization. It has implications for many areas throughout the manufacturing organization for engineering (in terms of the need for accurate and complete up-to-date bill of materials) for purchasing (in terms of generating accurate purchase lead times) and for the materials and production people (in terms of the discipline necessary to maintain accurate inventory data and working to the schedule).

Obviously, if the manufacturing organization wants to gain all of the potential benefits of any MRP system, management must accept the responsibility to fully support all the changes which the implementation process involves and must remain supportive of the new system.

Data accuracy: The greatest requirement of all for successful MRP systems implementation and operation is discipline. This includes the discipline to maintain accurate data and record (inputs). Inaccuracies in

inventory records, bill of materials, routing and master production schedules lead to inaccuracies in the (output) of the MRP system. However, Krajewski and Ritzman (1996) stated that "when MRP fails to live up to-expectations, management should look first at these inputs. Are they accurate and realistic?".

Practically, simple mathematical calculations can show how reliability of outputs of MRP system is affected by data accuracy. For example taking the accuracy of inputs as following; inventory records (94%), bill of materials (97%), routing (95%) and master production schedule (96%).

Individually, these figures seems quite respectable but as MRP calculations involve all four sources of data then output accuracy equal to overall accuracy which can be calculated as:

$$0.94 \times 0.97 \times 0.95 \times 0.96 = 0.83 \text{ or } (83\%)$$

This means that in every 100 MRP calculations there will be 17 errors, caused by the inaccurate inputs. Thus, data which appears acceptably accurate in isolation can results when combined in an unacceptable level of outputs.

Obviously, the accuracy of the master production schedule must be closed to 100% because MRP system is driven by the master production schedule. Hence, it affects the whole work and outputs of this system.

Education and training: A key element in any MRP implementation is to ensure that all personnel in the company who are likely to come into contact with the MRP system should have some MRP education. Given the nature of MRP, many people in the manufacturing organization are impacted by its introduction. Therefore, a comprehensive MRP education program has to be initiated to ensure that the system is used effectively. This is not to say that each employee from top management down to the lowest level has to be an MRP expert, rather each should have sufficient understanding of MRP principles and operation to work with the system as required.

However, Krajewski and Ritzman (1996) argues that "People are the key to a good installation and people is through education (Hinds, 1982) stated that "education is the first key to successful MRP implementation" and he concludes that "the MRP process begins with and its success is determined by the education process".

Basically, there is an important distinction between education and training. According to Wight (1981) education teaches people "why" and some of the "how" while training gets into the details of "how". The training for an MRP program should be done just prior to installation. Obviously, there can be no doubt that training is essential of maximum return is to be derived from an investment in a sophisticated tool like MRP-type systems and particularly to a wide-ranging application such as an MRP II system which its success depends upon the coordination of activities in almost all areas in manufacturing organization.

Moreover, Wacker and Hills (1977), argues that the key to success or failure of any MRP system is by overcoming human resistance to change and according to Evans (1987), good training can help alleviate the behavioral problems that often arise when any type of change occurs.

Technical expertise: Not only there is a need to improve users t raining techniques and general understanding of MRP systems principles, there is also a need of technical expertise to provide the leadership needed to implement the systems. Not only would the technical experts need to be familiar with 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.

In their study, Sum and Yang (1993) identified that the lack of MRP expertise, training and education were the major problems facing MRP systems implementations.

Regardless of the system selected, it is important for users to obtain the technical assistance needed. The chance of a successful MRP implementation increased with the amount of outside technical assistance and training utilized.

Practically, the outside consultant can say the right things to management when they need to be said whereas very few insiders can do this. Moreover, they can transfer the experiences of other organizations which implemented MRP systems.

User involvement: A team of people will be responsible for the development and implementation of MRP system. This team should be involving people from all departments of the company that will use the MRP system, so that, the system will reflect the particular needs of its users. The participation of users of the system in its development will make these people more familiar with the system, so, they will know better become more committed as a result of being involved in the development of the system.

Typically and since, MRP II system is a company wide system then its implementation success requires a

close cooperation among all groups in the company that will affect by the system, hence, a project team for MRP II implementation is including of personnel from manufacturing, data processing, marketing, accounting and purchasing is in charge of project.

Recognize that mrp software is only a tool: All MRP-type systems are only a software tool that needs to be used properly and effectively to achieve its maximum benefits.

Wight (1981) stated that "favorite mistakes stems from people's compulsion to believe that MRP is some kind of computer magic. But there is no magic in the computer. The real magic in MRP is people".

Cheng (1997) argues that one of the reasons of MRP-type systems failure to recognize that MRP is only a software tool which needs to be used correctly.

However, the MRP-type system package does nothing more than processing the data provided by the organization that use it and provides further information to the organization and the organization management must understand that MRP system is a people system rather than a computer system.

Selection of software package: Several companies offer software packages that perform MRP-type systems. A company considering the use of MRP system must decide whether to develop its own programs or to purchase and adopt some available "off-the-shelf" packages. When MRP was relatively new in the 1960 and 1970's, a majority of systems were developed in house by the users companies. Since, 1980, however an ever increasing majority of new MRP installations are off-the-shelf systems purchased from commercial suppliers. Dozens of commercial systems are available which run on a full spectrum of computer systems (Martinich, 2008). Many commercial packages are available in software market, each containing various modules (Krajwski and Ritzman, 1996).

Companies often tend to buy software because a great deal of time is required to develop these programs and there is the possibility of making mistakes that will probably already have been corrected in a commercial package.

Obviously, the ultimate success of MRP system depends upon providing all of capabilities that will enable the individuals responsible for the material providing functions to meet their responsibilities and eliminating any elements that are unnecessary or counter productive.

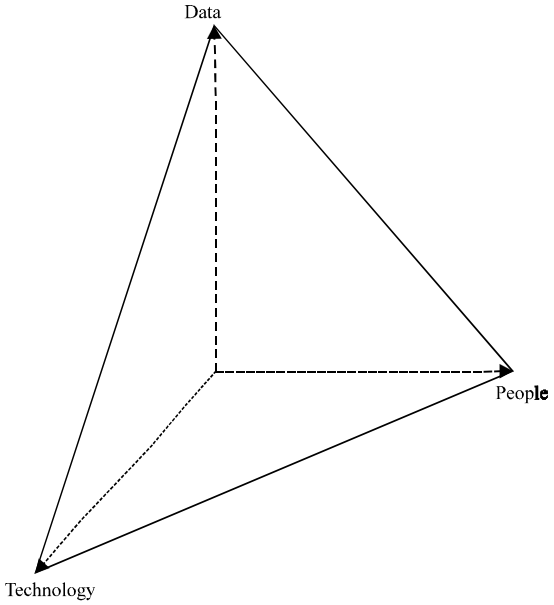

Fig. 2: People, data and technology relationship pyramid

By keeping it smooth and simple you can make MRP system work for you not against you (Schuchts, 1979). Practically, the success of an MRP system depends on good computer software and a close cooperation among all groups in the organization that will affect or be affected by MRP system.

A conclusion remark can be reached that the critical elements in MRP-type systems implementation success can be broken into the following three fundamental categories:

- People
- Data
- Technology

The relationship between these key elements can be represented by the generated pyramid which is shown in Fig. 2. Failure in use of any one of these elements can lead to ultimate failure of implementation and the degree of success of MRP system is represented by the volume of the generated pyramid.

Crucial activities of typical mrp-type systems implementation: When an Iraqi organization decides to implement an MRP-type system it undertakes a very complex project. This project requires intensive planning, preparation and teamwork involving persons at every level in the organization.

A typical successful implementation project in Iraq should include the following crucial activities:

First cut education: First cut education is prior to justification step. In this step the key people (top and operating managers) learn what MRP-type systems are how it works and how it might benefit the organization.

Justification: The aim of this step is to justify MRP system project which means to study whether the benefits expected to gain from MRP-type system implementation justify its costs or not. People doing the justification for the company should consider all of the areas and should come up with their own numbers. This is the reason that the key executives must have been educated. These are the people who will be responsible for making the commitment for the profit improvement that they can achieve using the new system.

Typically, the costs of implementing an MRP-type system includes the following categories:

Computer systems: Including the costs of hardware, software and systems work.

Data integrity: This includes the costs of preparing the data required for operating the system such as (bill of materials, inventory records, routing and master production schedule).

People: This includes the cost of time spent by all people involved in the implementation project, the cost of the education of these people and the cost of professional guidance.

Project leader: Since, MRP-type system implementation requires careful planning and coordination company resources then it is essential to establish a "steering committee" for the implementation project as the next step follows the justification step and taking the decision to implement MRP-type system. Normally it is important to pick a project leader to chair the steering committee. Obviously, project leader must be:

- One of the users not a systems person. The project leader should be the "champion" of the project throughout the organization
- One of the company people not an "outsider"
- The best project leader is one who currently has a title or position like materials manager or plant manager and has been with the company for many years, he knows the products, the problems and the people
- A project leader must be a full time not a part time project leader professional guidance

Professional guidance: Installing an MRP system successfully is a new experience for most of the people in any Iraq company. An outside consultant can say the right things to the management when they need to be said. However, experience has shown that very few companies are able to put an MRP system on the air successfully without some professional guidance.

Project plan: It is essential to establish a detailed project plan. This plan gives a schedule for all activities involved in the implementation project and represents a road map for implementing MRP successfully.

Education: Education is sufficiently a significant task in implementation project. The importance of education was discussed previously.

Regular management review: There should be a regular management review of the project plan with the top management people to make sure that the project is moving along the schedule.

CONCLUSION

There are three main approaches of production planning and control in practice; MRP-type systems, OPT and JIT. MRP is a planning system, JIT is a philosophy of management and OPT is a system that tries to prevent problems that might appear during execution. MRP-type systems are the most widely implemented in western countries and nowadays in many developing countries and China. MRP-type systems represent an effective technique to support manufacturing but the success of its implementation requires explicit management actions. Steps of implementation need to be clearly identified through an effective implementation plan.

In short, MRP-type systems cannot be implemented successfully without preparing its critical success factors first. The implementation of JIT involves many difficulties and problems that should be noted. Several conditions and supporting techniques must be available before implementing JIT some of them are related with external environments like suppliers and culture of people. Furthermore, JIT takes a very along time to implement.

OPT is the lowest influential technique according to comparative surveys. OPT ideas can be used to improve the effectiveness of MRP systems, especially when bottlenecks arise in the production process. Hence, MRP-type systems are the most practical choice for adoption in order to support manufacturing. JIT and OPT

can be used as supporting techniques to improve the effectiveness of MRP in the way that MRP provides the basic planning framework, JIT can be used as an execution system for shop floor control and several ideas of OPT can be useful for enhancing the work of MRP.

IMPLEMENTATIONS

Finally, to get an effective use of MRP-type systems in any manufacturing organization/s, we must ensure the successful implementation which cannot be achieved without studying the following:

- The concept of MRP-type systems
- The critical success factors for MRP-type systems implementation
- The environments of manufacturing organization/s in question
- Creating an implementation strategy

These points need to be studies deeply and carefully to establish a framework for developing production planning procedure in any industry especially in Iraq. Determining actual production requirements is difficult in the typical firms having large number of finished goods assembled from many thousands of subassemblies and piece parts. Some of the components may be purchased and others produced with many different lead times need to be considered.

Material Requirements Planning (MRP), combined with computer technology gave the most adequate successful computerized production requirement system. Success of implementing MRP-type systems is not automatic but it can be achieved only through intensive effort and explicit management actions. On the other hand, steps and activities of implementation need to be clearly identified through an effective implementation plan which must be prepared according to the environments of the industry in which these systems are to be implemented.

Obviously, MRP-type systems cannot be implemented successfully without preparing its three critical elements (people, data and technology). Practically, MRP-type systems may be implemented in different degrees of success and its implementation is an endless process because the successful companies continuously seek to improve their systems. In order to survive in today's business world, Iraqi companies need to control the components of the total costs and increase productivity, profitability and assets utilization. The main tool which these companies should use to achieve these goals is by improving the performance of their production planning and control activities through adopting the advanced formal production planning systems.

REFERENCES

Aghazadeh, S.M., 2003. MRP contributes to a company's profitability. Assembly Autom., 23: 257-265.

Anderson, J.C., R.G. Schroeder, S.E. Tupy and E.M. White, 1982. Material requirements planning systems: The state of the art. Prod. Invent. Mang., 23: 51-66.

Andreu, R., Sieber, S. and J. Valor, 2003. Introduction to ERP, IESE business school. University of Navarra, Navarra, Spain.

Ang, J.S.K., C.C. Sum and K.K. Yang, 1994. MRP II company profile and implementation problems: A Singapore experience. Intl. J. Prod. Econ., 34: 35-45.

Bartezzaghi, E., F. Turco and G. Spina, 1992. The impact of the just-in-time approach on production system performance: A survey of Italian industry. Int. J. Operations Prod. Manage., 12: 5-17.

Cheng, P.W., 1997. Effective use of MRP-type computer systems to support manufacturing. Master Thesis, Virginia Tech, Blacksburg, USA.

Clode, D.M., 1993. A survey of UK manufacturing control over the past ten years. Prod. Inventory Manag. J., 34: 53-56.

Evans, J.R., 1987. Applied Production and Operations Management. West Publishing Company, Eagan, Minnesota, USA., ISBN:9780314010384, Pages: 880.

Gaither, N. and G. Frazier, 2002. Operations Management. Cengage Company, Boston, Massachusetts, USA., ISBN:9780324066852, Pages: 811.

He, Z., M. Khalifa, M. Kusy and T. Zhao, 2005. A MRP II survey study of the Chinese manufacturing industry. Intl. J. Comput. Eng. Manag., 5: 24-39.

Heizer, J. and B. Render, 1996. Production and Operation Management: Strategic and Tactical Decisions. Prentice Hall, New Jersey, USA., ISBN:9780131994232, Pages: 900.

Hinds, S.W., 1982. Spirit of material requirements planning. Prod. Invent. Manag., 23: 35-50.

Hopp, W.J. and M.L. Spearman, 2001. Factory Physics: Foundations of Manufacturing Management. 2nd Edn., Irwin/McGraw-Hill, New York, USA., ISBN: 9780256247954, Pages: 698.

Hopp, W.J. and M.L. Spearman, 2004. To pull or not to pull: What is the question?. Manuf. Serv. Oper. Manag., 6: 133-148.

Krajewski, L.J. and L.P. Ritzman, 1996. Operations Management: Strategy and Analysis. Addison-Wesley Company, Boston, Massachusetts, USA., ISBN:9780130721228, Pages: 883.

Kumar, S. and D. Meade, 2002. Has MRP run its course? A review of contemporary developments in planning systems. Ind. Manag. Data Syst., 102: 453-462.

Lowe, J. and A.B. Sim, 1993. The diffusion of a manufacturing innovation: The case of JIT and MRPII. Intl. J. Technol. Manag., 8: 244-258.

Maertz, W.E., 1979. MRP's fourth requirement. Prod. Inventory Manag., 20: 81-84.

Martinich, J.S., 2008. Production and Operations Management: An Applied Modern Approach. John Wiley & Sons, Hoboken, New Jersey, USA., ISBN:9788126516094, Pages: 940.

Monks, J.G., 1987. Operations Management: Theory and Problems. McGraw-Hill, New York, USA., ISBN:9780070427273, Pages: 719.

Nah, F.F.H., J.L.S. Lau and J. Kuang, 2001. Critical factors for successful implementation of enterprise systems. Bus. Process Manage. J., 7: 285-296.

Reimers, K., 2002. Implementing ERP systems in China. Proceedings of the 35th Annual Hawaii International Conference on System Sciences, January 10, 2002, IEEE, Big Island, USA., pp: 3112-3121.

Salaheldin, I.S. and A. Francis, 1998. A study on MRP practices in Egyptian manufacturing companies. Int. J. Operat. Prod. Manage., 18: 588-611.

Schuchts, D.R., 1979. Give MRP a kiss: Keep it smooth and simple. Prod. Inventory Manag., 20: 68-80.

Silver, E.A., D.F. Pyke and R. Peterson, 1998. Inventory Management and Production Planning and Scheduling. 3rd Edn., Wiley, New York, ISBN: 9780471119470, Pages: 754.

Stevenson, W.J. and P. van Ness, 1999. Study Guide for use with Production/Operations Management. McGraw-Hill, New York, USA., ISBN:9780071158565, Pages: 912.

Sum, C.C. and K.K. Yang, 1993. A study on manufacturing resource planning (MRP II) practices in Singapore. Omega, 21: 187-197.

Swan, J., S. Newell and M. Robertson, 1999. Explaining national differences in the adoption and design of collaborative technologies for operations management. Proceedings of the 32nd Hawaii International Conference on System Sciences, January 5-8, 1999, IEEE, Piscataway, New Jersey, USA., pp: 10-11.

Vonderembse, M.A. and G.P. White, 2004. Operations Management: Concepts, Methods and Strategies. John Wiley & Sons, Hoboken, New Jersey, USA., ISBN:9780314063403, Pages: 845.

Wacker, J. and F.S. Hills, 1977. The key to success or failure of MRP: Overcoming human resistance. Prod. Inventory Manag., 18: 7-16.

Wight, O.W., 1981. MRP II: Unlocking Americas Productivity Potential. Oliver Wight, Europe, ISBN:9780843608205, Pages: 518.

Zhang, L., M.K. Lee, Z. Zhang and P. Banerjee, 2003. Critical success factors of enterprise resource planning systems implementation success in China. Proceedings of the 36th Annual Hawaii International Conference on System Sciences, January 6-9, 2003, IEEE, Hong Kong, China, ISBN:0-7695-1874-5, pp: 1-10.

Zhao, X., F. Lai and S. Young, 2002. A study of manufacturing resources planning (MRPII) implementation in China. Intl. J. Prod. Res., 40: 3461-3478