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MRP IMPLEMENTATION ON SUPPLY MANAGEMENT PROCESS: A BRAZILIAN FURNITURE INDUSTRY CASE STUDY

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ABSTRACT

This paper presents a case study of the implementation of a materials planning tool in a furniture industry, located in Goianira, state of Goiás, Brazil. The technique used was the MRP (Material Requirements Planning). The work was developed based on the process improvement identification, which includes: cost reduction in inventories, greater effectiveness in the production process, and better information accuracy. Based on these requiredments, was executed the MRP implementation, based on internal personnel allocation, and related Organizational Changes required. As a result of this project conclusion, satisfactory results were obtained in: materials flow control, cost decreases on raw materials stocks and purchases. This paper included the use of quantitative demand forecasting techniques, preparation of furniture production structures (BOM – Bills of Materials), and steup into the MRP function in the enterprise ERP (Enterprise Resource Planning) application: production batches, minimum inventory and safety levels, and lead times to raw materials supply.

Keywords:
Furniture Industry, MRP (Materials Requirement Planning), Stock Control.

1. Introduction

From mid-twentieth century, the industry entered in an era of unprecedented automation. Much of the labor force was engaged in activities that not only included production. Thus, the high-tech systems played an important role, since the evolution of technology led to great advances, initially in the 1970s by automating repetitive tasks, such as implemented in administrative systems. Later, in the 1980s, with the development of hardware (and hence also software), companies started to use computer applications in support activities such as sales force automation, MRP-II (Manufacturing Resource Planning) and others. Specifically in the production and operations management, significant contributions hapened during this period, such as Just-in-time (JIT), Statistical Process Control (SPC), Quality Function Deployment (QFD), Kanban, concurrent engineering, among others. In the managerial dimension, two new concepts have also contributed to the production management: Lean Production and the SCM - Supply Chain Management (FLEURY, 2000).

Before the MRP and MRP-II, was used a technique based on quarterly requests, that was specified by George Plossl and Oliver Wight in 1967. Basically, the concern with the demand predictability became more evident from the World War II end. At that time, many companies had competence to carry out its production plans based only on firm orders. There were a huge demand, mainly due to existing recession during the war, which caused many sales orders unattended, or with partial services, getting, in some cases, backordered for up to eighteen months. To minimize this mismatch between production and demand, were initiated sales forecasts on a quarterly basis (WIGHT, 1995). This method of demand planning was present mostly in European and also in American companies, however, did not occur in the same way in Japan that, by the need to rebuild the country, to face economic sanctions and policies imposed in the postwar period, and to deal with basic structural difficulties, had to adopt methods and techniques to bring appropriate and aligned results, consisting of low cost and high quality products and services, thus minimizing the trade-off between these traditional competitive priorities (FLYNN and FLYNN, 2004). Therefore, some scientists were invited to work in Japan to spread the concepts of quality. Among them was William Edwards Deming, who in 1950, began to teach the its process statistical course for entrepreneurs and Japanese leaders. Deming work brought results that culminated in the operations management, into the rise of Lean Manufacturing, whose automaker Toyota was the main precursor, naming it as "Toyota Production System" (MAXIMIANO, 2007).

In parallel to this fact, the US quarterly demand forecasts were based on pending orders. In the late 1950s and early 1960s, with the shortage of sales orders, companies begin to produce to stock (make to stock), anticipating the future demand. In this mode, Wight (1995) cites three basic elements required for an effective production control system:

- The demand forecast should be defined in terms of units, and be associated with the production capacity;
- There should be in place a production plan or a preliminary forecast;
- There should be applied procedures to control materials stock repleshinment levels, deciding at what speed they should be adjusted to estimated values, when there are deviations (or errors) of demand in order to avoid shortages or excesses.

In the 1970s, with the information technology development, computers had capabilities to do random access to data, which allowed that the MRP was used in the calculus for determining components and raw materials needs, from a given demand. Thus, the first company to develop an MRP system in batches (or asynchronously) was the American Bosch Company in 1959. In 1961-1962 the first replanning system was designed in the JI Case Company under the direction of then production manager, Dr. Joseph A. Orlicky

(WIGHT, 1995). In 1965, GR Gedye stated that, to optimize profits, companies should:

- Minimize lost time, thus maximizing the use of resources involved in the production process;
- Respect the customers orders delivery dates, adapting them, if possible, to their production process;
- Keep the minimum stock levels of goods in process, and lower inventories of finished goods to a minimum, required, since this does not impact the previous two goals.

The MRP concept has spread, especially in the United States and Europe, where changes were included in the model, mainly to get information of capacity requirements, and also to do a more reliable cost approach. These developments culminated in the 1980s, with the emergence of MRP II (Manufacturing Resource Planning), replacing the traditional MRP, the production management system that has been deployed by more companies since 1970.

Thus, this article was based on a case study in a furniture industry, with products for offices use. The project was designed around the MRP system implementation, covering all these steps, since the need collection for the studied industry, until the MRP implementation is completed.

The deployment project required five months to obtain the results, considering the system in operation. Briefly, it can be seen clearly the importance and the benefits that a material planning system brings to the industry, regardless of this enterprise industry sector.

2. Methodology

Peters (2010) state that companies that focus both on processes value increasing and in the ineeficiencies avoidances, are adopting some of the most important approaches to improve business performance in recent decades.

Additionally, Rother and Shook (2003) point out that a value stream, composed by essential activities by which a product passes, are competitive value sources that can be expanded to a broader framework, in which there is not only individual processes improvements, but also in a systemic and global scenario.

In this sense, Marconi and Lakatos (2002) explain that a problem must be formulated clearly and objectively. Thus, the problem addressed in this paper is summarized in the following question:

> ***What benefits can be obtained by a Furniture Industry due to a succesfull MRP Implementation, specifically on a Brazilian Market context?***

Within the context of this work, the basic assumptions of this article are:

- A MRP tool can improve production flow and decrease intermediate stocks needs;
- A MRP can provide a better understanding of the demand nature, thus reducing the number of sales backorders;
- A MRP can provide a better level of information, which can be used as basis to decision process.

To Silva and Menezes (2000), a research can be classified in four ways: on the nature, approach method, objectives nature, and on the technical adopted procedures.

Regarding the first level, the research nature can be classified as basic, or applied (SILVA and MENEZES, 2000).

This work is an applied research which objective is theoretically discuss the concepts, característics and benefits of a MRP Implementation. From this point, evaluate a case study in implementation a MRP solution into a Brazilian Company, components of a Furniture industry.

Related to the problem approach, a research can be classified into quantitative or qualitative (SILVA and MENEZES, 2000). This article, because of the characteristics and techniques used, falls into a qualitative research. This is due to the data interpretation inductive method, and main focus being the process and its meaning, beyond the researcher's role as a key element.

As for the research objectives, it can be classified, according to Silva and Menezes (2000), as exploratory, descriptive or explanatory. This research has characteristics of a predominantly descriptive research because it involves literature search and a case analysis of the application of these concepts identified in the theoretical foundation.

Regarding technical procedures, the research can be bibliographical, documentary, experimental, survey, case study, research ex-post-facto, action research or participatory research (SILVA and MENEZES, 2000). This paper consists of a case study because it considers the application of the concepts of MRP in an implementation of production processes into a furniture producer company.

The choice of case study is contingent and convergent with the nature of the problem, and the current state of knowledge. The following considerations justify the mehtod choice:

- This study focus in the application of a MRP principles into a furniture production process, specifically in the production planning and schedule;
- Based on this study characteristics, case study proves to be the most appropriate approach for the proposed research. As suggested by McCutcheon and Meredith (1993), Yin (1989) and Eisenhardt (1989), this approach is typical for scenarios where an empirical approach will be applied;
- Research these lean production principles application on a specific manufacturing process requires the researcher to place the events in a chronology, to determine causal connections. By doing this, the case study becomes the initial basis for such causal references (YIN, 1989).

This work intends to support the relevance of the concepts presented in the literature on MRP with the practical application of these concepts in productive environment. The contribution is the analysis of the results, the method employed, and the direct relationship of the benefits achieved compared with that described in the literature. By the characteristics of research and appropriateness to theme, it is justified to study the theme.

Thus, this work was developed through qualitate research. For this, was iniatilly done a literature review to examine broader topics related to the main subject, and enable the researcher to get more information on the issues related to it. Was also carried out a research with field case study in one Brazilian furniture industry. This case study was segmented into: data collection and analysis of these data; and was also done a proposal with MRP implementation process improvements in the company.

3. *Material Requirement Planning* (MRP) and *Manufacturing Resource Planning* (MRP-II)

Before defining characteristics and components of the MRP and MRP-II, it is important to highlight the role of information technology (IT) that, according to Fleury (2000), contributes effectively to business proceesses optimization, especially regarding transactional operations, focusing on the acquisition, processing and data sharing.

Hunter and Westerman (2009) indicate that IT is adding value in two specific ways: it allows greater assertiveness in decision-making, obtained by better information quality; and agility on production processes, which increases efficiency.

Towill *et al.* (2002); Zhang and Zhang (2007) and Lee *et al.* (1997b) point out IT as enabler for information sharing, not only in the business environment, but also in the management of supply chains. Such integration is reached through the use of technology in practices such as JIT (Just in Time) and ECR (Efficient Consumer Response) which, according to Lee *et al.* (1997b), provided potential reduction of $ 30 billion in a chain of grocery products analyzed.

In the lexical meaning, technology is presented as science or treatise on crafts and arts in general, or the application of scientific knowledge to general production (MICHAELIS, 2015). In many circumstances, the interpretation of the term technology is associated with the implementation of technical activities and the generation of technical products, the focus of the practice of specific skills. However, these are not complete visions of the term technology (FERREIRA, 2002). Abreu (2002) presents an evolution of the technology concept, which argues that it is "a set of tools or tools system by which we change part of our environment, derived from human knowledge, to be used for human purposes." In this sense, Ferreira (2002) points out that this new concept is an improvement on the traditional technology view, whose main landmark is the industrial revolution, which presents as an invention to improve the human life quality, to a vision of combining physical and process knowledge to transform material into final product.

Under these technology categories is the Information Technology (IT), which, for some authors, is one of the enablers elements for the development and establishment of extended enterprise operations in the last two decades, like supply chains (MABERT and VENKATARAMAN, 1998; HULT *et al.*, 2004), both in support and sharing information, and in competitive coordination efforts (FROHLICH, 2002; WU *et al*., 2006). Additionally, companies like Amazon, Dell, Honda, Procter and Gramble, Wallmart use IT solutions to immediately share data on inventory levels, and integration flows among its key suppliers (LEE 2004; CHOPRA and MEINDL, 2009).

Festa and Assumpção (2012) complement, stating that the use of IT in logistics activities management "causes changes in processes, improving asset utilization, generating higher productivity and quality / consistency in operations, reducing waste and delivery times." This statement was supported by the results that the authors identified in a study showing that IT enabled lower transport costs and improved customer service level, achieved through a better operational performance, and greater reliability in transports.

Fawcett *et al.* (2011) argue, however, that if IT is not used with a strategic focus, it can not bring the expected returns, not creating a competitive advantage for the company, precisely due the fact that communication and information technologies are mostly accessible for most companies, and their use can be imitated.

McKone-Sweet and Lee (2009) state that two IT related skills should be developed in the enterprise: exploration and extrapolation:

- Exploration is, according to the authors, the use of IT to improve operational efficiency (eg .: order processing, information exchange and inventory control), and thereby reducing the variability of business processes;
- Extrapolation is, based on the authors, the IT usage to learn about the environment, and find new ways to create value to this company (eg .: market research, integration with partners), in order to understand the market changes and develop new ways to deal with such variations. Extrapolation generally involves innovation risks and acceptability, while expliration brings great standardization and control.

Another classification is given by Hunter and Westerman (2009), that is based on value creation concept, in which information technology contributes to two specific purposes:

- Best assertiveness in decision-making: comprising relevant information delivery, with higher quality, and less lead time;
- Optimization of business processes: obtained by efficiency increase, quality improvement, and functionality agility of the Company processes.

Premkumar *et al.* (2005) agree, suggesting that one of the key aspects of the organizational ability to process information is given by IT solutions. Tushman and Nadler (1978) complement this statement, indicating that formalized information systems are more complex, but facilitate organizational capacity in information processing.

Within the enterprise information systems available, MRP II, as being engine base for ERP (Enterprise Resource Planning) solutions, is one of the most used to support transactional business operations.

Historically there are efforts directed to develop solutions that could minimise downtime, adding effectiveness in planning and controling production operations, as stated by Friend (1992) and Huiskonen (2001). Several software applications used for this purpose were standalone functional applications – founded on MRP concepts, project management and shop floor control – interfaced and integrated for overall planning and scheduling approaches, currently available in enterprise resource planning (ERP) software solutions, as modules (SAMARANAYAKE and KIRIDEMA, 2012).

In this sense, the main objective of the MRP systems is to allow that sales orders deadlines be accomplished, with minimal inventories generation, planning that production components purchases occur only at adequade times, and also on the required amount (WIGHT, 1995). To make this feasible, MRP is based on production routes and on the product bill of materials (BOM).

Wight (1995) state that a MRP weakness is that other relevant production process items are not planned, as labor, utilities, and machine hours required. Additionally, the MRP had an internal scope within the manufacturing universe, because there was no integration of planning with customer demand, nor with the delivery forecasts suppliers, without considering the scope of distribution logistics and supply issues.

In the past, due to the low number of changes in the quantity and diversity of items being produced (arising from the existing low competitiveness at the time), a typical production plan was valid for weeks and sometimes even whole months. With advances in production methods and computers capacity, the MRP-II arose, whose basic principle is to calculate all needs for the production process, both materials, as also capacity items. Thus, the MRP II is a hierarchical system in which the long-term production plans (SO&P - Sales and Operations Planning) are successively detailed into the master production schedule (MSP), and culminating with components and machines (or workcenters) schedule (WIGHT, 1995). Thus, the MRP II incorporates RCCP (rough-cut capacity planning) on its functionality. In addition to capacity requirements planning, MRP II provides, according to Correa et al. (2007), distributed resources planning (DRP), which means the possibility of demand attendance by spraying needs for production in geographically different places.

At the end of the eighties, as an attempt to integrate existing information systems in enterprises, as well as a new business opportunity for the consultants, in part because of globalization, and partly due to increased productivity arising scale own technology, ERP (Enterprise Resource Planning) are increasingly used.

There are many definitions of what is an ERP. According to the APICS (American Production and Inventory Control Society) it is an extension of the planning manufacturing resources concept, that it is a new version of MRP II, modified and adjusted to support organizations in the face of increased competitiveness in the 1990s. Gumaer (1996) agrees with this principle, just adding that ERP uses new information technologies, such as relational database, graphical user interfaces, and open systems architecture. Within this contexto, the author include tools for finite capacity planning and manufacturing execution systems (MES). Some other authors such as Farley (1998) and Stevens (1996) state that the ERP goes beyond the planning centered on materials, labor and production, to support multiple subsidiaries while consolidating and supporting their operations. For Michel (1998), ERP is a generic term for "integrated systems to support business processes". Thus ERP systems allow that information contained in the system be visible and able to be accessed by all organizational areas. The scale of operation of an ERP can include support for a subsidiaries network, allowing that each one use metrics and particular procedures, but generating consolidated results, adherent functionality to the globalized economy need.

These applications consist of modules with functions to support the enterprise core businesses (Figure 2): manufacturing, trade, logistics and finance (BIO 2008). By concept, ERP is an integrated system in the sense that the information entered by an area have an influence on the other. Another feature is that the ERP have the backbone to MRP-II methodology for planning the necessary resources. Some reasons that provided that there was a demand for ERP systems were:

- The idea of using an integrated system, enabling the adoption of standardized procedures, allowing greater management control and lower operating effort;
- Decreased costs in information technology by adopting latest technology, and therefore support the application vendor itself.

The main direct benefit of this architecture is therefore the uniqueness of information, eliminating re-keying activities without added value to the business.

To Bergamaschi (1999) the largest expansion of the ERP market in the second mid of 90 occurred in Latin America (63%) and Asia / Pacific (68%), regions with rapid economic expansion at that time. Statistics show that although the process industries represent 40% of all industrial facilities, only 20% of sales of ERP systems were aimed at them. One possible explanation is that the MRP, the main component of ERP systems, is focused primarily on discrete manufacturing processes. Still, according to Bergamaschi (1999), the main suppliers of ERP applications are European, representing 45% of the total value of software license sold during 1997.

One reason of the ERP great success is based on its political and organizational aspects, as the dominant administrative practice at the end of the eighties was the business process reengineering, with the consequent outsourcing of activities and people. The ERP were aligned with this trend because they were based on best business practices, avoiding re-work with non-value added activities, such as the inclusion of the same data in parallel systems. Thus, many managers saw in the ERP an ideal solution to integrate their internal processes, leaving in background organizational aspects, such as culture, strategy and structure of the company.

Thus, the MRP had as main objective, the computational implementation of planning activity to identify materials needs, and production control within the ERP solutions. The calculation of the materials needs is defined by Correia *et al.* (2001, p.88) as: *"The concept of necessary materials calculation is simple and known for a long time. It is based on the idea that, if they are known all the particular product components and the related time to obtain each one, it can be possible, based on the vision of the future availability of the product in question, to determine the time and the quantities that will be obtained from each of the componentes, so that there is no shortage or surplus of any of them, in the supply of data needs for the production of that product ".*

The limitation of the current ERP solutions is, according to Samaranayake and Kiridena (2012), the lack of capabilities for simultaneous planning, dynamic forward planning, finite capacity and loading, due collegues various data elements (materials, operations, Activities, resources and suppliers) are not completelly integrated, nor in the process or the date level, neither into the unified structure. Thus, data structures are designed to support individual techniques to run in standalone environment, with limited capacity of interface and integration. As a result, these applications could still generate “out-of-phase” plans for materials, operations and resources. Additionally, Samaranayake and Kiridena (2012) state that lack of capacity for finite loading translates into possible resources overloading, and also on subsequent manual schedule adjustments.

In addition, improve the production execution is one of the Lean Manufacturing goals.

Lean manufacturing philosophy advocates lean production, and one of the methods used is the Just in Time, which is the use of inventories to add value to place and space, which means, o that the right goods are delivered in the right place, and at the appropriate time. The JIT is characterized by narrowing in relationships with suppliers, reducing the number of these suppliers and carriers, seeking greater partnership between purchasing and supply. With this narrowing, increase communication and participation of the supplier within the plant, there is a reduction of the possible uncertainties in input supply channels, thereby improving the level of service (BALLOU, 2001, p.314).

Organizations seek to reduce items in stock and to maximize lean production. In the 1970s the material planning (MRP) was already done, which used the production planning information to see the need for materials, parts and supplies, based on one known demand. So, Ballou (2001, p.317) state that “the purpose of the MRP, from a logistics point of view, is to avoid as much as possible items in stock. In theory, stocks would not be necessary if the amount of the product and necessary time were known ".

It can be observed that the stocks of the plants are kept high to fulfill orders within the time limits required by the customers. By contrast, companies absorb a high cost to maintain these high levels of stock, immobilizing capital and generating moving and storage expenses. MRP helps reduce these inventory levels (DIAS, 1993, p. 118).

MRP, however, does not use its calculation time and capacity requirements from resources. Thus, a need was perceived for development of wider modules, receiving the designation of MRP II. These include besides the calculation of need for materials, functions as sales planning, calculating the capacity requirements at various levels and the shop floor control (CORREA *et al*., 2007).

In this sense, Junior (2008) explain that “the MRP or MRP II obey the following process: search product types with their respective constant amounts of order or sales forecast portfolio, identifies lists each product materials, calculates the gross requirements and subtracts the materials contained in inventory records. From generated calculations, program purchase orders, the materials plan and work orders.

However, MRP and MRP II have significative difference, as the MRP is a simplified system, restricted to the calculation of material requirements, while the MRP II brings comprehensiveness in planning various activities of industrial production. The right time to request the materials must be reconciled with the time that this material should be available for production. As important as knowing the demand, is to know the time of resupply of each item, respecting the lead time of the supplier. So, based on Dias (1993): “The center of the whole system is the modulus of the gross requirements, which means, the product manufacturing by the materials master program lists. To these gross requirements can be added safety stocks, percentage of waste, etc. Once determined the gross requirements, they are consolidated for all common items that need component being planned. The following are discounted the physical inventory and purchase orders already placed or internal manufacturing work orders. "

The MRP uses the full explosion liquid product to minimize and reduce the quantities stored inventory shortages, and can be demonstrated as follows, according to Dias (1993, p.120):

- Sales Forecast – Material Stocked = Net Sales Forecast;
- Master Production Schedule x Bill of Materials = Materials Demand;
- Materials Demand + Physical Inventory – Sales Backorders = Materials Needs.

Some of the important objectives of the MRP is the labor productivity and preparation time reduction. The materials management must have the purpose of attend the customer in a best possible way, with the lowest inventory investment. Main factors that influence these goals are the poor sales forecast, and not feasible production master plan. It would be taken into account that the process of materials planning should be coordinated, as it involves many people, different and sometimes conflicting needs and interests.

MRP II is composed of modules that interconnect different functions of the Operations, as follows: Production Planning, Master Production Planning, Calculation of Material Requirements, Capacity Requirement Calculation, and Plant Control (CHAN *et al*., 2005).

According to Chan *et al.* (2005), there are more than one hundred MRP II solutions in the market, and many of them are solid and mature enough to solve most operational issues on enterprises. However, the authors state that many of these systems are built with functions which are not adherent to the company needs. For the authors, many companies faced failures on their MRP II implementations, mainly due to managerial issues than to technical problems.

The uncertainty of demand is problem for most industries, as to know what will be produced for a long period of time is what all aspire production managers. In general, real markets are such that competition offers delivery times smaller and smaller, forcing companies to also offer shorter lead times to remain competitive (CORREA *et al.*, 2007, p.98).

To avoid problems of lack of materials caused by the demand supply uncertainties, Correa *et al.* (2007) explain that many companies use safety stocks, which can be defined as “security parameters that, if required, should be reported to MRP systems, to be considered in the calculation by MRP II algorithms, suggesting purchase orders and production in order to maintain, at least in terms of planning, inventories of items in the defined levels.

The MRP II setup is intended to align the system operations to the enterprise processes, adapting the calculation of the MRP to the specific needs of the organization. As the needs and characteristics of the organization are always changing, it is also necessary to periodically review the parameter settings for that reality is reflected as closely as possible in the system.

The parameters of the MRP system is one of the most important activities for the perfect functioning of the system. In addition to basic information about the product structure and the process of lead time or provider, one should take into consideration some reality and circumstances of companies environmant. As an example, can be mentioned a supplier whose deliveries not allways are on time. In this case, normally the safety stock option can be adopted, an this parameter should be included on the system. .

Based on this, Correa *et al*. (2007) state that some basic parameters are essential for MRP operation:

- Product Structure: is the specification of the quantity of each item that make up each product, known as Bill of Materials (BOM);
- Dependend Demand Items: these are those items that make up the finished product, whose purchase depends on the customer orders;
- Independent Demand Items: under this category are consumer items, that are part of the production process as an input, and are not raw materials, stored on the basis of consumption history;
- Repleshnment Lead Time: the time spent between placing the order and receiving the material;
- Production run time: also named as cycle time, is the time spent from the beginning to the end of an finished good production;
- Production batch size: is the amount of certain item to be manufactured in order to optimize the process;
- Replacement batch size: is the quantity of a particular item that is acquired each time also, with a view also on cost optimization;
- Minimum stock: is the minimum amount that must be kept in stock, either raw materials or finished product;
- Maximum stock: the highest level of materials that can be kept stocked.

With the increasing need for knowledge of various business areas of the company, it has become essential the creation and integration of new controller modules into the MRP II, like financial management, purchasing, support sales activities, and talent management, generating the ERP systems (CORREA *et al*., 2007).

According tho Correa *et al*. (2007), an ERP system is aimed to support all information needs to the enterprise management as a whole, supported by modules that give the information required to decision making in sectors others than just those related to manufacturing: physical distribution costs, tax receipt, billing, human resources, finance, accounting and others, all integrated with each other and with the manufacturing modules, avoiding redundant data. Among ERP main characteristics and features, can be identified the following: packaged softwares, which decreases IT cost (mainly if used as an external unit, in a Cloud solution), use standard models of business processes (disseminates knowledge about best practices); are integrated systems, helping avoid re-work and inconsistencies; use enterprise databases, providing data standardization and uniqueness; extended functional scope, generating procedures standardization.

4. MRP Implementation in a Brazilian Furniture Industry.

4.1 – Implementation Process

In the current market scenario the competitiveness of the industry is key to the success of the organization. This depends on of several factors evaluation, such as investments in technology, human capital and integration of the world market.

As a means of increasing competitiveness, companies choose technological systems that seek to reduce costs and labor in the production process. The MRP and ERP systems are the most sought by industry, as enablers elements for better control, and cost savings.

The furniture industry of Goiás is in high growth, with furniture cluster located in Senador Canedo and other major industries scattered in the surrounding cities of Goiânia.

The company studied, named Company A, is acting for 15 years in the Market, and is located in the city of Goianira, Goias State. Company A has 600 employees and owns one of the largest revenues in the business. It is very competitive in bidding, and have public agencies has its major customers.

Before investing in expensive and complex systems such as MRP enterprise, the company should evaluate its needs, understand the benefits that this type of tool can provide, and must have trained and involved professionals to achieve advantage generated by these systems.

In 2012 the company decided to invest in the MRP system of Totvs, because Company A already had the ERP system of the same supplier, and acquired the MRP module in January of 2013, due the fact that the current solution was being redesigned.

At first, this module was of simple operation, and easy to be understood among stakeholders. The only need consisted of definition of the products bill of materials, and to setup the MRP.

As directed by the MRP module supplier, was organized an implementation project, in which key users defined steps to be taken to the MRP final implementation.

This organization combined productive resources, such as personnel, raw materials, equipment and capital. The project gave direction to the process of making concrete plans and targeted actions, assigning tasks to those involved and correcting deviations, when needed.

4.2 – Implementation Project

The deployment project requires a large involvement of key people who are key users who make the decisions about the parameters used, and very knowledgeable about the operation of processes within the company. The areas involved were the following responsibilities:

- Prroduct Engineering: Identify the demand dependent items that make up the structure of the finished material;
- Warehouse: Register the inventory items, paying attention to avoid failures as registrations with incorrect description and duplicate entries. Set the minimum and maximum quantities held in stock for independent items, based on historical monthly consumption;
- Purchasing: Set the lead time of the supplier for each input and raw material, to raise the minimum quantities and lots of shopping;
- Commercial: Deploy the client request with the information necessary for planning of materials, such as delivery schedule and receive location;

- PPCP (Planning, Programming and Control of Production): Determine the items for dependent and independent demand. Parameterize the system with the production times, time of purchased materials receipt, and delivery time to the client, all based on information from other involved áreas;
- Logistics: Determine delivery times and costs for all regions served by the company;
- Production: Calculate the manufacturing times and lots for each product. Define the waste rate per product.

The project milestones were determined for each area as above, and for each task was set a delivery time. All tasks finalized two months before the final system implementation. In this way the system was being tested during these two months, also making the appropriate parameter settings.

One of the observed facts is that all the information to be raised to get parameterize the MRP system must be reliable, because any discrepancy undermines the functioning of the control materials.

This was the biggest challenge faced by project involved employees. Necessary information had not the desired reliability, and many data were collected during the deployment project, not having the ideal history.

4.3 – MRP Structure on the Focus Company

The main objective of the company studied when it acquired the MRP module was to reduce the costs of raw materials unplanned shortages, reduce the cost of inventory and improve inventory turnover. During the project of MRP implementation, it was concluded that the company could reduce its raw material inventories by 30%, which represented R$ 1,050,000.00 (average of US$ 350,000.00).

The well-calculated demand forecasting, with rigorous grounding in customer orders was essential to reduce purchasing volumes and maximize the stocks of nature of dependent and independente items.

The first step was the correct survey of the components used by finished goods, considering possible waste and reuse of wood scrap. With these well-defined parameters, set up to ABC curve where the dependent items of higher consumption of the finished product structure, classified as Curve A, being other items of low consumption value classified into curves B and C, as stated by Table 1.

		Product:	**RAVENA TABLE**		
ABC	QTTY	UM	DESCRIPTION	UNIT VALUE	TOTAL AMOUNT
A	6	Ea	Corrediças	R$ 25,00	R$ 150,00
B	3	Ea	Puxadores	R$ 12,00	R$ 36,00
B	8	Ea	Cantoneiras	R$ 3,00	R$ 24,00
B	2	Mt2	MDF	R$ 5,20	R$ 10,40
C	4	Mt	Fita de Borda	R$ 1,30	R$ 5,20
C	2	Mt	Tubulação Metálica	R$ 2,00	R$ 4,00
C	2	Mt	Chapas Metálicas	R$ 2,00	R$ 4,00
C	18	Ea	Parafusos	R$ 0,05	R$ 0,90

Table 1: ABC Curve for Raw Materials – Product Ravena Table

The items of Curve A in the general table represent all products used in industry, and requires more attention from the involved areas. In addition, the safety and the minimum stocks were better defined, with safety margin intended that the other items of the curves B and C, as these are more expensive items, parameterized in order to avoid faults and excesses in stock. In this parameterization process, suppliers were heavily involved in the delivery and lead times, treated with rigor, under fines and other contractual penalties, if the deadlines were not met.

Independent items were also classified in the ABC curve, but the parameters defined for them were based on the last semester consumption history. Independent items that made up the Curve A had their defined minimum stocks based on monthly consumption and minimum inventory of items of C curve were defined based on quarterly consumption. Thus avoided is small, frequent purchases of low-consumption items and value and increased the frequency of purchases of smaller batches of high consumption and value items.

The demand forecast was frozen in three weeks, in which the production schedule remained unchanged, thus creating a better control of purchasing and production planning. In some cases the demand was changed within these three weeks, but it happened only in extension requests and never in anticipation thereof.

Starting the MRP planning materials since the implementation of the client request until completion of the production of this application, materials planning and production processes of the company studied are presented as Figure 1.

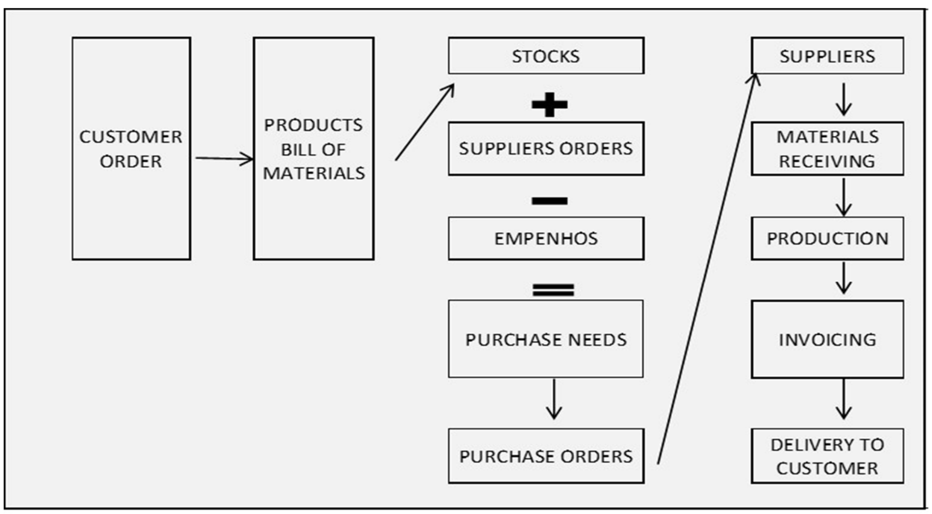

Figure 1: Company A MRP Process

The MRP process in the studied company works as follows: when the seller deploy the order in the system, it is calculated how much material that application will consume. This calculation is done by the product bill of materials, then the system checks whether the quantities in stock meet the demands of that request. This includes what already have been in backorder from the manufacturer, and subtracts the materials that were already booked for consumption in another client request, which is called in Figure 1 as "empenhos". If the calculation of these materials have a positive end result, the system does not generate purchase requirement. If the calculation arrives at a negative account are generated purchase requests and purchase orders are issued to supply this missing quantities, to meet the customer's request. After this purchase process, the material reaches the factory, is produced, billed and delivered to the customer, thus closing the supply chain cycle.

4.4 – Suggested Improvements

During the MRP implementation process in the furniture company, were appointed some deviations that could be corrected before the final system implementation, which are:

- Registrations of same products with different descriptions: Some products have been registered in duplicity and had different descriptions, to correct this failure was chosen the item with the same description used by the supplier and the other registered item was obsoletado system. In parallel was drawn deleting the item obsoletado of all product structures and exchanged for the item with the correct description;
- Reduction of the variety of items held in stock: Some items were very similar and could be used for the same purpose, so when finalized the entries of the items. Similar items were selected and kept only the most relevant item in stock;
- Waste Adjustment: The waste in the production process were calculated with a very high margin, which generated stock accumulations. It was suggested testing during the production process this real waste and then set out the parameters of these calculations per product;
- Lead time vendor Setting: The lead time parameterized for each supplier was done through the buyer's knowledge, and demonstrated a mean change of three days in the actual delivery time. This change represented an increase of safety stock and consequent excess stored material. To adjust this deviation, the parameters of the lead supplier of teams through results obtained with the actual lifting of all deliveries of all suppliers in the last semester. Thus the errors were corrected, and the lead times were parameterized as close as the real;
- Independent Items defined as dependents: Some items were inserted in the structure of the finished product and demonstrated hard inventory control and purchasing. These items are basically: carton, tape and solvent to remove the glue. These products show much variation in consumption by the operator, is consumed up to 60% difference between an operator and others. Thus, they found items with a very large variation in consumption and consequent deviation in the accuracy of inventory, since these items have a fixed quantity consumed in the production order. To stop this misuse of stock, the items were parameterized as independent demand items and their purchases were planned based on the history of half-yearly consumption, regardless of the customer's request.

5.Final Considerations

During the two months of MRP monitoring the test phase, improvements were suggested which were pointed out above. Some changes happened after the MRP system was already in operation, among them the correct structure of some products and waste percentages. After five months of MRP run, the following results were measured:

- 25% reduction in the volume of purchases;
- Reduction of 95% in the delivery delay indicator on the client;
- Reduction of 28% in stocks of raw materials;
- Reduced storage costs by 12%;
- Reduction of 62% in the missing raw materials;
- Negotiation of prices with suppliers, reaching up to 12% drop in the prices;
- Reduction of 8 employees who carried out the shopping tasks and planning material

In addition to these measurable improvements, was found improvements on the customer service level, based on their feedback. Suppliers' delivery times was also improved, as supply contracts were made, and the relationship between the company and its suppliers has been narrowed.

Based on all the data that have been raised and all the results can be seen the importance of an MRP system within industries, these results can be achieved by enterprises of any industry.

The MRP II brings even more improvements that the MRP, as results found after its implementation on the focused enterprise. In addition to determine the need to materials, MRP II can also schedule the production, calculating all manufacturing times, and allocation of output per machines.

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