A Development and Implementation of Manufacturing Resource Planning System for Small and Medium Enterprises

[1]Vita Kogan and [2]Morley Maria
[1,2] School of Business, Kazan Federal University, Kazan, Republic of Tatarstan, 420015, Russia.
[1]koganvita32@aol.com, [2]morelyma@kpfu.ru

Correspondence should be addressed to Vita Kogan: koganvita32@aol.com.

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Abstract – Material Requirements Planning (MRP) refers to a system of management practices where production planning is integrated with inventory control. According to this paper, we have been able to make significant progress toward a revised Manufacturing Resource Planning (MRP II) system. During the application of the MRP II database, it was also considered how much dataset might be obtained using reports. MRP II database creation in MS Access software is covered in steps 1 and step 2 of this research article. This paper refers to the MS Access software to create a database that incorporates the theoretical knowledge and suggested a custom MRP II solution. In this paper, a three-step technique as a research methodology to formulate and apply a customized MRP II model was used. For the creation of a custom MRP II system database, this paper employed the MS access application over other commercially known software. With MRP's core idea, we should be able to schedule just what materials are required and when. The relevant literature has also put significant emphasis on technical issues, e.g., the ineffectiveness of MRP frameworks for optimization of the internal workflow.

Keywords – Material Requirements Planning (MRP), Manufacturing Resource Planning (MRP II), Small and Medium Enterprises (SMEs)

I. INTRODUCTION

In the world of production today, an efficient manufacturing enterprise (whether large, medium, or small) is dependent upon the precise and accurate planning of resources e.g., capacity, labor, processes, tools, machines, and materials. Over the past few decades, various enterprises have adopted various manufacturing systems based on their organizational resources and activities. According to a study in [1], Small and Medium Enterprises (SMEs) are significantly behind their larger counterparts in particular manufacturing and development setting, mostly in developing nations because of a poor economy and scarcity of resources. Without deploying one of the Model Predictive Control (MPC) systems, a business in today's industrial environment is doomed considering the level of competitiveness. The deployment of MPC systems can be fulfilled using quantitative method and the systems approach. The quantitative method includes Reorder Point (ROP), Statistical Inventory Control (SIC), Aggregate Production Planning (APP) while the systems approach includes MRP, Hierarchical Production Planning (HPP), Optimized Production Technology (OPT), Enterprise Resource Planning (ERP), MRP II, Period Batch Control (PBC), Period Batch Control (PBC), Hybrid MPC system, Just-In-Time (JIT) production and Constant Work-In-Process (CONWIP).

During the 1960s, the operative MPC framework identified as MRP was developed and used as a successful inventory approach in a foreseeable demand context. Mobile phone and airline firms were the first to use the MRP approach. For the last ten years, the manufacturing sector has realized that the MRP framework requires critical transition on the based of how it conceptualizes other production resources other than material planning. There were several significant developments in the 1980s resulting in a new system approach (i.e., MRP II) [2]. There are multiple modules, which have been introduced in an MRP II system that look at various aspects of a company's resources, including manufacturing routes, production schedules, and work center capabilities as shown in **Fig. 1**. These modules include Cost management/reporting (cost control), Standard Costing (cost control), Capacity Requirements Planning (CRP) or Capacity Planning (CP), Material Requirements Planning (MRP), Purchasing Management, Inventories and orders (inventory control), Manufacturing technical data or Production resources data, Shop floor control (SFC), Bill of Materials (BOM) (technical dataset), Item master dataset (technical dataset), and Master Production Schedule (MPS).

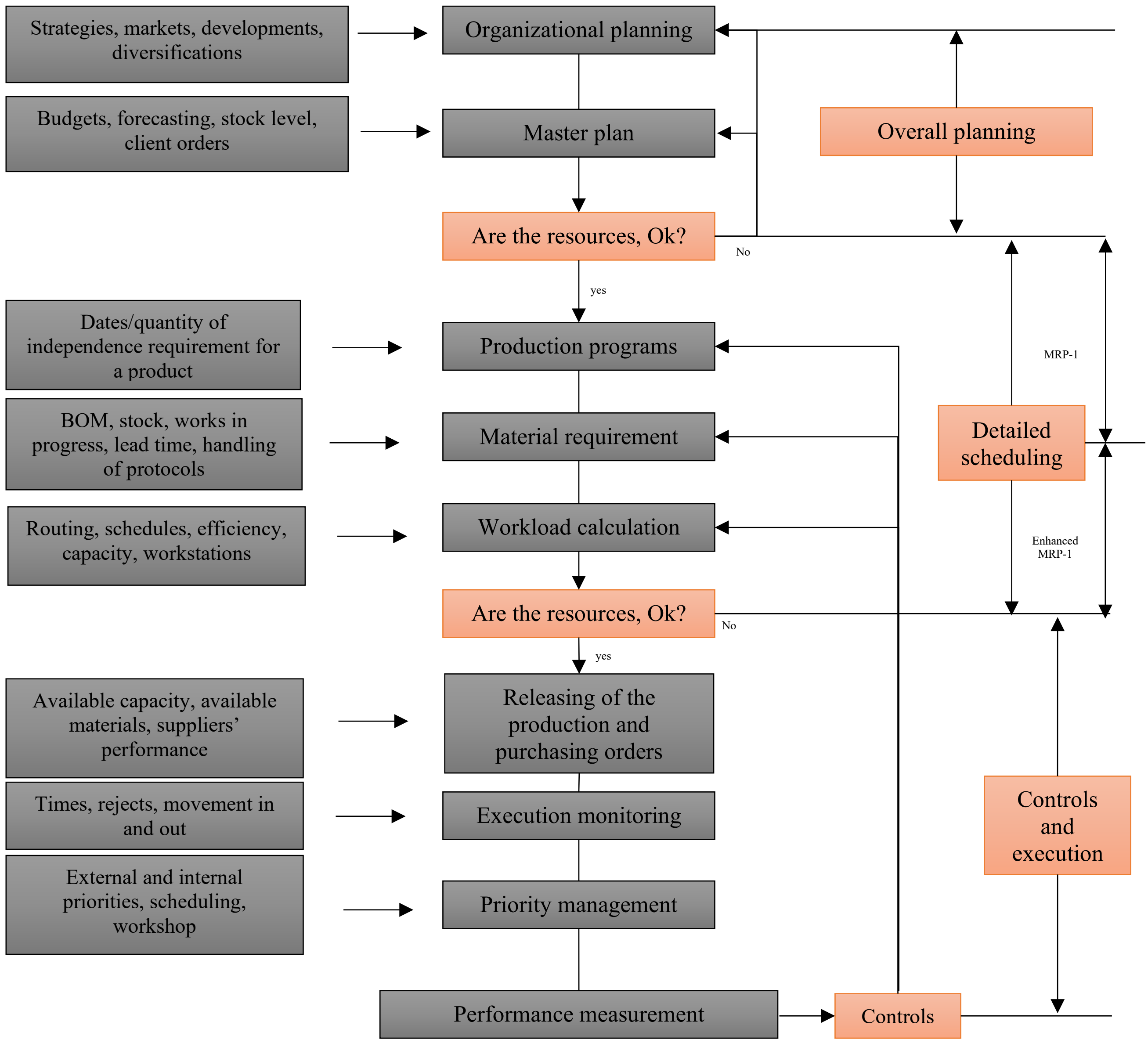

Fig. 1: Various modules of the MRP II

MRP II is an approach for the efficient planning of all the resources in a manufacturing enterprise. Due to the fact that MRP is a database planning tool, it has been dubbed "Closed Loop MRP" by authors in [3] because of its MRP closed-loop feedback feature. Corporate planning, production planning, capacity planning, shop-floor control, human resource planning, marketing, and purchasing are all linked together in MRP II's approach to integrating business processes. As a scheduling network-based management system, MRP II promises to assist individuals to operate their businesses successfully, toward high production levels and satisfied customers, and services, and at the same time minimize inventory and product/service costs.

An MRP II system consists of a series of interconnected modules, each of which has a feedback response mechanism so that an MRP II system identifies three primary planning and control strategies for a company's overall system: Strategic Planning, Tactical Planning, and Execution. A company's primary goals and objectives are defined and set in strategic planning (also identified as top management control), and then specific actions are taken to achieve those goals; tactical planning (also identified as the operational management control) guides putting those actions into action. Execution planning, often known as "operation management execution," encompasses not only the purchase and production plans, but also the actual demand production, shipping, and delivery actions. Modules in the MRP II system may also be divided into three categories based on the length of the planning period: long, medium, and short term. To ensure that information/data flow seamlessly from the top to bottom levels of the MRP II system, all of its modules are interconnected.

This paper focusses on a research study of MRP II system in a SME manufacturing environment. In this paper, the system is considered a vital reclamation tool for small manufacturing firm. Section I focusses on introducing the MRP II system as a methodology for planning and organization of resources, as well as identifying and defining the modules attached to it. The remaining part of the paper is organized as follows: Section II defines the key terms used in this study. Section III provides a critical review of the relevant literature texts. Section IV focusses on the study of the Manufacturing Resource Planning (MRP II) System in real SME manufacturing environment. Lastly, Section V draws conclusions to the research and provides directions for future directions.

II. DEFINITION OF TERMS

Material Requirements Planning (MRP)

Material Requirements Planning (MRP) [4] refers to a framework of management practices where production planning is integrated with inventory control. In other words, MRP is about using computer software to plan, track, and automate production processes across various departments in the organization. MRP systems can be either centralized or decentralized. Centralized MRP focuses on tracking material and resource usage at the central location, while a decentralized approach does not involve any centralization of data. The following (in **Table 1**) provides a brief description of four types of MRP.

Table 1: Types of MRP

Types of MRP	Brief description
Demand-Driven MRP.	Demand-driven MRP is simply a system where inventory levels exceed demand (or vice versa). A good example would be a company that sells widgets to make money. In this case, they have high inventory levels compared to their sales volume. Their goal would be to reduce their stocks, to maximize their revenue. If they were to do this, then they can use demand-driven MRP to accomplish this. Demand-driven MRP is best suited for companies who sell products in bulk. These types of businesses generally have high demand, therefore low inventories. On the contrary, companies that deal in small units per sale, such as restaurants, tend to have higher inventories than sales.
Time-Driven MRP	This is a method that uses the time to determine a company's stock requirements. An example would be a factory producing cars. When a car passes inspection, it goes out the door. Therefore, the factory does not need to keep any cars on hand. There are two advantages to using time-based MRP. One advantage is that it helps the user avoid having excess inventory. Another advantage is that it prevents shortages since the factory knows how much production it is going to get every month.
Lead Times	Lead times are based on the lead time, which is the amount of time between when client orders are received and when materials arrive at the manufacturing facility. It determines the length of time a manufacturer has to produce an item before shipping it to a buyer.
Critical Path Method.	The critical path method refers to the sequence of events that takes place within the company that influences the completion of products. Critical path methods are used for determining the correct flow of work and ensuring that nothing slips past the deadline.

Manufacturing Resource Planning (MRP II)

To manage the field of manufacturing efficiently, we need to understand how to effectively use MRP II principles. In addition to having basic operations knowledge, it's beneficial to have some understanding of MRP II to manage your inventory levels and plan production schedules. MRP II is a planning tool used to manage manufacturing activities (i.e., materials and services) throughout the entire supply chain. MRP II uses enterprise resource planning software to track various processes and activities. For example, if the enterprise wants to run a project management system, it would create a Project Management System using MRP II. There are three types of MRP II systems as shown in **Table 2** below.

Table 2: Types of MRP II systems

Types MRP II systems	Brief descriptions
Master Data Management Systems	A master data management system tracks customer information and product information. A master data management system records customer-product information. You might use this type of system if you sell products directly to customers via a website. One advantage of this type of system is that it is flexible. Another advantage is that it is simple to set up and maintain. However, it doesn't allow you to control each transaction. As a result, you might not be able to adjust your prices based on what happens during certain times of the year.
Master Production Scheduling Systems	A master production scheduling system provides tools to help you plan and execute manufacturing projects. Unlike master data management systems, these tools focus on the entire supply chain rather than just customer/customer relationship management. This type of system is often used in industries where companies make many diverse products and/or operate across multiple locations. An advantage of this form of control instrument is that it helps you plan across multiple sites. Many of the systems are web-based, meaning they can be accessed from any computer. This makes it easier to collaborate between users.
Master Inventory Control Systems	A master inventory control system focuses on managing inventory at a specific location. These systems typically only work with physical goods. If you're running a retail store, for example, you could use this system to keep track of inventory at your stores. You might use this system if you receive shipments of products from suppliers. The advantage of this type of master inventory control system is that it helps you control costs. By tracking inventory, you'll know exactly how much money you spend on products and services.

III. LITERATURE REVIEW

Evolution of Manufacturing Environment

According to Thürer, Fernandes, Haeussler and Stevenson [5], control systems and planned production have evolved significantly during the previous half-century. Inventory management has been done manually since the 1960s, when methods including stock repurchases, reorder points, EOQ, and ABC classifications were used. According to Matsuura and Tsubone [6], in the mid-1970s, some experience had been accumulated with Material Requirements Planning (MRP) as well as the significance of Master Production Schedule (MPS) had been recognized. The authors offer a history of production control in their work.

It was the 1950s when the first commercially available MRP programs supported the generation and management of master data for all goods and components, as well as a bill of materials (using demand-based 14 planning). It was possible to handle a large amount of data with these early programs, but only at a limited level of sensitivity. From the 1940s through the early 1960s, material management was based on simple 'order point' calculations that were employed to maintain an average inventory level. To address four issues referred to as the Universal Manufacturing Equation (UME), Milanovic, Milanovic, Misita, Klarin and Zunjic [7] recommended a novel approach to material management, dubbed MRP, in 1965.

According to [8], the MPS, BOM (Bill of Materials), as well as the real inventory records may provide answers to the first three inquiries. While MRP was a step forward from manual procedures, it was far from a final product. Equipment and human resources at a manufacturing facility, which isn't part of the Universal Manufacturing Equation, also have an impact on a company's output capacity. Manufacturing Resource Planning (MRP) uses a time-phased order release mechanism to ensure that all necessary components arrive on time at the assembly station. Product costing, marketing, and other business operations were added to MRP as competition increased and users became more knowledgeable. Closed-Loop MRP, the second generation of the MRP system, was introduced in 1975 and uses input on production status to keep planning choices valid even when needs change over time. The monetary perspective was still lacking from the production decision-making chain, and this was critical. Effective shop floor scheduling tools have previously been developed using top-down Manufacturing Resource Planning (MRP II) methods for directing productivity processes in the early 1980s.

In [9], the operative Closed-Loop MRP planning that was delivered in the materials unit e.g., pieces and pounds, was converted into dollars so that the who firm may operate a uniform dataset. The 'what-if' planning difficulties may be addressed with effective solutions using a simulation capability. MRP II's primary purpose is to integrate important operations (such as manufacturing, sales, and financing) as well as other activities (e.g., purchasing, engineering and personnel) in the process of planning to enhance the production enterprise's effectiveness. Manufacturing shop feedback and capacity planning on the shop floor are some of the new features of MRP II.

When MRP II programs were accessible on small and microcomputers in the 1980s, the number of MRP II installations was greatly increased. As with MRP I, the focus of MRP II was on the industrial operation. Then, MRP II was enhanced to integrate technical elements of product development and production. CIM's complete proposed model for manufacturing organizations may be used to combine financial management, sales & distribution, and human resource management. As computer costs dropped, just-in-time (JIT) manufacturing techniques emerged in the late 1980s as the next step in MRP II's growth. There have been several PPC systems and ideas established during the last 60 years. Customer Relationship Management (CRM) and Supply Chain Management (SCM) are two terms that may be used interchangeably or separately. The former refers to the management of materials needs, the latter to the management of manufacturing resources.

Material Requirement Planning (MRP)

Hasanati, Permatasari, Nurhasanah and Hidayat [10] divided the development of MRP into three distinct realms to describe it. In the first realm, MPS goods are generally completed, made-to-stock products; MPS is defined based on projected item demand deciphered to a succession of manufacturing systems through staged arrangements or regulations. The MPS may theoretically be described as finished products made fully to order in a second realm. This strategy might be effective if reaction time were not a concern. Competition, however, often calls for quicker turnaround times, thus some storing of at least the commodities with the longest lead times happens. To create an end product, which may have several distinct varieties, a relatively large number of various components are integrated. The third MRP ream has all of the second realm's intricacy plus the extra challenge of producing huge numbers of finished products from smaller numbers of raw materials.

Numerous rules must be established for the MRP system. Permitted sizes, rejected allowances, and safety stocks are a few of them. The MRP is based on three concepts, which include time phasing utilizing data on lead times and demands, netting inventories with organized deliveries, as well as open orders purpose to issue a balance on-hand, as well as demand dependencies for the finished goods. Data on inventory, Master Production Schedule (MPS), Designed BOM for the MPS, open orders and lead times are the three fundamental MRP inputs to the system.

According to Gelders and Van Wassenhove [11], minimizing inventory costs and maintaining customer service standards are the goals of MRP systems. One advantage of MRP is its capacity for quick planning and scheduling adjustments in reaction to the transitions in the dynamic ecosystem. It is adaptable and mindful of the demands of the client. Wuttipornpun and Yenradee [12] has investigated the benefits and drawbacks of MRP (material requirement planning), as well as its primary flaws. They look at the negative effects of the flaws if they are not fixed. Several variables (see **Fig. 2**) may be responsible for the challenges that businesses have faced while using MRP.

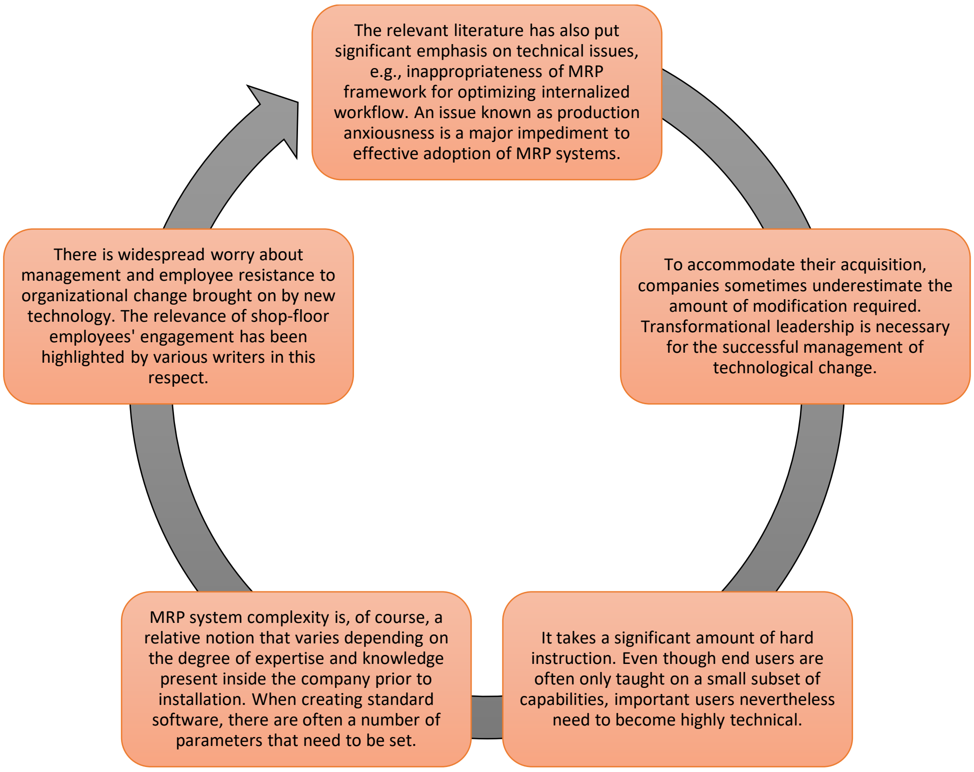

Fig. 2: Several variables responsible for the challenges that businesses have faced while using MRP

According to considerable literature and conference materials from firms such as American Production and Inventory Control Society (APICS), Material Requirements Planning (MRP) has gone out of favor in the 1980s [13]. The efficiency of MRP has been seriously questioned in Japan. It is widely assumed that the main reason so many firms are still using MRP is because of the complexity of transitioning to a different system. With MRP's core idea, we should be able to schedule just what materials are required and when. Product customization is made easier with MRP.

MRP's most glaring flaw is its overemphasis on worker productivity. Our primary resource is not labor, but rather materials, which are the most crucial to our success. We must reduce the number of routings and, as a result, the length of the lead time. We need to use safety capacities (machine and labor capacities) instead of safety stocks in our buffering strategy (materials capacity buffers). To maximize efficiency, we should reduce the number of non-value-added processes. Time and high batch size are also major contributors to inventory.

Manufacturing Resource Planning (MRP II)

The theoretical framework of MRP II have widely been researched in literature, with emphasis on the idea, methodology, application, and future developments. It is founded on the principle of combining the plans of sales, finance, and operations to regulate all flows of materials and commodities. Master Production Scheduling (MPS) and Rough-cut Capacity Planning (RCP) are two examples of how MRP II concepts may be used in business planning. For a firm to be successful, it must first define its goals. The sales, finance, and operations strategies are all included in the company plan as a whole. Calculating the firm's expected net income is based on the anticipated total revenue, the anticipated costs of operations and sales, and all the costs of every planning period. An annual planning horizon is common and a month or more is required for planning. Resource Requirements Planning (RRP) is used to determine how many resources are needed for a certain aggregate production plan to be realistic. What-if questions can be answered using MRP II's simulation capacities and integrations with the operating framework as well financial framework. It is possible to alter the business strategy and start a fresh simulation to determine the new resource needs if it leads to unrealistic or unacceptable resource requirements. Once a workable and satisfying business strategy has been established, these processes may be repeated. Master production scheduling relies heavily on the aggregate production plan, which has been approved by the end user.

MRP II tends to connect manufacturing, marketing, engineering, management, and finance. It also tends to connect the operations of production, e.g., inventory production control, capacity planning, master scheduling, and purchasing with manufacturing planning as well as sales, logistics, production, engineering, and auxiliary tasks, which are the main components of almost every manufacturing organization. Order entry, sales analysis, forecasting, and customer service are all possible additions, along with financial applications. A single information control system, on its whole, distributes data across numerous applications for mutual gain. At the planning level, MRP II functions in a "pull" fashion. It is utilized for early capacity estimates as well as high-level organization of inventories and demand functionality.

For the MRP II application procedure, Kim and Hosni [14] devised a master plan, which incorporates innovation and management of strategic components e.g., problem analysis, MRP II resolutions, procedural layout, application administration, and management of the many stages of the application procedure. With simulation capabilities and operational planning in units, MRP II should be able to answer "what-if" queries. To put it simply, it is a collection of interconnected systems that includes everything from strategic business planning to detailed production schedules to detailed inventory management to detailed resource planning. Financial reports, e.g., business strategy, purchase commitment reporting, chipping budgets, inventory control in financial terms, and so on, will be combined with the outputs from these platforms. MRP II is an advancement of MRP and is a direct result of both of these processes.

IV. SME MANUFACTURING ENVIRONMENT FOR STUDY

The author chose to conduct his investigation in an actual SME manufacturing setting. In this research study, a custom-built MRP II system is shown for a small manufacturing firm that specializes in tool reclamation. This small business employs around 45 people and has an annual revenue of about £1.5 million. It has three primary manufacturing lines, each of which produces a wide range of items with a turnaround time of two weeks. Welding, milling, grinding, fitting, and inspection are all subprocesses of each manufacturing line. Drills, end mills, and milling cutters are some of the most often purchased goods. Three employees work for a firm that uses Equinox and Opera software to manage manufacturing lines, major goods, and client requests as well as financial statistics.

Research Methodology

This paper involves a three-step technique as a methodology to structure and implement the customized MRP II model. MRP II database creation in MS Access software is covered in steps 1 and step 2 of this research article. The first covers a conceptual MRP II system design for a chosen SME. An SME must put in place a custom MRP II system and see success. Following an in-depth investigation of the company's management needs and production environment, the author proposes a customized MRP II system architecture based on the findings. An MRP II system tailored to the needs of a Small Business (SMB) is then developed using the conventional MRP II system as a guide.

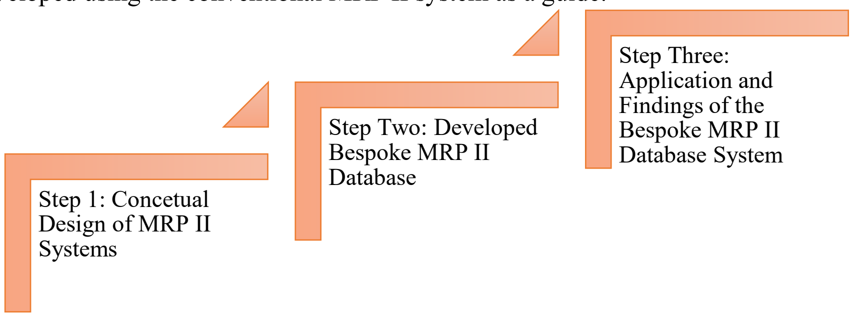

Fig. 3: The three steps of the research process

There are various forms of databases; however, the most typical one is a relational database, which organizes and links data in an orderly fashion. This paper references MS Access software to create a database that incorporates the theoretical knowledge and suggests a custom MRP II solution. Visual Basic for Applications (VBA) and Structured Query Language (SQL) are only a few of the application elements that MS Access is built on. These elements aid in the systematic creation of databases and the Related Database Management System (RDBMS). An assembly MRP II database in MS Access established by authors in [15] proved this point. Instead of utilizing any other software, this article uses MS Access to create a custom MRP II database framework for a tool reclamation firm because of the product's ease of use, rapid availability, and inexpensive purchase cost. MRP II database is contrasted to the present software and experimented in the real working environment of an SME firm by the author with good results. One by one, the subsections below discuss each phase of the research process shown in **Fig. 3** above.

Step 1: Conceptual Designing of the MRP II System

Both MRP and MRPII (as data integration business process techniques) use a central database to store, retrieve, and distribute the company's business data. MRP focuses on raw materials, while MRPII coordinates the complete manufacturing process, comprising all of the aforementioned elements as well as financial and human resources. MRPII aims to offer consistent datasets to all members involved in the process of manufacturing as the product develops down the line of production. Paper-based data, and non-integrated computer models, which provide disk or paper output, result in various data errors, as well as missing data, numerical errors, which occur from erroneous keying into the system, redundant data, wrong computing according to the errors, as well as erroneous decisions based on incorrect or outdated data. Some datasets are untrusted in non-integrated models because the same set of data is classified differently in different databased employed by various functional domains.

As with any MRPI system, Material Requirements Planning (MRP) is the first step in the process. Customers' orders may be entered into MRP, as well as sales estimates from the marketing department. Because of this, raw resources are necessary. MRP and MRPII frameworks rely on master production planning, which provide a breakdown of certain schedules for every product on the line. A precise production plan that takes into account machine and worker capacity and schedules production run following the delivery of materials is made possible by MRPII, whereas MRP provides from a planning of raw materials purchase. MRPII generates a final schedule for manpower and equipment. It is possible for accounting and finance to get information from the MRPII system regarding the whole production cost including materials consumed, worker time, and machine time.

An integrated organization data framework identified as the Manufacturing Resource Planning (MRP II) has been developed for use by companies. Material Requirement Planning (MRP) systems progressed from their predecessors by including more data, e.g., budgetary and personnel demands, into the process of planning. The system is meant to consolidate, integrate, and analyze data for optimal decision-making in planning, design engineering, inventory control, and cost management in manufacturing. Predecessors of Enterprise resource planning (ERP), a method through which a corporation organizes and integrates the most critical aspects of its business are both MRP and MRP II. Planning, buying, inventory, sales and marketing, human resources, and finance are all integrated into an ERP management data system. Many big apps have been created to assist corporations in implementing ERP, making it the most often used term in this context.

MRP II is a computer-centric advancement, which can develop exact manufacturing plans that use real-time information/data to synchronize the arrival of component supplies with the availability of the machine and human resources. MRP II is extensively used as a stand-alone system, but it may also be integrated into larger enterprise resource planning (ERP) platforms. As an addition to the initial Materials Requirements Planning (MRP) system, MRP II provides additional functionality. MRP (materials requirements planning) is one of the earliest software-based integrated data systems meant to increase efficiency for enterprises. According to the assumptions of machine and manpower units needed to meet sales forecasts, the Materials Requirements Planning Information System (MRPIS) uses sales forecasts to arrange raw material deliveries and quantities. Manufacturers discovered in the 1980s that they required software that could integrate with their accounting systems and estimate their inventory needs. There was a solution in the form of MRP II, which contained this feature in addition to all the others included in MRP. MRP II can only be modified to a limited extent by firms that concentrate on manufacturing and fabrication rather than assembly. The suggested SME-specific MRP II system design framework is compared to the standard current MRP II system, all while keeping in mind the production environment of an SME. The details may be found in the sections that follow.

Demand Management Customer Related Files (DMCRF)

Several files are necessary to maintain track of client batch orders, such as the name of the customer's firm, delivery address, contact information, date of order, shipment date, and batch amount. Clients, orders, and order details are all files that the author believes are vital to connecting.

Rough Cut Capacity Planning File (RCCPF)

A RCCP file is needed to keep track of the company's capabilities, including the processing time, shift per day, time per shift, utilization, action, and efficiency data linked with production machines. Creating this file allows the SME to acquire a better understanding of their manufacturing environment and production performance since it contains information on both automated and manual equipment (such as CNC milling).

Master Production Schedule File (MPSF)

The product code, descriptions, unit cost, and marketing mix must all be kept in the product master file. As a result of this document, the author hopes that the firm will be able to keep track of its most important goods, such as end mills and tool holders. As sub-tools for final tool/product manufacture, no component file has been created for this application's needs.

Capacity Requirements Planning Routing File (CRPF)

The CRP tool uses a capacity planning model to determine how much product can be produced at any given time. It then determines the number of days it takes to produce the amount of product based on the production schedule. When using the CRP tool, there is a routing file outputted that contains information about how the product is going to be delivered to the customer. It is important to create a routing file to easily use the CRP tool. This document outlines the steps used to complete the final product. Additionally, this file displays each setup's time and procedure for each key product. All of the operator's data is also included in the route file.

Shop Floor Control (SFC)

The Shop Floor Control (SFC) framework is a basic setup that consists of sensors connected to a central controller via a network. A sensor is a device capable of measuring something and reporting back its measurement to a computer. There are many different types of sensors including pressure sensors, motion detectors, vibration sensors, humidity sensors, and temperature sensors. When a sensor reports data to a controller, it is called reading. For the controller to understand what the reading means; it must have information about how the sensor works. For example, if a sensor measures the temperature inside of a room, then the controller must know what temperature range the sensor covers before it can use the reading to determine whether to turn on an air conditioner or not. Three important reports that provide information on buying, inventory management, and production control are included in this module. Each report is produced when data is seamlessly transferred from the demand management program/modules to the planning of the capacity requirements.

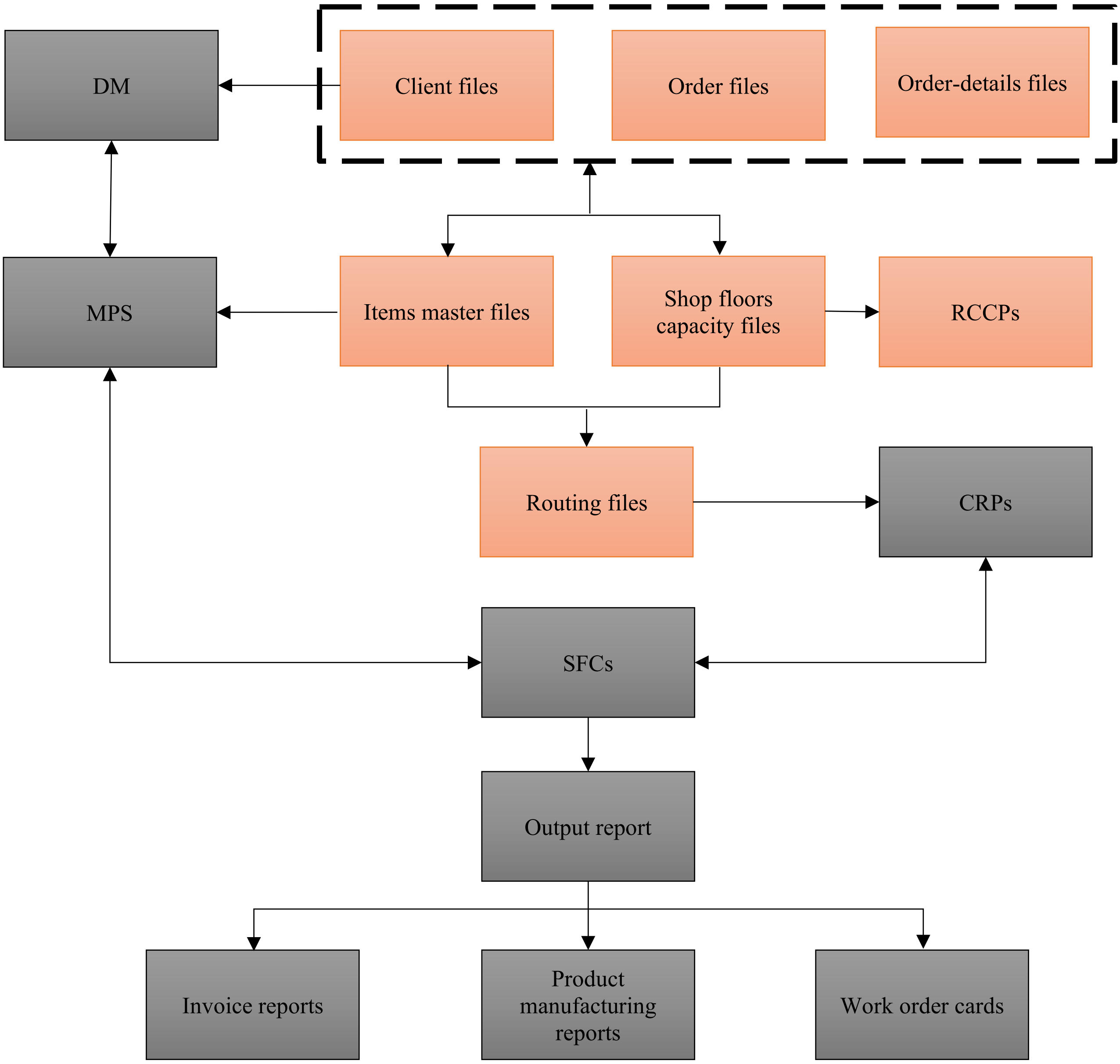

Fig. 4: The Bespoke-MRP-II model

Step 2: Improved Bespoke MRP II Database

The usage of the application, which should yield to a reduction in costs, minimal operational complexity, as well as prompt access, was a crucial step in this research study. The proposed SME now uses Opera software for account data and Equinox application for the manufacturing sector that is operated by 3 employees each. For the creation of a custom MRP II system database, this paper utilizes the theoretical framework of the MS access technological advancement over other software. This choice resulted in a notable labor cost reduction as well as cost minimization. This section now discusses the general structure of the MRP II database. The 10 main files that make up the developed database are connected via the one-to-infinity ($1:\infty$) referential veracity protocol of RDBMS. MS Access ensures adequate data upkeep and guards against data duplication and incorrect input. With the aid of the VBA, SQL, and Macros software, it was feasible to construct a human interface database system after configuring the tables, interfaces, and reports.

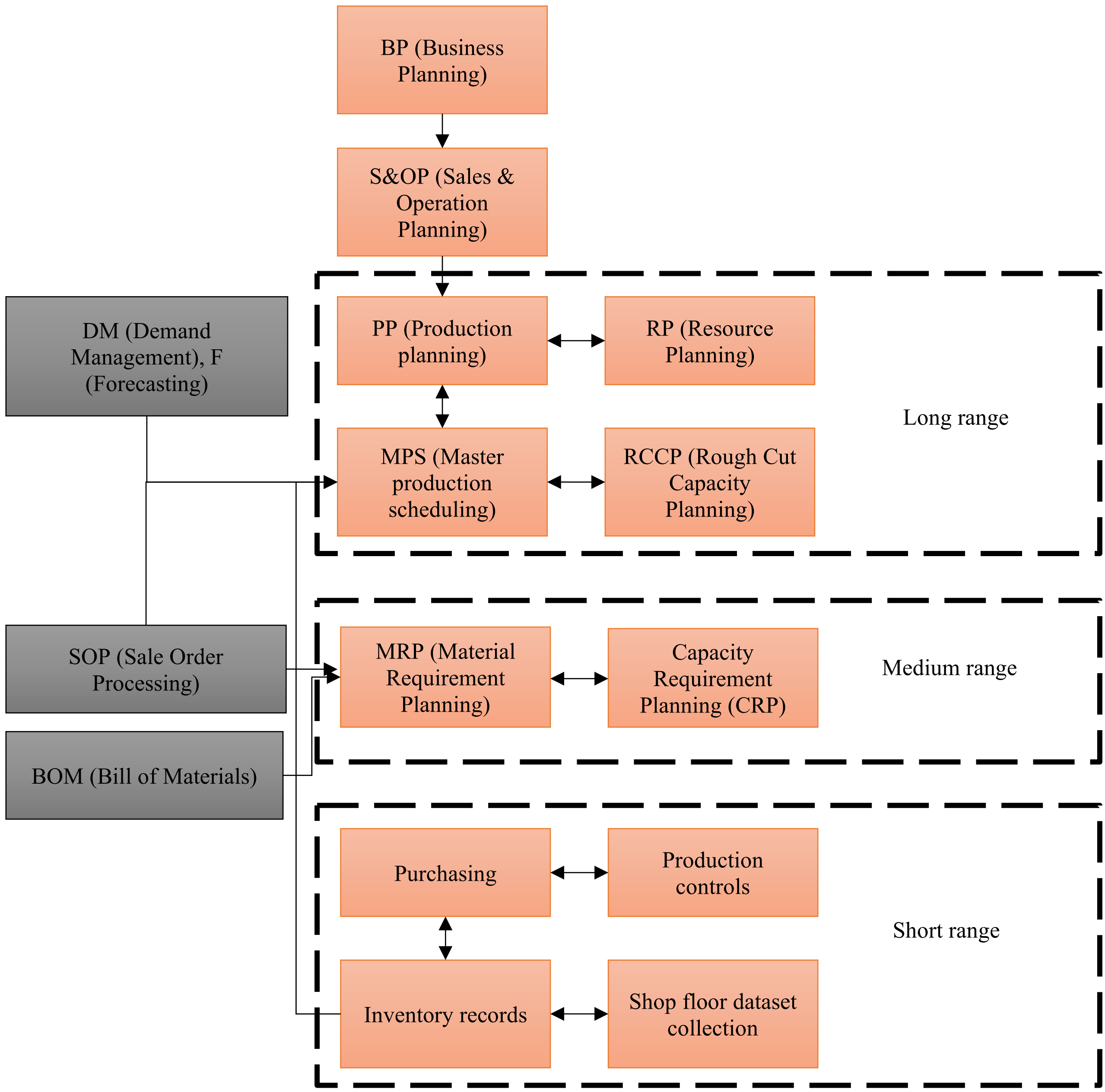

Fig. 5: Standardized MRP-II model

Step 3: Application and Findings of the Bespoke MRP II System

The MRP II model structured by SMEs was employed into the firm's present manufacturing infrastructures. The employment of the database lead to a vital cost, time and labor savings. As a result, it eliminates the need for five separate employees to handle both production and accounting. In addition, MS Access replaces Equinox and Opera, two separate programs. Researchers found that the database was successful because it could be used by a large number of people with little or no training and with less qualification than Equinox and Opera, which necessitated specialized training. These were the main differences between MRP II and other software available on the market. In simpler terms, the user does not need any help understanding it.

When the MRP II database is launched, the user is greeted by four helpful command buttons on the Switchboard Form, which is an example of the first screen that appears. During the application of MRP II, it was also determining how much information/data might be collected through reports. Additionally, it was also determined that executives have access to the most data through reports that were not feasible to the firm's existing databases. However, workers and managers did not have access to Equinox's reports on CNC program codes, batch production times, or special guidelines, for example.

Integrating Modules

As illustrated in **Fig. 4**, the paper's new MRP II system for a small business uses the integration of all the specified modules to provide three critical reports. Some essential components are missing from the newly constructed MRP II system (**Fig. 4**) when compared to the regular MRP II system (see **Fig. 5**). It was considered that a lean MRP II framework was fundamental for the SMEs under consideration. BOM is considered an illustration of the manufacturing process, which define the manner in which assembly processes amount to development of finished goods, and identifies process sequences and sub-tools required to build the final product example. There is no need for this information in the routing files of the customized MRP II framework since the SME is not involved in the assembly procedures.

To make matters worse, the SMEs do not deal with the different quantities and lead times of the elements such as shims, insert ad filler rods sub-tools operating as manufacturing instruments, which are all employed in the final product. This makes implementing an MRP file difficult. Because a single filler rod might be employed for many products and a single product might need anywhere from three to six filler rods, it is impossible to quantify the gross or net required for the components. The technique uses historical demand data and product demand forecasts to generate the gross future expected demand. There are significant variations between the conventional MRP II system and the customized MRP II system when it comes to the capabilities offered to LEs and SMEs. Considering the advancement of a single MPC framework using MS, a lot of implications may be derived. Working on modules like DMCRF, RCCP, MPS, BOM, MRP, CRP, and SFC in the MRP II system allows for system adjustments. Even though ERP, OPT, and JIT systems provide greater advantages, many studies believe that MS Access may be used to execute MRP II in small or big firms with an acknowledge diversity of resources and cost efficiency. As a result of the present effort, we have been able to make significant progress toward a revised MRP II system.

V. CONCLUSION AND FUTURE RESEARCH

A growing number of Small and Medium-Sized (SMEs) Businesses have come to recognize that implementing Model Predictive Control (MPC) systems, such as the Manufacturing Resource Planning (MRP II), is critical to their future growth and success. There are several MRP II systems on the market, as well as significant purchase prices and setup fees, which prevent many SMEs from installing them. As a result of this research study, an in-house, low-cost, lean, and custom-tailored MRP II system may be developed for a small manufacturing company. Only one person was needed to design and install this lean system in only two months using open-source software, according to data. The present lean MRP II framework that is operated by one operator, can efficiently handle the current production environment of the SME organization. However, the present research was not able to complete the task of accumulative planning. A novel accumulative planning framework for the MRP II database should be implemented so the firm can determine the number of batches to be processed in a single data as well as the type of batches to be planned for the following day. We highly urge that this research be carried out in design and development for future years so that an advanced, dependable, and adaptable MRP II system may be developed without any obstacles.

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