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Inventory Management using Demand Driven Material Requirement Planning for Analysis Food Industry

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Abstract:- Supply chain system is one of the main factors that need to be considered in the rotation of industrial processes. Manufacturing industry is a real example of an industry that relies heavily on the smooth supply chain system to ensure the smooth production processes and business processes of the company. The main problem facing the sauce industry using traditional MRP systems includes performance in the form of bad maturity dates, stock levels that do not match actual market requirements and overall system instability which causes inefficiency. However, achieving this goal is a challenge in today's dynamic production environment because traditional systems of planning and manufacturing control cannot develop this context. Inventory management as a component in the supply chain system that continues to evolve to adjust technology needs. Demand Driven Material Requirement Planning (DDMRP) is one of the latest innovations in inventory management. The development methodology of the MRP aims to address and handle material management needs more efficiently. By comparing before and after, an analysis was conducted on the management of the sauce industry material. The results show that the use of DDMRP can increase visibility in the supply chain. In addition, inventory levels experienced a savings of 53.5% while material consumption increased to 10%. Thus demonstrating the potential of DDMRP can improve system stability and product availability.

I. INTRODUCTION

The upward trend and the development of the economy in Indonesia has made competition even tighter in all manufacturing and service sectors. One of them is in the food and beverage industry. The growth of the food and beverage industry helps economic equality because the majority of perpetrators are in the SME / SMEs sector. Small Medium Enterprise (SME) is a part of a large proportion of the economy and is considered as a growth engine in developed and developing countries (Boocock&Shariff, 2005).

These SMEs / SMEs play an important role in the economic industry throughout the world. Moreover, they need to upgrade their performance to achieve economic, social and environmental improvement (Cherrafi et al. 2016). This shows that the industry has a big role in Indonesia's economic growth. In addition, exports of food and beverage products including palm oil in 2017 have a positive trade balance compared to 2016. The figure reached US $ 31.7 billion (detikfinance, 2018).

According to MotaMonge et al (2010) explained that visibility is key in supply chain management because it increases operational efficiency, prevents the effect of running out and increasing the productivity of resources. In addition, visibility increases the effectiveness of the planning process, reduces inventory levels, and improves delivery performance

Customer satisfaction increasingly depends on logistical success achievement factors such as Lead Time (LT), service level and delivery grace period. It is also emphasized that comprehensive inventory management is very important in achieving these goals (Lutz et al, 2003). In addition, according to Bower and Hout (1988); Christopher (2012); Amirjabbari and Bhuiyan (2014) and AlaitzKortabarria et al (2018) suggest that a reduction in the order cycle causes the main source of competitive advantage, because it directly affects the level of customer satisfaction.

According to Orlicky (1974) MRP allows companies to improve the quality and effectiveness of planning and scheduling dependent demand items. By creating a more credible schedule and due date by linking the maturity date of the component to the date of the needs of the parent item. The result is that MRP helps create an integrated system where changes at any level will produce potential changes at other levels.

The logic of material requirements planning (MRP) was first implemented in 1961 (Plossl, 1994) and because it has become the foundation for planning and controlling raw materials in environmental production now. It was shown to prevent capacity problems at the MRP calculation stage using the integrated MRP approach and capacity planning. There are several research work that addresses this issue.Evolusi*InventioryManagement*berlangsungcukup lama danbertahap, beberapaistilah yang cukuppentingdiantaranyaadalah*Bill of Material Processor* (BOMP) yang dibuatoleh Gene Thomas dari IBM padatahun 1961, *Material Requirements Planning* (MRP) padatahun 1964, *Manufacturing Resource Planning* (MRPII) padatahun 1980, *Enterprise Resources Planning* (ERP) padatahun 1990 danpadaakhirnyadikenal*Demand Driven Material Requirements Planning* (DDMRP)

padatahun 2011. (Ade S.B danXanty A.P, 2013).

The middle class sauce industry is currently experiencing difficulties in carrying out production planning, the company has difficulty controlling the level of performance in accordance with maturity. Thus, resulting in activities that are disturbed almost every day around factories and warehouses. One of the reasons is in terms of planning the production needs of finished goods, the company in planning production still uses assumptions based on historical experience so that it still uses traditional equipment, which is at risk of mismatches in demand and unavailability of goods. The absence of a policy to anticipate fluctuations in unknown product demand.Plus the absence of optimal procurement methods, in order to overcome the excess and lack of inventory.

Material Requirement Planning (MRP) as one method that can be used as a planning for raw material needs of SMEs / SMEs in handling inventory and control of raw materials, as well as being able to plan production needs. However, the MRP is only used to produce proposals for finished goods rather than making components for semi-finished products along the Bill of Material (BOM). Besides the results of manual work, it often only gives less optimal results. In addition, production function performance is measured by focusing on the output value of finished goods. This encourages planners to minimize "unproductive" time caused by set up and cleaning.

The result is that batch size is often too high with regard to actual demand and production lines that are occupied too long by work orders and provide unnecessary stock to produce the actual product needed. The purpose of this paper is to identify a series of policies and procedures that are appropriate in establishing effective and efficient production planning and control functions in the middle-class sauce industry.

According to AlaitzKortabarria et al (2018) explained in his writings in the last century, many Manufacture Process Control (MPC) systems were developed, the most extensive being Material Requirement Planning (MRP), Just in Time (JIT) and Theory of Constraint (TOC). Ade S.B and Xanty A.P 2013 explained in his research that this was the basic concept of DDMRP. DDMRP that is run effectively and precisely will increase product prices, product value, accelerate distribution, reduce industrial waste and streamline company inventory.

II. OVERVIEW MPC

A. Material Requirement Planning (MRP)

Beginning in the early 1970s, material requirements planning (MRP) was widely adopted by manufacturing organizations which was seen as "a new way of life in inventory production and management" (Orlicky, 1975). Material requirement planning (MRP) is a technique used to plan the needs of components and raw materials needed in accordance with MPS (Smith, 1989). However, because computer technology is still quite expensive, popularity needs to be seen as around 700 applications in the mid-1970s (Orlicky, 1975). One of the main influences of the MRP is on the planning process of manufacturing companies, due to the fact that only finished products need to be planned based on estimates or historical data.

MRP considers a bill of material (BOM) to identify demand for semi-finished products and raw materials based on demand calculated for finished products. The concept of this dependent demand according to (Wight, 1970) is seen as the most influential component of the initial MRP system because it frees manufacturing organizations from the requirements to plan and control inventories at all BOM levels. MRP requires a main production schedule (MPS), realistic times, correct inventory levels and valid Bill of Material to calculate materials, components and assembly requirements (McGaughey and Gunasekaran, 2007).

This allows for the use of the MRP system not only to calculate demand but also to schedule manufacturing orders on the shop floor (Shehab et al., 2004; Olhager, 2013 and Mathias Ihme 2015). Following a higher level of use, the MRP system and the underlying data are augmented and enriched to enable a further level of functionality including capacity requirements planning, labor calculations, distribution management (Robinson, 2006; McGaughey and Gunasekaran, 2007 and Mathias Ihme, 2015) . The transformation generated from the regenerative MRP system into an almost real supply of data makes it possible to better reflect the reality of the production floor (Ptak and Schragenheim, 2004)

APICS (2016: p. 110) defines MRP as a series of techniques using BOM data, inventory data, and Master Production Schedule (JIP) / (MPS) to calculate material requirements. By making a recommendation for the re-release of filling orders for raw materials.

Despite the fact that technology has evolved and market requirements have changed, the basic machinery used to drive information systems in ERP is still a traditional MRP system, developed in the 60s (Guide Jr&Srivastava, 2000; Chung & Snyder, 2000; Ptak& Smith, 2011; Wang & Liu, 2013; AlaitzKortabarria et al 2018).

B. MRP II

According to S.D.P Flapper et al (1991) MRP is an ideal mechanism for planning and controlling production activities, but is less useful as a mechanism to reduce costs and waiting times, and improve quality. Following the trend of the entry of more functions into the previous MRP system, the term MRP II was born which means manufacturing resource planning. According to Klaus et al. (2000), MRP II takes sales forecast as the main input to determine the production master schedule which represents gross primary demand.

The material management function is to calculate the demand for secondary products by considering demand and consumption-based information. This material is then considered in the capacity management stage to try to

adjust the demand to the engine. The production schedule is obtained by comparing the available resources and the appropriate schedule so that production orders can be used on the production floor.

Furthermore Framinan and Leisten (2012) explain the main value of this functionally can check how much certain material is available for immediate delivery or at a certain point in time. However, according to Landvater and Gray (1989), it has been identified that the number of functions integrated into the MRP II system is not directly related to its value to the organization.

C. ERP

In the early 1990s, Wylie (1990) coined the term corporate resource planning (ERP) which was originally created by Gardner Group. This system evolved from its predecessor, MRP II, by providing functions for all chain values (Shehabet al., 2004; Siriginidi, 2000; Mathias Ihme 2015). Not only is the integration of various back-office functions such as: order processing, distribution, warehouse, finance, human resources and quality to name a few general, but also functions that focus on planning and controlling external resources such as supplier schedules or dynamic customer demand (Chen, 2001). Another feature that is becoming more common for ERP systems is then called the focus on advanced planning (Olhager, 2013). It explicitly emphasizes the importance of introducing sales and operations planning (S & OP) functions in a new generation of enterprise software. Olhager (2013) integrates S & OP into four-level planning and remote-short control structures: S & OP, MPS, MRP, and shop floor controls.

Finally, during its development in 2000 (Y2K) and anticipated problems with customized software packages triggered the growth of ERP systems that were increasingly fast, increasingly sophisticated and full of functions (McGaughey and Gunasekaran, 2007). The ability of the system is not only to serve the needs of manufacturing organizations but also used by many other industries and the fear of effects (Y2K) has led to the widespread deployment of increasingly affordable ERP systems for small and medium organizations (McGaughey and Gunasekaran, 2007; Elragal and Haddara, 2012)

No.	References	Approach	Limitation
1.	Orlicky (1975) Harl (1983)	Traditional MRP MRP, CRP	Fixed capacity, infinite capacity Identification of capacity problems after the MRP is implemented, sufficient planning participation is needed
2.	Pandey (2000)	FCMRP	Capacity problems are not solved at the MRP level, lot size: only lot-for-lot, single resource for each type of component
3.	Choi danSeo (2009)	Finite capacity scheduling algorithms	Flexible flow lines, theoretical approaches, constraints for real problems do not exist
4.	Kanet and Sto ̈ßlein (2010	MRP dan integrated capacity planning	One-stage production, single-level, single-source, uninterrupted BOM

Table 1:- Development of MRP

D. Demand Driven MatrerialRequairement Planning (DDMRP)

According to Ptak and Smith (2011) in Ade S.B and Xanty A.P (2013) In principle DDMRP is an improvement on the basic pattern of the MRP. DDMRP is a combination of MRP with other IM methods, including Distribution Requirement Planning (DRP) and Theory of Constraints / TOC. By combining different levels and different processes in a manufacturing process, it is expected that consumer needs can be met. DDMRP aims to shift the point of inventory to an effective balance point by pulling on consumer needs or in other words, inventory management is driven by consumer needs.

In addition, Ptak and Smith (2016) explain that DDMRP is an integral element of a demand-driven operation model or a strategy for making compression of dramatic waiting times and alignment efforts to respond to market demand. This also includes synchronizing careful planning, scheduling and carrying out consumption. This DDMRP refers to material planning and scheduling of system components.

DDMRP can be considered a hybrid system that takes best practices from four other systems - MRP, Lean, Six Sigma and Theory of Constraint (TOC) (Goldratt and Cox 1992). Many authors highlight the effective performance of TOCs that show that TOC increases revenue while lowering inventory, lead time and cycle time to provide competitive and substantial superior sources (Mabin&Balderstone, 2003; Mohammadi&Eneyo, 2012).

Ptak and Smith (2011) have defined five main components as building blocks on DDMRP which are designed to be introduced and applied together as "ignoring any of the components that will reduce the value of the solution dramatically in most environments". The five factors as in figure 1.

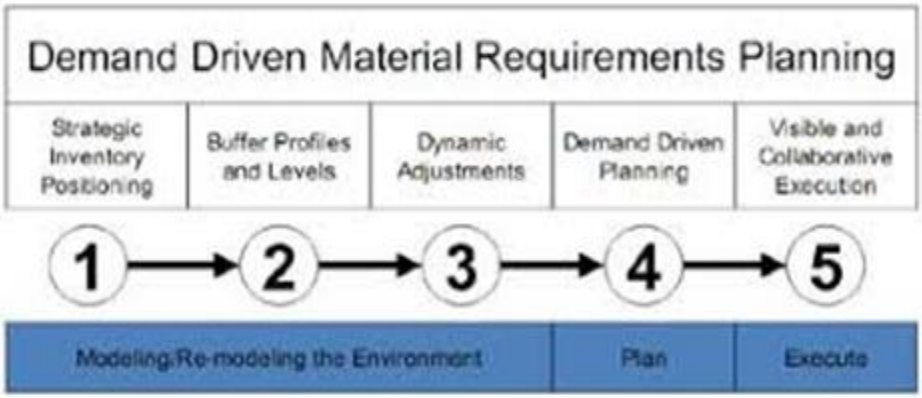

Fig 1:- Five Components in DDMRP (Ptak and Smith, 2011)

➢ *Strategic Inventory Planning*

Aims to plan the extent to which inventory is managed by a company. some things that must be "positioned" in the concept of inventory needed to support the implementation of DDMRP; Customer Tolerance Time, Market Potential Lead Time, Supply & Demand Variability. Supply & Distribution Net Structure and Critical Resources Consideration.

➢ *Buffer Profiles and Levels.*

It is a process that really needs a software to regulate buffer conditions or buffer against existing and able stock supplies. Without adequate buffer adjustments, the industry will be very difficult to adjust to the needs of the overall supply chain system. Buffer in manufacturing is needed for working time conditions and unpredictable situations. With the buffer, there is a working time tolerance and tolerance of raw material supply for conditions that are outside the plan. Buffer is a temporary buffer, so, it cannot be included in the total inventory amount.

➢ *Dynamic Adjustment.*

It is a process for dynamically adjusting a given buffer. With this concept, by referring to the position of available inventory and average daily use, recalculation of the buffer given is shown in Figure 2. In addition, it is the main planning process carried out after the three previous components have been carried out.

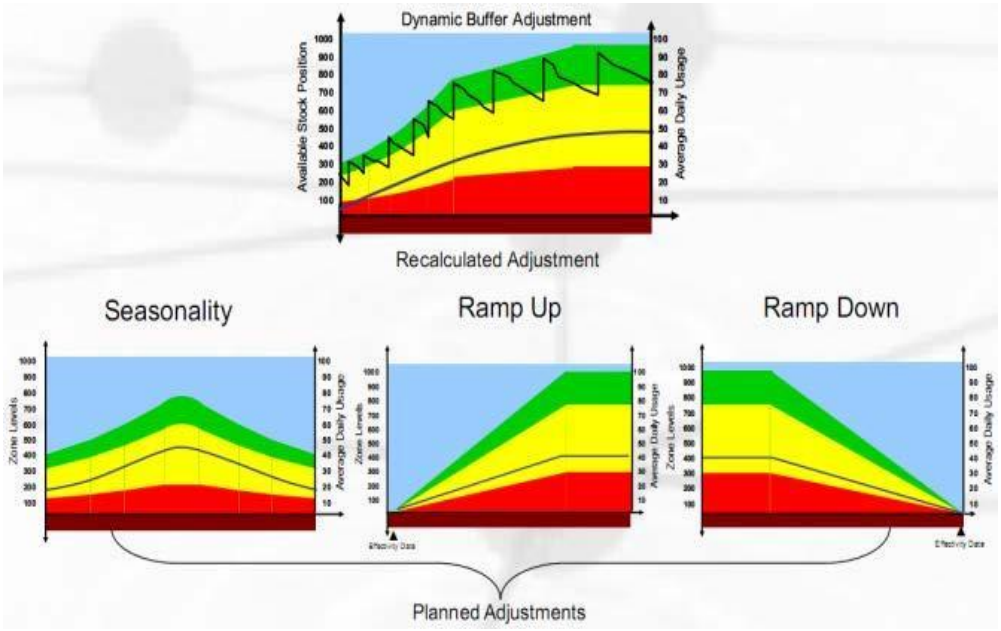

Fig 2:- Dynamic Adjustment (Ptak and Smith, 2011)

➢ *Visible & Collaborative Execution.*

As a step of execution or implementation of the results of modeling and planning, each plan and action taken must be seen in both the procedure and the technical implementation. As with the nature of the supply chain which cannot work independently, in its implementation it must collaborate with all other members of the supply chain, for this the whole concept of the plan and implementation is visible.

The description shows that DDMRP can overcome the main MRP weakness standards as a result. Using appropriate elements such as Theory of Constraint (TOC) and other continuous improvement methodologies to form a

unique framework and production planning and control (Mathias I and Roy S, 2015)

III. ANALYSIS

MRP is a computer-based system designed to manage the time and ordering of products depending on consumer / market demand. Based on the results of calculations that have been done, there is a difference in the total inventory management costs (IM) between the conditions of existing companies and this method. Where there is a savings of 53.5%. In the existing conditions, the company carried out a inventory management system that was carried out structurally and traditionally. Whereas by using DDMRP, inventory management carried out is varied both the frequency and the order interval, according to the calculations that have been done. Then the consumption of raw materials can increase by 10%. This result is obtained after making improvements at the inventory management level. DDMRP implementation requires information technology hardware and software. Information technology is needed to capture (capturing) information, process (processing), retrieve information core (extracting) and channel it to the entire system of information chains (distributing).

IV. CONCLUSION

The middle class sauce industry's raw material requirements planning system is not yet structured. This can be seen from the inventory management system classified as still using traditional systems. Thus, the Demand Driven Material Requirement Planning (DDMRP) method can be recommended for companies as an alternative method that can be used in controlling the company's raw material inventory. Because this can minimize the costs incurred by the company, so that the costs incurred become more efficient. Conventional inventory management models will be increasingly irrelevant and less able to bridge the reduction in value due to piling products / stocks, reducing high goods distribution costs due to poorly planned transportation schedules, reducing production waste and increasing service effectiveness to consumers / markets.

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