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Purchasing Functions and MRP in Foodservice Firms

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Abstract
The study examines the purchasing functions and material requirement planning (MRP) in food service and hotel purchasing. Bill of materials (BOM) is one of the three main inputs to the MRP programme (the other two are the master schedule and the inventory record file). Purchasing food and supplies is somewhat unique in that it goes beyond specifying products and placing orders. In foodservice, the functions related to purchasing should be generally done by the same people who do the purchasing. The paper looks at array of purchasing functions in foodservice and offers an effective management of materials approach. It addresses situation where materials planning are established in consultation with other departments, the resources needed and translation of the master plan into specific materials requirement. A detailed example in the foodservice firm is presented to explain the concept of MRP.
Keywords: Bill-of-materials, materials requirement planning, master production schedule, purchasing function

1. Introduction

Purchasing is a function common to most organisation. Effective standards and controls need to be established and thoroughly understood in order to purchase economically. The purchasing function impacts upon the entire organisation and, therefore, must be carefully integrated (Enns 2002; Jacobs & Chase 2008). Peddersen (1981), states that purchasing food is an art, a science, and a business. There is an art involved in judging just the right ripeness of a melon, the qualities of a wine, and the consistency of a potato. There is a science to the objective measurements of quality as well as the procurement of the correct use-level of an item at its best market price. The business is the management of materials, money, and time in the most economical way.

In many industries the purchasing function stands alone. But in foodservice the quality and the quantity of materials purchased are both the beginning and the end of the circle of total operation. Purchasing must be tightly interrelated and in another way, it is not possible to prepare high quality food from low quality ingredients, but it is possible to prepare low quality food from high quality ingredients. Purchasing food and supplies is somewhat unique in that it goes beyond specifying products and placing orders. In foodservice the functions related to purchasing are generally done by the same people who do the purchasing. While a large volume operation might be an exception, most foodservice operations are not large volume (Peddersen 1981).

Material requirements planning (MRP) aims at efficient scheduling of production requirements so that raw materials, components, and subassemblies can be provided in the right amount and at the right time. A MRP system needs to adjust production plans in order to counter the adverse effects caused by various unexpected disturbances or production uncertainties such as unexpected demand increases, tool or machine breakdowns, new product introduction, non-arrival of raw materials, and excessive rejects (Chakravarty & Balakrishnan 1998). Excessive changes in production plans, a problem referred to as nervousness (Vollmann et al. 1999), can be an obstacle to effective execution of material requirements planning (MRP) systems. System nervousness leads to high rescheduling costs and fluctuation in capacity utilization (Murthy & Ma 1991).

Many strategies have been scientifically examined by Scholars to lessen the nervousness in MRP systems. Still, there have not being a broadly accepted method that performs satisfactorily in a variety of production environments (Ho & Ireland 1998; Guide & Srivastava 2000). The occurrence of too many uncertain events tends to make any sophisticated method invalid (Ho & Ireland 1998). Typical methods such as safety stock and safety lead time come with a major cost in inventory investment and unused capacity (Ho 2002). Other approaches are either associated with high total cost (e.g. freezing the master production schedule (MPS), are sensitive to demand variability (e.g. forecasting beyond the planning horizon), or nervous to the value of change cost (e.g. lot-sizing rules). Moreover, the above approaches are not efficient in keeping the original production plan unchanged. Especially when there are unexpected shortages in some component items, they fail to see whether the amount of items is negotiable so that the original plan can proceed without interruption.

The remainder of the paper is organized as follows. Section 2 briefly reviews the methods reported in the

literature to tackle MRP uncertainty. Section 3 presents MRP approach. Section 4 provides detailed example to show how the BOM approach may be used and section 5 includes the conclusion and future work.

2. Literature review

Purchasing is responsible for acquiring products and services for manufacturing and day to day operation of the business. The function of purchasing spread across the units of the organisation by procurement of the materials required to meet the customer demand and manufacturing schedules. In a distinctive manufacturing organisation, the majority of the goods purchased get into the product and in the event of manufacture, the acquisition of supplies is thus the beginning of the production process. For example, Nazareth, (2013) states that the hotel purchasing function supports virtually every department, whether purchasing chemicals for housekeeping or stewarding, office supplies for marketing, computer supplies for accounting, or food and beverage.

Materials requirements planning (MRP) is a product-oriented computerised method proposed at minimising inventory and maintaining delivery schedules (Lysons, 1996). As reported by Dobler & Burt, (1996), MRP is a technique used to determine the quantity and timing requirements of "dependent demand" materials used in the manufacturing operation. Lysons (1996) relates the dependent requirements for the materials and components comprising an end product to time periods known as 'buckets' over a planned horizon (typically of one year) on the basis of forecasts provided by marketing or sales and other input information. Safety stock and safety lead time are two widely used, inventory-oriented approaches to cope with system uncertainty. Safety stock generates net requirements to ensure a minimum level of inventory at all times. It absorbs changes at the top level, thus reducing the amount of nervousness transmitted to lower levels (Kadipasaoglu & Sridharan 1995; Ram at al. 2006). Heinritz et al. (1991) emphasise that Safety stock levels are established by reviewing the lead-time variation and the demand variation. An estimate of the criticalness of the item is made, and the amount of safety stock is calculated. Safety lead times inflate production lead times at the component level. They are used to cope with time uncertainty such as delivery delays (Koh et al. 2002). Whybark & Williams (1976) opine that safety stock should be used to deal with product demand uncertainty while safety lead time should be used to address completion time uncertainty. Lambrecht et al., (1984) submitted that when complete information about future customer demands is available, safety lead times are always preferable to safety stocks. Similar results for different production configurations (e.g. multi-stage, multi-product manufacturing) are also reported by Buzacott et al. (1992), Buzacott & Shanthikumar, (1994), Molinder, (1997) and Krishnamurthy et al. (2004). Although safety stocks and safety lead times are intended to improve performance, it has been shown that due to the uncertainties in customer demands and errors in estimates of planned lead times, push strategies may result in excessive inventories (Hopp & Spearman 1996; Ram at al. 2006). Hegedus & Hopp, (2001) assert that product level safety stock is a less efficient approach for addressing system nervousness because it increases the inventory level for the entire bill of material rather than specific components.

Lysons, (1996) opines that master production schedule(s) (MPS) uses the inputs from marketing and sales to forecast demand for quantities of the final product over a planned time horizon subdivided into periods known as 'time buckets'. Forecasting beyond the planning horizon has been used to smooth out the cost error. The effectiveness of this approach depends on the accuracy of the demand forecasts and the level of variability in demand (Kadipasaoglu & Sridharan, 1995). De Bodt & Van Wassenhove (1983) study the impact of forecast errors in a rolling horizon Material Requirements Planning (MRP) system. They concluded that the forecast error has a large effect on total relevant costs. Zhao and Lee (1993) report that forecast errors significantly increase total costs and scheduling instability, and influence the selection of some MPS freezing parameters. Lee and Adam (1986) investigate the effect of forecast bias on MRP system performance and suggest that 'over' forecasting may be beneficial since such inflated forecasts provide safety stock. Enns (2002) investigates the effect of forecast bias and demand uncertainty in a batch production environment. He concludes that it is not advisable to use 'over' forecasting. Minimizing forecasting error and then controlling for time and quantity uncertainty by using appropriate planned lead times and safety stock would appear to be the best approach (Ram at al. 2006).

There are numerous studies devoted to developing mathematically sophisticated lot-sizing rules to incorporate the cost of schedule changes into the lot-sizing procedure (Kropp et al. 1983). The approach attempts to provide a balance between the cost of nervousness and the cost of a non-optimal schedule. Lot-sizing rules such as economic order quantity (EOQ) and part period balancing (PPB) consider the cost ratio between inventory carrying cost and set-up cost. The fixed order quantity (FOQ) lot-sizing rule simplifies experimental control and interpretation and is one of the lot-sizing rules most used in practice (Haddock & Hubicki, 1989). Although lot-sizing rules are attractive, the approach is extremely sensitive to the value of the change cost. Ho (2002) states that the lot-sizing rule creates the most nervous MRP schedule because it reacts to every schedule change

in MRP systems.

One important area of research, called 3C (capacity, commonality, and consumption), is presented by Fernandez-Ranada et al. (2000). The technique aims to solve the problem of lack of materials or goods to satisfy customer orders under current market conditions. It reduces investments in inventory by using the commonality of components, and obtains dramatic improvements in the lead time of customer orders by using the actual consumption of materials instead of inaccurate sales forecasts as the basis for purchasing. It is a proven alternative to MRP for optimizing supply chain performance. However, 3C cannot solve all problems (Ram at al. 2006).

One issue that has not been addressed is the instantaneous capacity vs. instantaneous demand. If demand has, for example, a season when the peak demand is higher than production capacity (this is the most common scenario in chemical, health, food, beverage, some electronic and textile industries), then using 3C will cause a serious stock out. Another issue that has not been considered is the raw material lead times vs. instantaneous consumption. If the instantaneous consumption is high and the Material requirements planning storage capacity is lower than procurement lead time, using 3C will lead to a material shortage (Ram at al. 2006). Most of the approaches in the literature assume that BOMs for products are fixed. In a MRP system with fixed BOMs, the only way for these approaches to deal with shortages is to change the production plan to deal with unexpected shortages in some of the components in the BOM. However, there are some situations that allow some flexibility in BOMs. The flexibility is characterized by ranges of quantities of lower-level items in a parent or end item instead of a fixed number.

3. Materials Requirement Planning

The MRP has being described by Baily & Farmer, (1985) as a process that starts with a production programme, or, as it is often called, a master production schedule, which schedules the end-products to be completed week by week during the planning period. It is based on customer orders, sales forecasts, and manufacturing policy. Weele, (2000), suggests that MRP begins in the sales department with drawing up a sales plan. This plan provides an estimate of the volume that management thinks can be sold in the following months or the year to come. Data are presented both at product-group level and at the product/article level. Comparison of the sales plan with the available finished product stock yields the volumes to be produced.

Acordingly, Jacobs & Chase, (2008), emphasise how MRP works as follows: Orders for products are used to create a *master production schedule*, which states the number of items to be produced during specific time periods. A *bill of materials* file identifies the specific materials used to make each item and the correct quantities of each. The inventory records file contains data such as the number of units on hand and on order. These three sources – master production schedule, bill of materials file, and inventory records file – become the data sources for the material requirements programme, which expands the production schedule into a detailed order scheduling plan for the entire production sequence. Procurement of foodservice goods is part of purchasing function. When placing an order for goods or services, the burden of being specific is on the buyer based on the materials requirement planning. Goods delivery entitles buyers to accept all of the goods, reject all of the goods, or accept some fungible amount of the goods. Fungible goods are those which can be weighed or measured (Peddersen, 1981). Upon delivery, buyers have the obligation to inspect goods to ascertain that they conform to certain specifications. Buyers must inspect the goods within a reasonable time which is being determined by the nature of the goods. For example, fresh produce must be inspected much sooner than canned goods.

3.1 MRP Approach

Weele, (2000) underscores MRP approach as follows;

-*Master planning*. In the master plan the manufacturing plans at the level of the product families (product groups) are established in consultation between the departments of sales, product development, manufacturing, finance and administration and logistics. In the master plan the customer orders, the sales plan, the planned stocks of finished products and the production and purchasing plans are linked together.

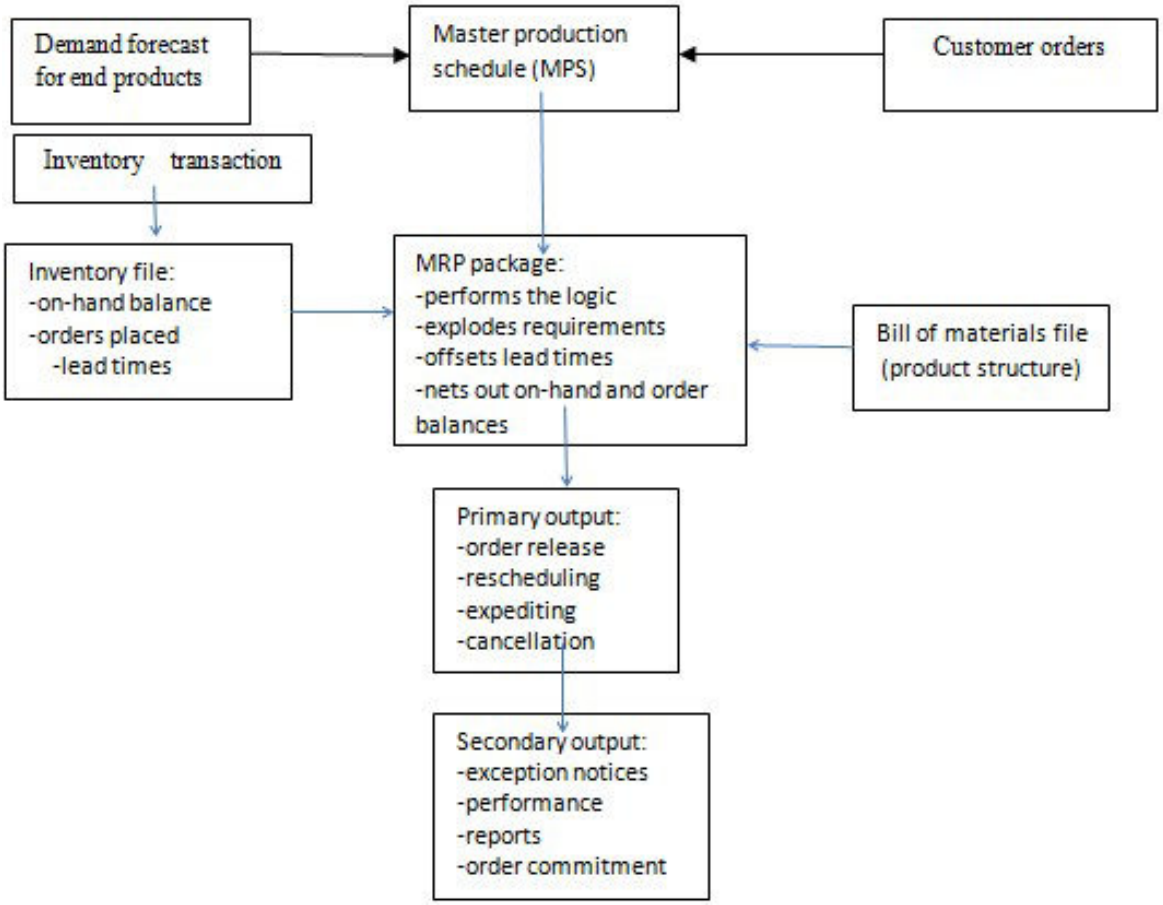
-*Manufacturing resources planning (MRP-11)*. The resources needed to realise the master plan are recorded in the manufacturing resources plan, from which the required composition of manufacturing resources is derived. In the process it may become clear that particular production series are not feasible because production capacity is insufficient. This necessitates adjustment of the master planning and/or adjustment of the manufacturing capacity. In the latter case an investment plan needs to be prepared for adding additional production capacity.

-*Master production scheduling*. The master production schedule transforms the master plan into particular materials requirements. The MPS supplies the necessary resources for estimating the net materials requirements.

-*Material requirement planning (MRP)*. The materials requirement planning 'set off' the MPS requirement level,

gradually, in conformity with the bill of materials. It ascertains the materials requirements at the different stages of product structure and, eventually, at the materials (item) level.

Fig 1. Material Requirement Planning



Source: Lysons, K.. (1996). *Purchasing*. London: Pitman Publishing

-The Bill of materials (BOM) file comprises full product description, containing not only the materials, components, part and sub-assemblies but also the order of arrangement in which the product is made. The BOM file is one of the three main inputs to the MRP program and it is often called the product structure file or product tree because it shows how a product is put together (Jacobs & Chase, 2008). It contains the necessary information required to describe the detail of each item and the quantity used per unit of the item of which it is a part.

4. Manufacturing Resource Planning (MRP II)

Manufacturing resource planning (MRP II) is an elaborated system which contributes two new capabilities to a closed loop material requirement planning (MRP) system. According to Dobler & Burt, (1996), MRP II provides the ability to convert operating production plans into financial terms, so the data can be used for financial planning and control purposes of a more general management nature while the second addition renders a simulation capability that makes it possible for management to do more extensive alternative planning work in developing the marketing and business plans. With MRP II development, its implementation benefit, as highlighted by Wisner & Stanley, (2007), included better production scheduling, reduced component shortages, reduce delivery lead times, better inventory control, reduce overtime, better cost estimating, improved customer satisfaction, reduced production lead times, and improved financial position.

5. A detailed example

Baked products include pastry, pie, cake, bread, doughnut, rolls, buns, and quick breads. These products are obtained in the following forms: ready to serve, partially baked, ready-to-serve frozen, canned prepared, and prepared mixes.

Freezing is an ideal method of prolonging shelves life of most baked products. Bread, if quick frozen and held at 0 degree (-18°f) will remain fresh for many months. When thawed, bread will have a freshness equivalent to a product held for two days at 70°F(22°C). Cakes will remain their palatability for at least 6 months at 0°F (-180°C) and longer at lower temperatures. Proper thawing conditions, such as a low-moisture atmosphere, are essential to prevent rapid staling. Although almost all kinds of cakes can be frozen and thawed without noticeable change, the following defects may occur as a result of prolonged storage: loss of volume, abnormal softness or compressibility, crumbliness, and tenderness (Pedderson, 1981; Olaore, 2003). Quick breads should not be over-mixed. Over-mixing develops the gluten too much, causing tunnels and coarseness in the finished product.
Materials require to make bread and formation are stated below;

Fig.2 MRP for baked bread

Ingredients	Formation
Flour	40 units
Yeast	1.4 units
Sugar	3 units
Salt	1 units
Milk powder	3 units
Water	80 units
Dough conditioner	0.2 units
Butter	2 units (end use)

Source: Olaore, R. A. (2003), “Self-Employment Strategy” Osogbo: Ola-Akin

The required materials must be in the store to avoid delay in production schedule and to make the expected quality. In order to avoid stock-out, safety stock and safety lead time must be given adequate consideration (Hopp & Spearman 1996; Ram et al. 2006). Heinritz et al. (1991) emphasise that safety stock represents inventory held for emergency requirements and keeping it to a minimum without disrupting production or service is important.

6. Conclusions and future work

Purchasing and MRP produces “planned orders” that tell inventory planning and control what and how much to order, when to order, and when to schedule delivery (Heinritz et al. 1991). Materials are required in quantity that will meet the production schedule and demand for a long period of time, so, it is the responsibility of the purchasing to procure required materials at the right time. Bill of Materials (BOM) must include the list of all components, finished parts, raw materials and purchased parts that go into a given product or end item, and the amount of each required in each unit of that item (Enns, 2002; Heinritz et al. 1991; Ram at al. 2006).
It was observed in the literature that MRP goes beyond the traditional bases for determining quantity requirements but thus directly affects purchasing schedules. In an MRP approach, the (dependent) requirement or demand for food ingredient depends on the forecasted (independent) requirement for the finished good. As it was stated in the example, if we forecast selling 100 loaf of bread, it may requires 40 units of flours, 1.4 units of yeast and so forth.
MRP II syatems can be used for tracking food supplies at a number of a resort’s restaurants; for growth and hiring plans; and possibly to analyse the impact a large concert would have on the resort’s hotel rooms, restaurants, and other amenities (Wisner & Stanley, 2007). It was observed that forecasting is essential in MRP because if you do not know how many you are going to serve or sell, you cannot know how much to buy or produce, Therefore, you must predict how much to sell or serve. Foodservice firms who make precise forecasting achieve good controls, smooth production without delay, waste reduction through calculated inventory control

(lead time and safety stock) and predictable operating expenses.

Finally, future study in this area can still be carried out on the use of electronic means to determine Materials Requirement Planning using data from the inventory records, bill of materials and the master schedule. Furthermore, we expect more empirical work to discover additional factors (including price trends, market demands, new sources of supply, fluctuation in the availability of materials and so on) that can facilitate the procurement process in food production to avoid delay and stock out.

References

Baily, P., & Farmer, D., (1985). *Purchasing Principles and Management*, (5th ed.), London: Longman

Buzacott, J. A., Price, S. M. & Shanthikumar, J. G. (1992). *Service level in multistage MRP and base stock controlled production systems*, New York: Springer

Dobler D. W. & Burt, D. N. (1996). Purchasing and Supply Chain Management: Text and Cases, (6th ed.). New Delhi: McGraw-Hill

Chakravarty, A. K.., & Balakrishnan, N. (1998). "Reacting in real-time to production contingencies in a capacitated flexible cell. *European Journal of Operational Research*, 110, 1–19.

De Bodt, M. A. & Van Wassenhove, L. N. (1983). "Lot sizes and Safety Stocks in MRP: A case study". *Product Inventory Management Journal*, 24(3), 1–16.

Enns, S. T. (2002). "MRP Performance Effects due to Forecast Bias and Demand Uncertainty". *European Journal of Operational Research,* 138(2), 87–102.

Fernandez-Ranada, M., Gurrola-Gal, F. X. & Lopez-Tello E. (2000). *3C: A Proven Alternative to MRPII for Optimizing Supply Chain Performance*, Florida: Saint Lucie

Haddock, J. & Hubicki, D. E. (1989). "Which lot-sizing techniques are used in material requirements planning?" *Product Inventory Management Journal*, 30(5), 53–56.

Hegedus, M. G. & Hopp, W. J. (2001), "Setting Procurement Safety Lead-Times for Assembly Systems". *International Journal of Production Research*, 39(2), 3459–3478.

Heinritz S., Farrell, P. V., Giunipero, L., & Kolchin, M. (1991). *Purchasing Principles and Applications,* (8th ed.), New Jersey: Englewood

Ho, C. J. (2002). "Evaluating Dampening Effects Of Alternative Lot-Sizing Rules To Reduce MRP System Nervousness". *International Journal of Production Research,* 40(11), 2633– 2652.

Ho, C.-J. & Ireland, T. C. (1998). "Correlating MRP System Nervousness with Forecast Errors". *International Journal of Production Research,* 36(3), 2285–2299.

Hopp, W. & Spearman, M. (1996). *Factory Physics: Foundations of Factory Management*, Chicago: Irwin/McGraw Hill

Jakobs, F. R. & Chase, R. B. (2008). *Operation and Supply Management*, New York: McGraw Hill

Kadipasaoglu, S. N. & Sridharan, V. (1995). "Alternative Approaches for Reducing Schedule Instability in Multistage Manufacturing under Demand Uncertainty". *Journal of Operational Management,* 13(4), 193–211.

Koh, S. C., Saad, S. M. & Jones, M. H. (2002). "Uncertainty Under MRP-Planned Manufacture: Review and Categorization". *International Journal of Production Research,* 40(4), 2399–2421.

Krishnamurthy, A., Suri, R. & Vernon, M. K. (2004). "Re-Examining the Performance of MRP and Kanban Control Strategies for Multi-Product Flexible Manufacturing Systems". *International Journal of Flexible Manufacturing System*. 16(2), 123–150.

Kropp, D. H., Carlson, R. C. & Jucker, J. V. (1983). "Heuristic Lot-Sizing Approaches for Dealing with MRP System Nervousness". *Decision Sciences,* 14(2), 156–169.

Lambrecht, M. R., Muckstadt, J. A. & Luyten, R. (1984). "Protective Stocks in Multi-Stage Production Systems". *International Journal of Production Research*, 22(5), 1001–1025.

Lee, T. S. & Adam, E. E., Jr. (1986). "Forecast Error Evaluation in Material Requirements Planning (MRP)". *Management Science.*, 32, 1186–1205.

Lynson, K. (1996). *Purchasing* , London: Pitman Publishing

Molinder, A. (1997). "Joint Optimization Of Lot-Sizes, Safety Stock and Safety Lead Times in an MRP System". *International Journal of Production Research*, 35(2), 983–994.

Murthy, D. N. & Ma, L. (1991). "MRP with Uncertainty: A Review and Some Extensions". *International Journal of Production Economics,* 25(1), 51–64.

Nazareth, J. (2013). Purchasing Power. Hotelier Middle East; ITP Business Publishing Ltd.

Olaore, R. A. (2003). *Self-Employment Strategy*, Osogbo: Ola-Akin

Pedderson, B. R. (1981). *Foodservice and Hotel Purchasing*, New York: CBI publishing Company

Ram, B., Naghshineh-Pour., & Yu, X. (2006). "Materials Requirements Planning with Flexible Bills of Materials". *International Journal of Production Reseach*, 44(2), 399-415

Sridharan, S. & Berry, W. (1990). "Freezing the Master Production Schedule under Demand Uncertainty". *Decision Sciences*, 21(3), 97–120.

Sridharan, S., Berry, W. & Udayabhanu, V. (1988). "Measuring Master Production Schedule Stability under Rolling Planning Horizons". *Decision Sciences*, 19(6), 147–166.

Vollmann, T., Berry, W. & Whybark, D. C. (1992). *Manufacturing Planning and Control Systems,* (3rd ed.), Homewood: Irwin

Vollmann, T. E., Berry, W. L. & Whybark, D. C. (1997). *Manufacturing Planning and Control Systems,* (4th ed.) New York: McGraw-Hill

Weele, A. J. van (2000). *Purchasing and Supply Chain Management*, London: Business Press

Whybark, D. C. & Williams, J. G. (1976). "Material Requirements Planning under Uncertainty". *Decision Sciences*, 7(3), 595–606.

Wisner, J. D. & Stanley L. L. (2007), Process Management: Creating Value Along the Supply Chain: Text and Cases. London: Centage Learning

Zhao, X. & Lee, T. S. (1993). Freezing the Master Production Scheduling for Material Requirements Planning Systems under Demand Uncertainty. *Journal of Operation Management,* 11(3), 185–205.