Available online at www.sciencedirect.com
ScienceDirect
Journal of Operations Management 25 (2007) 346–356
JOURNAL OF OPERATIONS MANAGEMENT
www.elsevier.com/locate/jom

The early road to material requirements planning

Vincent A. Mabert

Kelley School of Business, Indiana University, Bloomington, IN 47405, United States

Available online 24 May 2006

Abstract

Material requirements planning (MRP) systems became a prominent approach to managing the flow of raw material and components on the factory floor in the late 20th century. Its adoption was not an over night phenomenon, but was a slow progression over many decades. This article chronicles many developments and events during the formative years of MRP, highlighting changes in computer technology and contributions by key early proponents of this approach for managing the flow of material on the factory floor.

Keywords: Material requirements planning; MRP Crusade

1. Introduction

During the 20th century many individuals made significant contributions to the development and advancement of material planning and control systems. One of the earliest contributors was Ford W. Harris (1913), with the application of mathematics for setting manufacturing lot sizes. Harris' basic economic order quantity (EOQ) model and numerous variations have been studied by dozens of researchers in the following decades. Additionally, the EOQ analysis, with many different variants, is a key component of any operations management text containing a chapter on inventory management.

While Harris focused upon a world of certainty and constancy of demand, Wilson (1934) recognized the world is volatile and difficult to predict. In such an environment, an analysis found it useful to break the inventory control problem into two distinct parts that focus upon: (1) determining the amount of inventory to purchase or produce, and; (2) determining the reorder point or level of inventory that will trigger a replenishment order to purchase or produce material. However, the "when needed" question inherent in the MRP explosion process was not directly considered in this early period.

This early work provided the foundation to the inventory management literature frequently referred to as independent demand management. It led to the development of numerous reorder order point (ROP) systems like base stock, continuous review, (S, s), periodic review, etc. Much of this work was done manually, using pencil and paper, a slide rule or a simple tabulating machine available during the 1930s and 1940s. The approaches normally focused upon single level stocking decisions, even though many companies were dealing with multi-echelon material flow on the factory floor.

However, the development of improved computing technology was changing the way material planning occurred on the factory floor for many firms. By 1940 office machines were being produced by IBM, NCR and Burroughs that could sort, consolidate and summarize data coded on a punch card. For example, a tabulating machine (Fig. 1, left side) was capable of adding,

E-mail address: mabert@indiana.edu.

0272-6963/$ – see front matter
doi:10.1016/j.jom.2006.04.002

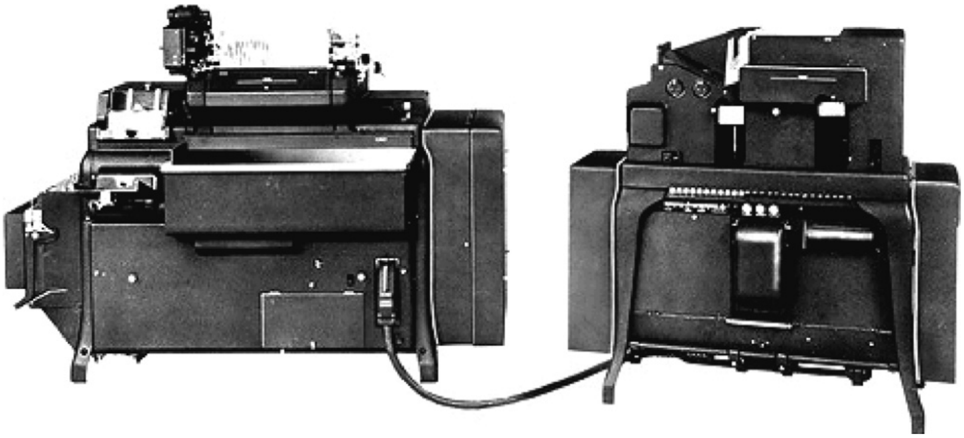

Fig. 1. Early office machines—tabulator (left) and reproducing gang punch (right).

subtracting, and summarizing totals and printing tabulated reports. It used a control panel (Fig. 2) that had almost 5000 wireable plug holes as the primary processor for completing this task. The ''Tab'' machine, as it was frequently called, could be connected to the reproducing gangpunch machine (Fig. 1, right side) to punch summary cards that contained new information for use in subsequent steps.

Even during World War II, the basics of material planning systems were being used, but the medium was a manual punched card approach versus computers with random access memory (RAM) and disk drives that are in use today. For example, the Ford Motor Company plant at Willow Run (Michigan) produced ten different models of B-24 bombers during the war. Using a modular design of 24 major subassemblies and batch scheduling of fabricated major components, the production rate peaked at 25 planes per day coming off the assembly line. To manage the production flow on the shop floor, the material planning process used punched cards, tabulating machines, reproducers and sorters to determine requirements for the major items from the set of 30,000 components that were needed in the plane. The card's punched data contained the order quantity, due date, department, work center, etc. for the order. Using pre-punched bills of materials, the keypunched order cards were processed through a series of steps as illustrated in Fig. 3. By collating, summarizing, gangpunching and sorting the requirements cards, a material plan was developed for the production horizon for the different B-24 models. A slow and time-consuming function, normally requiring many data processing operators to handle tens-of-thousands of punched cards for a routine single update. While the approach was very labor intensive, the general logic is the heart of an MRP system.

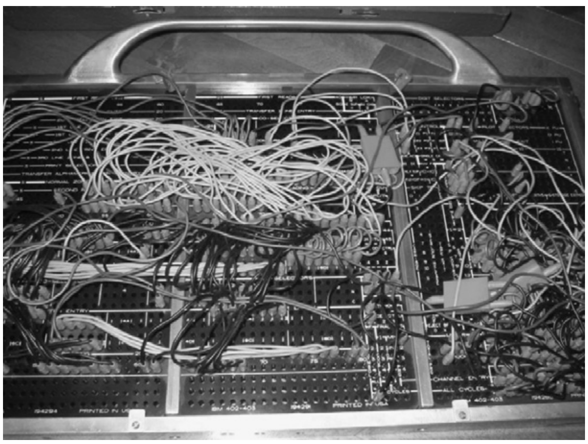

Fig. 2. Plug board control panel.

> ''The farther back you look the further forward you see''.—Winston Churchill (1874–1965).

The use of punched cards with machine summarizing and sorting continued into the 1950s. Robert W. Hall of *Zero Inventories* (Hall, 1983) fame worked in the production control department at Link Belt Corporation in Indianapolis during the mid-1950s. The card approach was the heart of the planning system for controlling the production flow of batched orders on the shop floor. Because of the sequential nature of data storage (cards or tape), the material requirements logic was regenerative in scope when a planning run was executed. This made an MRP update very time consuming, frequently requiring a whole weekend to complete. Constraints like this defined many of the structural characteristics of early