Assembly FG: An Educational Case on MRP II Integrated within ERP*

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ABSTRACT
This case teaches students how discrete (job order) manufacturing companies use Manufacturing Resource Planning (MRP II) within Enterprise Resource Planning (ERP) systems to plan purchase orders for direct materials and shop orders for work-in-process and finished goods. Students simulate MRP II integrated within ERP, using Microsoft Excel to learn MRP II’s bill-of-materials (BOM) Explosion that plans order quantities and MRP II’s scheduling logic that uses lead-times to determine start dates for planned orders. Students explain why MRP II is most practical and effective when executed within ERP and how MRP II can reduce excess inventories, prevent inventory shortages, and help companies deliver quality products to customers on schedule. Also, students explain why BOM, inventory, and lead-time inaccuracies can adversely affect the accuracy of MRP II-planned replenishments and identify controls that reduce the risks of these inaccuracies.

Keywords BOM explosion; Enterprise resource planning; Manufacturing resource planning; Multi-level bill of materials

ASSEMBLY FG: ÉTUDE DE CAS PÉDAGOGIQUE SUR LA PLANIFICATION DES RESSOURCES DE PRODUCTION ENCHÂSSÉE DANS LE PROGICIEL DE GESTION INTÉGRÉ

RÉSUMÉ
L’étude de cas proposée par les auteurs vise à enseigner aux étudiants comment les entreprises de fabrication sur commande utilisent la planification des ressources de production (manufacturing resource planning — MRP II) enchassée dans le progiciel de gestion intégré (enterprise resource planning — ERP) pour planifier leurs commandes de matières premières et leurs ordres de fabrication relativement aux produits en cours et aux produits finis. Les étudiants simulent l’enchâssement de la MRP II dans l’ERP à l’aide de Microsoft Excel pour apprendre comment fonctionne la décomposition de la nomenclature de la MRP II permettant la

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planification de la taille des lots et la logistique d’ordonnancement de la MRP II faisant appel aux délais d’exécution pour déterminer les dates de début des commandes planifiées. Les étudiants doivent expliquer pourquoi la MRP II offre un maximum de commodité et d’efficacité lorsqu’elle est enchassée dans l’ERP et comment elle permet de réduire les excédents de stock et de prévenir les ruptures de stock tout en aidant les entreprises à livrer diligemment aux clients des produits de qualité. Les étudiants sont également appelés à expliquer en quoi les inexactitudes des nomenclatures, des inventaires et des délais d’exécution peuvent nuire à la précision des réapprovisionnements planifiés à l’aide de la MRP II et à repérer les contrôles propres à réduire les risques liés à ces inexactitudes.

**Mots clés :** Décomposition de la nomenclature, Nomenclature multiniveaux, Planification des ressources de production, Progiciel de gestion intégré

## INTRODUCTION

Manufacturing Resource Planning (MRP II) is at the heart of Enterprise Resource Planning (ERP) systems that support discrete (job order) manufacturing (Klimek, 2013). MRP II integrated within ERP helps companies plan and control their manufacturing operations (Samaranayake, 2013; Samaranayake and Toncich, 2007). Manufacturing companies have invested millions of dollars and considerable man-years of effort in improving the performance of MRP-based systems (Koh and Sadd, 2002). Master Production Scheduling (MPS) within ERP sends MRP II the required quantities and delivery dates for finished goods. MPS considers many factors affecting the planned production of finished goods, including sales orders, forecast demand for finished goods, manufacturing capacity, and human resources (Hall and Vollmann, 1978). Then, MRP II uses finished goods’ bill-of-materials (BOM) together with on-hand and on-order inventory quantities stored in ERP to determine the quantity of each BOM component required to manufacture the MPS requirements for finished goods. Also, MRP II uses the MPS delivery dates along with purchasing and manufacturing lead-times stored in ERP to plan start dates for the purchase orders and shop orders that will replenish the required quantities of BOM components (Aydin and Gungor, 2005; Dickersbach, Keller, and Weihrauch, 2007; JD Edwards, 2016). Although many companies use lean manufacturing strategies such as Just-In-Time (JIT), most of these companies continue to use MRP II along with JIT (Agrawal, Minis, and Nagi, 2000).

The case that follows describes how MRP II functions within all ERP systems that support discrete manufacturing. In the case, a small manufacturing company that assembles staircases on-order for its customers is using a small business software package that does not support MRP II. The company is experiencing excess inventories, inventory shortages, defective staircases, and late deliveries of staircases to customers. The company’s owner engages a consultant who describes the purpose and function of MRP II within ERP.
Assembly FG is a small manufacturing company that assembles wood and steel staircases ordered by customers. The company uses a small business system that does not support MRP II. The company uses Economic Order Quantity (EOQ) to plan its purchase orders and shop orders. The company’s managers have expressed the following issues:

- Purchasing Manager, Jack Gordon, stated, “Our EOQ formulas are not accurately planning the quantities and delivery dates for the materials we need to assemble our staircases. For indirect materials, EOQ is working, but for some direct materials, we are experiencing shortages while, for other direct materials, we have excess inventory.”

- Production Manager, Sam Johnson, expressed similar concerns, “For some work-in-process components, we are experiencing shortages in assembly while, for other components, we have excess inventory. The inventory shortages are causing work stoppages and delays in assembling customers’ staircases.”

- Sales Manager, June Wilcox, expressed her frustration, “Often, we are late in delivering staircases to our customers by the delivery dates specified on our sales orders. Also, our customers are finding defects because we used the wrong materials in assembling the customers’ staircases. Late deliveries and defects in delivered staircases are adversely affecting customer satisfaction that, in turn, is causing reduced sales.”

- Accounting Manager, Jane Aston, concurs, “Excess inventories are causing higher inventory carrying costs, and inventory shortages are causing costly production delays.”

John Smith, the owner and Chief Executive Officer, has engaged Terillium to assess the issues stated above and to recommend a solution. After completing a survey of the company’s manufacturing planning and scheduling operations, the consultant, Bryan Rose, provides the following presentation to John and his management team.

Consultant’s Presentation

The consultant begins by informing John and his managers that MRP II integrated within an ERP system would help the company to operate more effectively and efficiently, reduce excess inventories, and prevent inventory shortages. Many discrete manufacturing companies (for example, manufacturers of airplanes and ships)
use MRP II integrated within ERP to plan manufacturing operations. In the 1970s, discrete manufacturing companies used material requirements planning (MRP) to plan purchase orders for direct raw materials. MRP became MRP II when developers expanded the system to include planning production orders for manufactured parts. In the 1990s, developers integrated MRP II, accounting, and other business processes within ERP systems. Examples of ERP systems that can include MRP II are Oracle JD Edwards EnterpriseOne, Oracle E-Business Suite, and SAP Business Suite.

Figure 1 illustrates the integration of the MRP II module and the Master production scheduling (MPS), bill-of-materials (BOM), purchasing (PUR), inventory (INV), and shop floor control (SFC) modules in ERP systems that support manufacturing.

**MPS: Master Production Scheduling**

MPS reflects the results of front-end planning that a company performs in determining the required quantities of finished goods parts to manufacture during each period. MPS requirement quantities and scheduled delivery dates for finished goods parts are inputs to MRP II. MPS planning considers many factors affecting the planned production of finished goods, including sales orders, forecast demand for finished goods, manufacturing capacity, and human resources. For example, Figure 2 shows the JD Edwards EnterpriseOne “Work With Time Series” screen displaying MPS/Forecast (shown in the screen as “-FCST”) for 10 FG Standard Staircases for the month ending 9/30/2020 which summarizes the detail MPS requirements shown in the MPS TABLE in Figure 10 for FG.²

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² By running single-level MPS in JD Edwards EnterpriseOne for the FG Standard Staircase, the company has the flexibility to change quantities and dates for the FG before sending the demand for FG to MRP II. The “Work With Time Series” screen shows quantities for +BAU (+Beginning Available – Unadjusted), +BA (+Beginning Available), +WOU (+Work Orders – Unadjusted), +WO (+Work Orders), –FSCU (–MPS/Forecast – Unadjusted), –FCST (–MPS/Forecast), –SOU (–Sales Orders – Unadjusted), =EAU (=Ending Available – Unadjusted), =EA (=Ending Available), and CATPU (Capacity Planning – Unadjusted).
BOM: Bill-of-Materials

A multi-level BOM like the one depicted in Figure 3 provides the hierarchical structure of the work-in-process and direct raw materials part numbers used to manufacture one finished goods part. Each box in Figure 3 contains a part number followed by the part number’s name. Every part number except the finished goods part has “QTY PER” specified above its box. “QTY PER” specifies the standard quantity of the part number required to manufacture the next higher level part. A multi-level BOM contains multiple Single-level BOMs showing the materials and work-in-process parts used directly in manufacturing a “make” part. For example, in Figure 3, FG on Level 0 and its direct components, RM_3 and ASSEMBLY on Level 1, comprise one of the single-level BOMs within FG’s three-level BOM.

In Figure 4, JD Edwards EnterpriseOne “Bill of Material Inquiry—Multi Level Indented” screen displays the BOM level and quantity per for each component part number in the BOM for the FG Standard Staircase depicted in Figure 3. For example, RM_1 Wood Dowel is shown in the screen to be on Level 3 with a quantity (QTY PER) of one, and this information matches RM_1’s description in the BOM in Figure 3.

The consultant points out that MRP II is not directly involved with performing or costing the purchase orders and shop orders that it plans. In processing that is separate from MRP II, ERP systems support completing MRP II-planned
purchase orders and shop orders and use cost rollup controlled by multi-level BOMs to cost manufactured parts.\(^3\)

One reason MRP II normally plans replenishments for BOM components more accurately than EOQ is because MRP II uses the dependent demand created by the components’ relationships to other part numbers in a BOM. EOQ uses independent demand for a single part number without considering the part number’s relationship to other part numbers in a BOM.

\(^3\) For example, Lambert and Bee (2015) uses QuickBooks Premier Accountant to show how manufacturing costs charged to part numbers at lower levels of a BOM are rolled up into the cost of higher-level work-in-process parts and, ultimately, into the cost of finished goods parts.
Also, the BOM tables within an ERP system's relational database store lead-times for the various processes required to replenish each part number. For each purchased part number, lead-times specify the standard times to complete various procurement activities. Purchasing activities include preparing purchase orders, shipping purchased parts from vendors, receiving and counting parts, inspecting received parts, and transiting parts to their storage bin in the stockroom. For each manufactured part number, lead-times specify the standard times to complete manufacturing activities such as setting up machinery and tooling on the shop floor, completing shop orders, and inspecting manufactured parts. MRP II uses lead-times to schedule the start dates (release dates) of planned purchase orders and shop orders, as explained in the section that follows on MRP II. For example, Figure 5 shows JD Edwards’ EnterpriseOne “Leadtime Inquiry—Multi Level Indented” that BOM specialists use to review lead-times established for BOM part numbers. The “Actual Level” of 3 for RM_3, 2 for RM_2, and 2 for RM_1 correspond to “Complete Purchase Order Lead Time” in the BOM TABLE in Figure 10. Also, the “Actual Level” of 11 for ASSEMBLY and 8 for SUBASSEMBLY.
correspond to “Complete Shop Order Lead Time” in the BOM TABLE. The “Actual Cum” are total lead times that correspond to the sum of the lead times for each component part number in the BOM TABLE.

**INV: Inventory**

MRP II inputs on-hand quantities from INV for each part number in a BOM. All ERP systems support the Perpetual Inventory System that maintains an inventory record for each part number’s current on-hand quantity and unit cost. ERP determines unit costs, using either first-in-first-out (FIFO), last-in-first-out (LIFO), or average cost. All ERP systems provide a report that shows the current on-hand quantity and unit cost for all inventory part numbers. This report is the subsidiary ledger for the raw materials, work-in-process, and finished goods inventory control accounts in the general ledger. The inventory records store other attributes such as...
each item’s standard unit cost and storage bin location in the stockroom. For example, Figure 6 shows the JD Edwards EnterpriseOne “Item Master Revisions” screen for the FG Standard Staircase. Inventory specialists use this screen to revise the item master data for manufactured and purchased part numbers.

**PUR: Purchasing**

MRP II obtains on-order quantities from PUR and sends planned purchase orders to PUR where Materials Analysts review the MRP II-planned replenishments. Once approved, the planned purchase orders are released and sent to the vendors. Materials Analysts may modify the purchase orders by changing the MRP-II-planned start dates or order quantities or by combining multiple purchase orders on one purchase order. PUR tracks the status of purchase orders from release until completion. For example, Figure 7 shows the “Order Detail” screen that Buyers use in JD Edwards EnterpriseOne to specify order quantities and unit costs on a purchase order to procure seven RM_3 and six RM_2 part numbers.

**SFC: Shop Floor Control**

MRP II obtains on-order quantities from SFC when planning replenishments and sends planned shop orders (also called “jobs” or “work orders”) to SFC for

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**FIGURE 6**  JD Edwards EnterpriseOne “Item Master Revisions” Screen (JD Edwards, 2016)
manufacturing work-in-process components and finished goods. Production Analysts review and approve the MRP II-planned shop orders, thereby converting them to released shop orders. SFC tracks the status of shop orders from release until completion. Whether used immediately in the next stage of manufacturing or stored in the stockroom, completed work-in-process parts’ quantities and costs are tracked in INV until subsequently used in manufacturing. For example, Figure 8 shows the “Work Order Details” screen in JD Edwards EnterpriseOne used to

FIGURE 7  JD Edwards EnterpriseOne “Order Detail” Screen (JD Edwards, 2016)

FIGURE 8  JD Edwards EnterpriseOne “Work Order Details” Screen (JD Edwards, 2016)
create a shop order (work order) starting on 8/26/2020 to manufacture five FG Standard Staircases.

**MRP II: Manufacturing Resource Planning II**

MRP II integrates the MPS, BOM, INV, PUR, and SFC modules to plan replenishments for all of the part numbers specified in a BOM. In a process called the **BOM Explosion**, MRP II begins with the MPS requirement for the finished goods part number and processes down through the successive levels of the BOM to determine the replenishment order quantity for every other part number in the BOM. The MPS quantity is the **gross requirement** quantity for the finished goods. MRP II subtracts the finished goods part number’s on-hand and on-order quantities from its MPS gross requirements quantity to derive its **net requirement** quantity. Next, MRP II computes the **start date** (release date) of the planned shop order to manufacture the net requirement quantity of the finished goods by subtracting the sum of the individual lead-times for manufacturing the finished goods from the MPS delivery date. Completing the shop order in SFC provides the net requirement quantity of the finished goods that, when added to the finished goods’ on-hand and on-order quantities, fulfills the MPS quantity, and delivery date requirements.

The shop order that builds FG cannot deliver the required quantity of FG on schedule unless the required quantities of both of its direct components (RM_3 and ASSEMBLY in FG’s single-level BOM in Figure 3) are available at the start of FG’s shop order. Hence, MRP II next determines the order quantities and start dates for the replenishments of RM_3 and ASSEMBLY. In a key processing step, MRP II determines the gross requirement quantities for RM_3 and ASSEMBLY by multiplying the “**QTY PER**” for each component times the net requirement quantity for FG. Then, MRP II computes net requirement quantity for RM_3 and ASSEMBLY by subtracting each component’s on-hand and on-order quantities from its gross requirement quantity. Next, MRP II uses the start date of FG’s shop order as the completion date (due date) for RM_3’s and ASSEMBLY’s replenishment orders. MRP II then computes the start date for these orders by subtracting each part’s total lead-times from the completion date, which is the start date of FG’s shop order. After adding the ordered quantities to the on-hand quantities of RM_3 and ASSEMBLY, the parts needed to make the net requirement quantity of FG should be available at the start of FG’s shop order.

Proceeding from “top to bottom” through the successive levels of the BOM, MRP II repeats the process described in the previous paragraph for each part number in the BOM. Each component’s gross requirement quantity is the net requirement quantity of the next higher level BOM part number that uses (consumes) the component multiplied by the component’s “quantity per.” Each component’s net requirement quantity is its gross requirement quantity minus its on-hand and on-order quantities. Each component’s replenishment order start date is the start date of the shop order that manufactures the next higher level BOM part.
number that uses the component minus the component’s total lead-times. These three key processing steps determine the net requirement quantity and start date for the planned replenishment of each component part number in the BOM. Using this information, MRP II sends planned purchase orders to PUR for the raw materials BOM part numbers and planned shop orders to SFC for the work-in-process BOM part numbers. Material and production analysts review, revise as necessary, and release MRP II-planned orders by accessing a screen like JD Edwards EnterpriseOne “Work With Detail Messages” shown in Figure 9. For example, Figure 9 indicates JD Edwards EnterpriseOne MRP II has planned (signaled) a purchase order for seven RM_3 with start date 8/9/2020 and six RM_2 with start date 7/25/2020. These quantities and start dates match those for RM_2 and RM_3 shown at the bottom of Figure 10 in the section titled “MRP II BOM Explosion and Order Scheduling Processing and Output.” Using the same MPS, BOM, Inventory, Shop Floor Control, and Purchasing inputs, the planned quantities and start dates for purchase orders and shop orders generated by MRP II within JD Edwards EnterpriseOne match those generated by the Excel simulation of MRP II within ERP illustrated in the following section.

Using Excel to Illustrate MRP II Processing Integrated within ERP

Next, the consultant uses Excel to illustrate how MRP II integrated within ERP plans and schedules purchase orders and shop orders to fulfill an MPS requirement quantity and delivery date for FG. Figure 10 below begins by showing five tables stored within an ERP system’s relational database. The last section in Figure 10 titled “MRP II BOM Explosion and Order Scheduling Processing and Output”

FIGURE 9  JD Edwards EnterpriseOne “Work With Detail Messages” Screen (Oracle, 2016)
simulates MRP II’s processing logic within ERP. For each part number in FG’s BOM, MRP II inputs and processes the data stored in the five tables and outputs a planned purchase order (PO) or shop order (SO) with order quantity equal to NET REQUIREMENT QUANTITY (PLANNED ORDER QUANTITY) and release date equal to PLANNED ORDER START DATE. If a part number’s net requirement quantity is zero, MRP II does not plan a replenishment order, as shown for RM_1. Production and Materials Analysts use a screen like “Work With Detail Messages” in Figure 9 to view MRP II-planned shop orders and purchase orders.
Simultaneously pressing Ctrl and ~ displays the Excel references, formulas, and functions shown in Figure 11 that are used in “MRP II BOM Explosion and Order Scheduling Processing and Output” in Figure 10. These formulas and functions simulate MRP II processing logic within ERP. The cell references in Figure 11 refer to cells in the numbered rows and lettered columns in Figure 10.

Following the consultant’s presentation, John schedules a meeting with his managers to discuss whether the company should replace its small business system with an ERP software package that includes MRP II.

**EXERCISES**

**Exercise 1**

Figure 12 shows the BOM for Assembly FG’s Deluxe Staircase, part number FG_3.

Figure 13 contains Excel representations of five tables stored within an ERP system’s relational database pertaining to the part numbers in FG_3’s BOM. These tables contain data accessed and updated by the MPS, SFC, PUR, INV, and BOM modules integrated within ERP.

*Required:* In the rows following row 52 in your Excel worksheet that matches Figure 13, enter the Excel references, formulas, and functions that simulate how MRP II processes the data stored in the ERP system tables shown in Figure 13 for all of the part numbers contained in FG_3s BOM beginning with FG_3. Copy and paste a screen print of your spreadsheet and submit this screen print in your Word document that will also contain your memos for Exercises 2 through 7. Also, submit your Excel spreadsheet.

**Exercise 2**

Write a memo that describes MRP II’s primary purpose within ERP. Also, explain why MRP II normally is most practical and effective when executed within ERP.

**FIGURE 11** Excel references, formulas, and functions in “MRP II BOM Explosion and Order Scheduling Processing and Output” in Figure 10

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PART NUMBER</td>
<td>GROSS REQUIREMENT QUANTITY</td>
<td>NET REQUIREMENT QUANTITY (PLANNED ORDER QUANTITY)</td>
<td>PLANNED ORDER</td>
</tr>
<tr>
<td>37</td>
<td>828</td>
<td>657 (B19+C7) = 637</td>
<td>657 (B19+C7) = 607</td>
<td>=IF(C37=0,F.C15=&quot;MAKE&quot;,&quot;50&quot;,&quot;0&quot;,&quot;0&quot;)</td>
</tr>
<tr>
<td>38</td>
<td>829</td>
<td>639 (B20+B13) = 639</td>
<td>639 (B20+C3) = 609</td>
<td>=IF(C38=0,F.C16=&quot;MAKE&quot;,&quot;50&quot;,&quot;0&quot;,&quot;0&quot;)</td>
</tr>
<tr>
<td>39</td>
<td>830</td>
<td>637*E30</td>
<td>637 (B19+B3) = 607</td>
<td>=IF(C39=0,F.C17=&quot;MAKE&quot;,&quot;50&quot;,&quot;0&quot;,&quot;0&quot;)</td>
</tr>
<tr>
<td>40</td>
<td>831</td>
<td>C39*E31</td>
<td>840 (B32+C14) = 640</td>
<td>=IF(C40=0,F.C18=&quot;MAKE&quot;,&quot;50&quot;,&quot;0&quot;,&quot;0&quot;)</td>
</tr>
<tr>
<td>41</td>
<td>832</td>
<td>639*E32</td>
<td>841 (B32+C9) = 641</td>
<td>=IF(C41=0,F.C19=&quot;MAKE&quot;,&quot;50&quot;,&quot;0&quot;,&quot;0&quot;)</td>
</tr>
<tr>
<td>42</td>
<td>833</td>
<td>C41*E33</td>
<td>842 (B32+C15) = 642</td>
<td>=IF(C42=0,F.C20=&quot;MAKE&quot;,&quot;50&quot;,&quot;0&quot;,&quot;0&quot;)</td>
</tr>
</tbody>
</table>

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Exercise 3

Review Assembly FG managers’ statements quoted at the start of the case about the issues they are having and then prepare a memo that explains how MRP II/ERP might resolve these issues.
Exercise 4

Review the definitions for direct and indirect materials described in most management and cost accounting textbooks. Using these definitions, write a memo explaining why companies normally classify raw materials shown as component part...
numbers in a BOM as direct materials, and raw materials not shown as component part numbers in a BOM as indirect materials. Provide examples of indirect materials and indicate whether companies typically use MRP II or EOQ to plan replenishments for indirect materials.

**Exercise 5**

Using the RM_2 part number in the BOM shown in Figure 3 as an example, write a memo describing five data inaccuracies that, if they existed in ERP, would adversely affect the accuracy of MRP II-planned purchase orders for RM_2. For each inaccuracy, indicate whether the error results in excess inventory or inventory shortages. For a part number with an error, does its location in a BOM make any difference in the impact of the error? Finally, describe avoidable costs and loss of revenues that can result from excess inventory and inventory shortages.

**Exercise 6**

Write a memo describing at least five internal controls that can reduce the risk of inaccuracies in the ERP data that MRP II inputs and processes. Specify whether each control is an information technology (IT) control or a non-IT control.

**Exercise 7**

Write a memo describing the discussion that you believe takes place between John and his managers when they meet to decide whether or not to replace their small business software package with an ERP system that supports MRP II. Describe what might be the pros and cons for Assembly FG installing the new system. Discuss how ERP/MRP II may improve the company’s profitability. Also, discuss other costs besides the cost of the ERP/MRP II software package that the company likely will incur if it installs the new system.

**CASE LEARNING OBJECTIVES AND IMPLEMENTATION GUIDANCE**

**Case Purpose**

This case provides an introduction to MRP II within ERP as opposed to illustrating MRP II within a specific ERP software package. Although the case shows copies of screens taken from Oracle JD Edwards EnterpriseOne, the case does not teach students how to use these screens or any other screens within a specific ERP software package. The case is designed to be generally applicable to all ERP systems that support MRP II. AIS instructors at institutions that use an ERP system such as SAP in their AIS courses may wish to adapt the case so that students perform Exercise 1, using their ERP system.
Manufacturing companies comprise approximately one-third of all U.S. corporations. Boeing, General Electric, General Motors, Harley-Davidson, Lockheed Martin, and Intel are just a few of the many companies that manufacture discrete products such as airplanes, electric generators, cars, motorcycles, and computers. Accounting students who may eventually work for or audit a discrete manufacturing company will benefit by understanding how MRP II within ERP helps these companies to operate more efficiently and effectively. Although not directly involved in costing manufactured parts, MRP II is important for accountants to understand because it helps manufacturers to plan and manage their manufacturing operations. MRP II helps companies reduce excess inventories and the associated carrying costs. By reducing excess inventories, MRP II also reduces the risks of lost, stolen, and obsolete inventory. Also, MRP II helps companies use the correct parts in production and reduces inventory shortages and the related costs of production delays and expediting orders. As such, MRP II not only reduces manufacturing costs but also helps companies deliver quality products to customers on schedule thereby increasing customer satisfaction and sales.

Learning Objectives

The purpose of this case is to help students understand how MRP II plans purchase orders and shop orders within ERP systems that support discrete manufacturing. Using this knowledge, students explain how MRP II helps to prevent excess inventory and inventory shortages and why MRP II requires highly accurate input data from ERP to function effectively. The specific learning objectives are:

- To create a simulation of MRP II’s BOM Explosion and scheduling logic within ERP using Excel (Exercise 1).
- To explain why MRP II normally is most practical and effective when processed within ERP (Exercise 2).
- To analyze why MRP II-generated orders normally are more accurate than EOQ-generated orders for part numbers specified in a BOM structure (Exercise 3).
- To explain why raw materials assigned as part numbers in BOMs normally are direct materials while the other raw materials often are indirect materials (Exercise 4).
- To analyze why BOMs, lead-times, and inventory records in ERP must all be highly accurate for MRP II to plan replenishment orders accurately (Exercise 5).

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4. Based on the authors’ analysis of corporations in Standard & Poor’s COMPSTAT comparing the total number of SIC “2***” and “3***” firms to the total number of firms in fiscal year 2014. Percent of manufacturing firms ranges between 31.8 percent for all firms to 38.8 percent for the largest corporations with sales and total assets exceeding $10 billion.
• To describe internal controls that reduce the risks of inaccuracies in BOM, lead-time, and inventory records in ERP (Exercise 6).

• To analyze the costs versus benefits of installing a new ERP/ERP II system (Exercise 7).

**SUGGESTED AUDIENCE AND USE**

We developed this case for use in an undergraduate accounting information systems (AIS) class or an undergraduate cost accounting class. The case fits well with discussions about the Production Cycle and the general description of MRP II provided in AIS accounting textbooks, such as Chapter 14 on the Production Cycle in Romney and Steinbart (2015). Also, the case complements discussions in cost accounting courses about the use of a bill-of-materials to determine the direct material production and purchase requirements with the preparation of the Direct Material Usage Budget and the Direct Material Purchases Budget as discussed on pages 192 and 193 in Horngren, Datar, and Rajan (2012).

The case displays Oracle JD Edwards EnterpriseOne screens to illustrate an ERP system’s use of the data discussed in the case, such as multi-level BOMs, BOM level numbers, “quantity per” for BOM part numbers, and lead-times. However, the case is not software-specific and does not teach students how to use the JD Edwards EnterpriseOne screens displayed. Also, the case and does not require prior experience with MRP II or ERP software.

We recommend assigning the case and Exercise 1 individually to students so that each student benefits from “hands on” developing MRP II’s processing logic in Excel. Exercises 2 through 7 can be assigned individually to students or to groups of students who present and discuss their responses in class. Students use critical reasoning along with the case’s descriptions to explain how MRP II can reduce excess inventory and prevent inventory shortages and why MRP II is most practical and effective when integrated with ERP. Also, students respond to the more complex but less directed question in Exercise 7 about whether the case company should install an ERP/MRP II system.

When assigning the case, we spend about an hour in class introducing the case and performing a BOM explosion and order scheduling demonstration with Excel using the BOM provided in Figure 3. Then, we instruct students to complete the case and exercises and submit their work the following week. Students need about two hours to complete the case and exercises. After students have completed the case and exercises, we spend about 30 minutes in class summarizing the case’s learning objectives.

**TEACHING NOTES**

Teaching notes for instructional cases are not published in the journal but are made available to full CAAA member subscribers via the CAAA website. If you
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REFERENCES


