College Students Understanding of Production Management and Master Production Schedule through Using a Real World Tool, Complimented with Company Tours and In-Class Visits, Provides an Excellent Learning Experience at Farmingdale State College.

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ABSTRACT

Manufacturing is playing a significant role in its re-shoring into America. Companies are grappling with ways to obtain that competitive advantage by distinguishing themselves through their intellectual capabilities, process improvements, technology, people, shop floor management and information flows.

The purpose of this paper is to describe the effort at Farmingdale State College to educate our students in understanding Production Management and Master Production Schedule (MPS). We are trying to prepare students for entry into the workforce. By using a Real world ERP tool in the classroom while complimenting this learning with touring local manufacturers who use this tool and having production control experts in our classrooms. [1]

The opportunity presents itself for these students to visit real world manufacturers using the same tool these students use in the classroom, the Infor Visual ERP. Each semester students go to a local manufacturer to see how the product is made and the ERP system is used to make it. Each semester a subject matter expert, SME, in manufacturing comes into the class and talks about how they use their ERP to perform their functional responsibilities. Students go into these companies and sit down with these Production Manufacturing and IT SME's to see how they use the modules in their ERP system from estimating, Production Management, MPS to delivery and payment. From the manufacturing window to the Master Schedule Window students learn from these companies SME's just how they perform their functions, how they use this tool. Then that is replicated this in the classroom lab assignments for students to better understand Production Management, scheduling and work order integrity. They identify the desired schedule (forecast) and populate a Master Production Schedule. They create a BOM with work orders adding operations and material.

The Production Management/Control is the function of directing or regulating the movement of goods through the entire manufacturing cycle from the requisitioning of raw material to the delivery of finished products. **(APICS Dictionary 13ᵗʰ Edition)**

The Master Production Schedule is often a major component of Sales and Operations Management. The purpose of the Master Schedule is to translate the Sales forecast into a Production Plan that must be executed by the organization. The Master Schedule is the demand side of the equation and must represent the customers' needs. In this way

the Master Scheduler can give manufacturing its best chance for success

Master Production Schedule (MPS): The MPS should be closely aligned with the Sales Forecast. Students enter a Sales Forecast into the system similar to what they have seen at the companies. Students see how it is the liaison between the Sales Forecast and a production work order. Its function is to translate the Sales Forecast into a viable production schedule that supports the customer requirements, while taking into account shop floor constraints. The MPS must support the Sales Forecast and customer demand. Students learn the importance of this in their lab assignments. They identify and enter shop floor resources.

Students learn that companies should never chase supply they should chase demand and manage supply. Supply can mean, purchased parts, and externally produced parts, internally made items, internal machine or labor constraints. The student's comprehension of this topic, concept and knowledge is significantly enhanced due to the tours to local manufacturers and the individuals that come into the class to discuss these functional areas and the processes they perform in their organizations.

Key Words: **Master Production Schedule (MPS), Production Management/Control, ERP, Shop Floor Management, Effective Learning.**

1. Introduction

All manufacturing companies that produce products must define in detail how a product is made, what materials are used, what it should look like when it is done and many other aspects of the product. Students learning how to use an ERP tool need to understand this. This entire process is called 'Product Management'. APICS defines Product Management in two ways; the first is as the planning, scheduling, execution, and control of the process of converting inputs into finished goods. The second definition is as a field of study that focuses on the effective planning, scheduling, use and control of a manufacturing organization through the study of concepts from design engineering, industrial engineering, management information systems, quality management, inventory management accounting, and other functions as they affect the transformation process. While it may differ in complexity from company to company, students learn the fundamentals are typically:

- Drawings that illustrate and describe what the product is. These will contain the critical dimensions of the product and how various 'pieces' need to be assembled. There is typically an 'Assembly' drawing that shows the final product and then 'Detailed' drawings which illustrate each individual part.

- A list of materials needed to make each part. This is called a 'Bill of Material' or BOM

- A list of steps to follow to make each part and the final assembly. This is usually called an 'operation sheet'.

Quality Requirements include critical dimensions that must be checked or tests that must be performed.

2. Students Learn How an ERP System Supports Product Management

Students learn that every ERP system has a module that allows Designers and Engineers to store the information listed above. This module is a series of tables that store the materials needed for a part (BOM), the operation steps needed to build it (Operation Sheet), the Quality information that may be needed to be checked during the process or at the end of the process and finally, any and all drawings that may be required. The quality of the product and most it costs are determined in the design process. It is during the design that alternate products or suppliers can be considered for better integration or for cost considerations. To satisfy the requirements of the customer, feedback and interaction may be necessary during the design. The ability to use the minimum amount of resources while meeting the needs of the customer is essential. Students hear this when visiting and touring local manufacturers. Configuration functionality allows for variations in design if the customer desires. Meeting the needs of the customer in design with delivering at the lowest cost is paramount. Continuous improvement and innovation in design are strategic means to cost savings and best practices.

The information that is stored in these tables are then used to create 'Work Orders' when the Planning Department decides that it is time to build a part to meet demand. The functional characteristics of the part are conveyed in this data. Because this Product Management data is now stored in the ERP system, it can be easily be copied to a Work Order. A Work Order is the document that the shop floor uses to produce parts. This is the authorization for the shop floor to start work on the product or activity. It is literally 'an Order for Work'. Students can think of the Product Management data as a library of product data that is used to build parts.

The Visual ERP system allows students to enter this information about a product by using three primary areas: Shop Resources – this table allows us to define the resource areas that we will need. Part Maintenance – as seen in earlier chapters, this table will contain the parts that are needed to produce the solar panel. Manufacturing Window – this is the module in the system that allows us to associate operations and material to develop a product structure. In Visual, this is called a Bill of Manufacture because it contains both materials and operations. [2]

3. Students Entering Data into the ERP System

Shop Resources in Shop Resource Maintenance
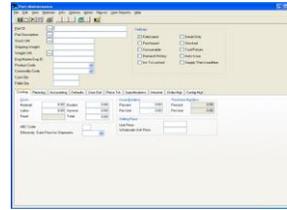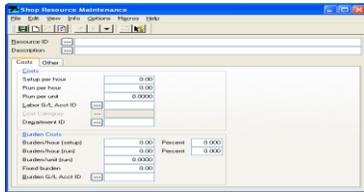
Students see these exact screens at local manufacturers during the information sessions at these company's before the walking tours. The last tour, a week ago, in this Fall semester, the students toured a local gear manufacturer starting at the beginning of the process through the complete transformation of the parts to the shipment and invoicing of the customer. Students were able to see the raw material in eight to ten foot steel rolls and how it went from machine center to machine center for the different processes performed whether on a CNC machine a lathe or a drill that results in the finished good the gear.

Students Enter Parts into the system
The Parts table can be found by:

Going to the Main menu then to Inventory then to Part Maintenance.

The following screen should display:

The very basic information that students need to enter a Part is: Part ID, Description, A Unit of measure, Default Warehouse and Default Location. Students enter data based on a table that provides the data that they will enter for the Parts that will be made.

4. Make versus Buy and Vendor Management
When students in the class consider the supply chain concerns of a company, students can only imagine theses company's choices in make or buy considerations. They need to closely monitor purchased and fabricated parts. With the information readily available make or buy decisions are more accurate as well as decisions about sources of supply. The ability to quickly asses their vendors allows for a better managed operation. Students better understand this when they visit local manufacturers and listen to the

classroom SME guests who specialize in production using this ERP tool.

5. Entering Product Structures

Student's next step is to combine the resources with the Parts to create what is typically called a 'Product Structure'. This is also known as the 'Bill of Manufacture' or an 'Engineering Master'. To do this, students do the following steps: Open the Manufacturing window, go to Main menu then Eng/Mfg and finally the Manufacturing window

The window should look like this:
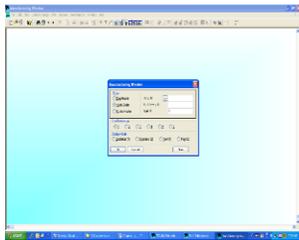
Because students are instructed to make an Engineering master, they click on the radio button for this and then click on the 'New' button. The screen should now look like this:
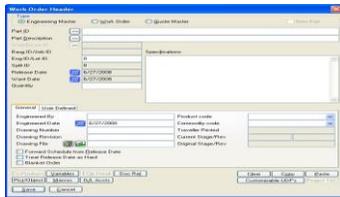
This is what is called the 'header' of the product structure. The Work Order Header. This contains the details of what exactly it is that we want students to make.

When students click on Save the screen will now look like this

:

The 'card' at the bottom of the screen represents the finished product (the XX-XXX) that we would like to make. Now students add an 'Operation'. An 'Operation' in a product structure tells students what should be done at a certain step of the process. When students build the product, the first step is an Operation that uses the resource called Foundation Assembly which we have coded as FOUNDASSY. To add this operation, follow these steps:

1. Click on the card so that an arrow points at it
2. Right Click and a menu will appear
3. Select 'Add an Operation'
4. A new box will appear on the screen

In this box there are five fields that we will be entering: Resource ID, Set Up hrs, Run hrs, and Run Type. Specifications (large white area)

6. Students Add Material to the Product Structure

After we have described the manufacturing steps students must now associated material to be used at each of the operation. To do this, they click on the operation box that we would like to add material to. Students will start with the first box – FOUNDASSY. After the click, the arrow should be pointing to the box. To add material

1. Right Click and a menu will appear
2. Select 'Add a Material'
3. A new box will appear on the screen

The screen should now look like this:

If we complete all of the parts, the screen should look this:

This Engineering Master can now be used to make products for customers who order the product.

7. Student Retention

Students at Farmingdale State are very capable of understanding the Production Management and MPS concepts as well as the reasoning behind their actions in these ERP lab assignment activities. This becomes clear because of the added value of tours of the local manufacturers and individual production and manufacturing SME's that come into the class showing students their actual parts, BOM's, Work Orders and Op sheets. [2]

8. Students enter a Master Production Schedule into Visual

After students set up a part they can now go to the Material Planning Window to enter a Master Schedule. To get there:

- From the main menu select the Inventory menu
- Select Material Planning Window
- Enter the part XX-XXXX into the Part ID

The following window should be displayed:

Now they select the File pull down menu and then they select the Master Production Schedule. The window should look like this:

Running MRP

Now that students have a Master Schedule in place they can run MRP to see the planned orders it will generate. To do this, they the File pull down menu again but now select 'Material Requirements Planning'. The window should look like this:

Students see a number of settings on the screen. The second radio button allows them to process only the parts that have had changes that would affect the running of MRP.

Now students click on OK and the system will display the part numbers that are being processed. When the MRP run is complete, the Material Planning Window will look this

:
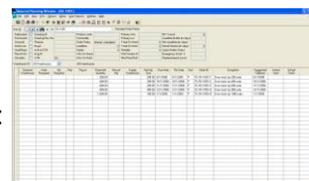
Students can see that MRP used the Master Production Schedule data to generate 'planned'

work orders' for the quantity and dates on the schedule. On the far left column we can also see the projected inventory that will be built up. The planner will now look at this output and decide which orders need to be released. Typically the first order will be released to build up stock and then on this same screen we will see customer orders being placed.

9. Conclusion

This explains a little of what we are doing in the ERP classes at Farmingdale State College to better prepare our students for entry into manufacturing, distribution and or service companies. Students clearly understand Product Management using this ERP system by actually entering the information required.

Additionally, students comprehend the concepts because of the assistance from our local manufacturing partners. [3] These activities replicate what companies do in these functional areas. This is confirmed at the companies these students visit and tour as well as the production and manufacturing SME's that come into the classroom. With over 700 companies locally that use this ERP there is a demand for this type of prepared student.

This appears to be one of the most successful ways to get students to best understand the system they are using, and the reasons behind all the inputs and the resulting outputs.

The visits to our classroom are very valuable to helping the students connect the idea and acquire the knowledge while the hands on applications in the lab reinforce the process.

Many students from the previous ERP classes, now in industry, come to visit this class and explain to the current students just how they use this tool daily and how beneficial it was to have taken this course. Students are prepared for the workforce after this course experience.

References

[1] J. O'Sullivan and G. Caiola, Enterprise Resource Planning a Transitional Approach from the Classroom to the Business World, The McGraw-Hill Companies, 2008.

[2] J. O'Sullivan, "Validating academic training versus organizational training: An analysis in the enterprise resource planning (ERP) field," ACM, Pace University, 2011.

[3] Jill O'Sullivan (2014), Validating Academic Training Versus Industry Training Using ERP, LAP LAMBERT Academic Publishing is a trademark of: OmniScriptum GmbH & Co. KG Heinrich-Böcking-Str. 6-8, 66121, Saarbrücken, Germany, ISBN 9783-659-59768-8.