ABSTRACT
This paper discusses the suitability of simulating material-requirements-planning (MRP) problems on Lotus 1-2-3. It gives an example of such a simulation, suggests techniques to enhance user-friendliness, and proposes that students may be assigned to work with the template in number-entering mode or formula-entering mode. Because learning is profoundly affected by the extent to which students are motivated for performance or motivated for learning, the two modes may induce different motivations, and consequently, lead to different effects on learning.

INTRODUCTION

Material Requirements Planning (MRP) is a computerized system for managing materials used in producing goods. Its importance in the study of manufacturing operations is well-recognized. Gaither (1986) has noted that “no course in [production and operations management] is complete today without a treatment of MRP” (p. 505).

Although MRP is covered in several simulations (Able Associates, 1983; Greenlaw & Hottenstein, 1969; Fok, Kwong, & Hiranyawasit, 1987; Pray, Strang, A Burlingame, 1984) written in languages such as Fortran, Basic, and Pascal, the fact that MRP contains, as Dilworth (1986b) notes, “no complex and sophisticated mathematical models” (p. 399) makes the subject suitable for spreadsheet simulation. In fact, simulation by spreadsheet is uniquely appropriate to the task because spreadsheet templates may be designed to allow students to enter formulas in place of or in addition to numbers, a feature difficult to implement in rudimentary computer languages.

The difference between students entering numbers and students entering formulas into a simulation is not of trivial consequence. A student can enter numbers that work correctly while understanding little of the structure of the problem. The likelihood, however, that a formula entered without understanding will work correctly in any situation is exceedingly small, a lesson quickly learned by every beginning programmer. In essence, when students are required to enter numbers into a simulation, good performance is demanded of them, but when they are required to enter formulas, good learning is that which is demanded. Thus, motivation for performance or motivation for learning may be induced by the demands of a simulation. The qualitative difference in motivation so induced can, as Dweck (1986) has observed, have profound effects on learning.

Recognizing the value of students entering formulas, Schroeder and Gentry (1987) suggested that students be required to develop their own templates for MRP. That approach, however, is feasible only if either the MRP system is exceedingly simple or several weeks of class are allocated to the task. In the case when a complex MRP system must be covered in a week, which is usual in most introductory courses in production and operations management, that approach is infeasible.

This paper shows how a template for a complex MRP system can be created. It discusses several ways of making the template more “user-friendly,” and points out the possibility of judiciously encouraging motivation for learning by properly constructed students’ assignments.

IMPLEMENTATION

The essence of an MRP system is the proper organization of data so that material and capacity requirements can be computed readily from a production schedule. A complex MRP system consists of the following elements:

1. product-structure tree
2. routing file
3. item master file
4. bill-of-materials file
5. work-center master file
6. master-production-schedule record
7. material-requirements-planning record
8. capacity-requirements-planning record

Examples of these elements taken from our particular implementation is shown in Figures 1 through 8 below.
TECHNIQUES FOR USER-FRIENDLINESS

in implementing a simulation on a spreadsheet, the user-friendliness of the Implementation is important. An unfriendly implementation irritates, and becomes a hindrance to learning. A few of the less obvious techniques for making a spreadsheet template more user-friendly are discussed below.

Use of Page-Up, Page-Down, Tab, and Shift-Tab Keys

Lotus 1-2-3 displays a screen of 20 rows and a variable number of columns. By grouping items such that they consist or a complete unit of display within the confines of a screen, users may rely upon the paging and tab keys to page across displays. This makes it unnecessary to stroll the screen, which tends to cause disorientation.

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Prompt for Input

Unprotecting cells for input in a 1-2-3 spreadsheet has the effect of accenting the cells by color or intensity, depending on the monitor in use. To call for input in these cells, the cell may contain a label, such as the following:

B3: ‘ _____?_____’

In the first release of 1-2-3, formulas referencing labeled cells assigned the cells zero value; in the second release, however, such a reference results in error, indicated by ERR. To prevent such ERR’s from cluttering a template, reference to the labeled cell may be called through the second release’s @N function, as follows:

B4: @N(B3)

Informative Error-Trapping Messages

Perhaps nothing else is so helpful in learning than the informative trapping of errors. The second release of 1-2-3 allows labels to be printed conditional upon calculations. This enables the template to include informative error traps, such as the following:

B5: @IF(C4<0,” Not enough capacity.”,””)

STUDENT ASSIGNMENTS

Students can be assigned to work with the MRP template in two modes. In number-entering mode, the students would be told to change certain values, such as MPS Receipt on the Master-Production-Schedule Record, and observe the consequences on capacity, inventory, and cost. In formula-entering mode, the students would be told to enter formulas such as to yield the right values. In the first instance, the students would be taught to use a template; in the second, they would be taught to create one. The differential effects on motivating and learning of the two alternative modes have not yet been studied.

SUMMARY

The simplicity of the mathematics in MRP problems, and the complexity of relationships involved make such problems suitable for simulation in a spreadsheet. A unique advantage of using a spreadsheet for such simulations is the possibility of designing the spreadsheet such that students are required to enter formulas, instead of numbers.

To implement an MRP system on a spreadsheet, the MAP database must be carefully organized. Matters of user-friendliness must be addressed. Students assigned to work with the MRP template can be directed to work in number-entering mode or formula-entering mode. The differential effects of these two modes on motivation and learning are worth investigating.

REFERENCES


