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THE USE OF PRODUCTION SCHEDULING SIMULATION IN A PRODUCTION PLANNING AND CONTROL COURSE

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INTRODUCTION

According to instructions given in the call for papers, we are to emphasize the unique variables or usage of our games. Since we have already heard of other games used in production planning and control courses, I imagine the most unique aspect of my game is that it has been in use longer than any of the others.

Production Scheduling Simulation was developed in the early 60's by a graduate student, Gray J. Arnold who is now president of a consulting firm in Atlanta, with guidance and assistance from Robert S. Hoeke, now with Southern Illinois University at Edwardsville. It is published for internal use only by the Center for Business and Economic Research at The University of Tennessee at Knoxville.

The game was used for the first time during Spring quarter of 1963, and has been used almost every quarter since that time. The course is required of all Industrial Management majors and until just recently by all Industrial Engineering majors. There have been many revisions, with parameters being changed almost every time the game is used.

It is strictly a functional game in the area of production planning and control. By the time students get to this course they have had basic courses in production management and management science, and have played a general management game in a previous course.

I consider the course to be a senior seminar where we look at the nuts and bolts of the production planning and control function. During the quarter the student studies the production system, examines production planning and control functions at a number of companies in the Knoxville area (including Alcoa, Magnavox, Robin and Haas, Robertshaw-Fulton Company, Levi Strauss, etc.). Then they spend about twenty-five percent of the class time in playing the game.

Purpose of Game

The game is designed to give students an opportunity to make decisions in a realistic and dynamic situation. The decisions deal with the method of scheduling varying quantities of three different products through a series of machine operations.

All teams are, in a sense, competing against an environment. The success of this competition will depend upon a team's analysis of the various scheduling alternatives available and upon a careful comparison of the relative cost considerations involved with each alternative.

Decisions are made based on this analysis. The play of the game provides an opportunity to evaluate the effectiveness of these decisions in terms of the results that are obtained. It is hoped that feedback will enable

players to recognize their mistakes and, in addition, suggest alternative methods and procedures that will avoid similar errors in the future. Thus players are encouraged to adapt to the changing conditions that characterize a dynamic environment.

Objectives

Objectives of the game are as follows:

1. To teach fundamental techniques involved in the functioning of a specific industrial area.
2. To provide a problem situation such that the consequences of the decisions made influence any subsequent decisions.
3. To demonstrate the value of careful planning and analysis.
4. To encourage discovery and analysis of advantages and disadvantages of alternative strategies.
5. To provide a dynamic situation for learning various management skills.
6. To provide future managers with practice, insight into, and improvement of their main function-decision making.

Simulates Production Department Operations

The game is designed to simulate the production department operations of the Arnold Engineering Corporation, a firm engaged in the production of two related products, hiptoids and ziptoids, and one special order item, piptoids. The market demand for hiptoids and ziptoids fluctuates considerably from week to week. Correspondingly, production requirements vary and must be determined at the beginning of each week by an analysis of the demand history and current inventory level of each product. The demand for piptoids is based on the order size of the buyer, and it is unknown until the buyer requests a bid for the manufacture of a specified number of this item.

Because of involved packaging and delivery procedures, the shipping department at the beginning of each week sets up for each product a production deadline, a day at the end of which all units of a product scheduled to meet demand for that week must be available for shipment processing.

Due to the mechanical nature of each of the three products, precision parts and close tolerances are required. All quantities produced are thus subject to rigid inspection and testing with the possibility of rejection and subsequent scrapping. Allowances for such rejections must be made when determining production quotas.

Weekly Schedules

All teams assume control over the production department of the company under the same set of conditions. Each team is required to decide upon and submit a weekly production schedule for each product, allocating machine time in such a manner that production deadlines for each product are met. The various machines used are all subject to breakdowns, the frequency of which depends upon their degree of usage. The time required to repair a machine failure is a function of the size of the maintenance crew available. Several of the machine operations are used in the production of more than one product. Thusly, conflicts may arise over the

priority of use of those machines where one or more products are competing for processing time on the same machine at the same time.

The set of decisions of one team has no direct bearing on the operation of another team except in the situation where the various teams are bidding for an order of piptoids. Despite the relative absence of team interaction, a good measure of a team's overall effectiveness in planning and decision making can be obtained by a comparison between teams as to their relative cost outlays, success in meeting production deadlines, accuracy in forecasting demand, competitiveness among teams for special order contracts, or some combination of such factors.

Rules of Game

Some general considerations and requirements of the game which might be of interest are the following:

1. The length of each period of play is one week.
2. Students in the class are divided into teams of three (3), with each student acting either as production manager, production line superintendent or cost accountant.
3. Each team determines the quantity of each product that it will manufacture in the coming week and enters these figures along with other required information on a Weekly Decision Sheet.
4. Each team submits a detailed production schedule for each product.
5. Students are given the sequence of machine operations required to produce each of the finished products, and the time to produce one unit through each machine operation.
6. All cost factors involved in production are given to the student for a specific period of play.
7. Up to twenty-four hours may be scheduled per day on any one machine. Hours may be scheduled as shift time, overtime or some combination.
8. Additional machines may be purchased at the discretion of the team.
9. Workers may be hired or discharged as the team desires. Hiring and training costs are given to the student.
10. Up to fifty (50) percent of the scheduled load of any product on any given machine may be purchased from an outside firm in the form of preprocessed assemblies, or as custom work. Students are given the cost for such work as of the week purchases are made.
11. Each error in the production schedules results in a penalty being assessed.
12. If the quantity demanded (the usage quantity) should exceed a team's production output plus its inventory stock, the unsatisfied demand will be added to the market demand for the following week. In addition, a run-out cost is assessed for failure to meet consumer demands.

Requirement for Each Period of Play

For each period of play the students (by team) prepare the following:

1. Weekly Decision Sheet showing units scheduled for production,

preprocessed assemblies purchased, changes in production personnel and changes in maintenance personnel.

2. An Inventory Control Record.
3. A Production Cost Sheet.
4. Complete Production Schedules (for each product).
5. Key Punch Form (Instructions to Key Punch Operator).

Information from Computer Run

The teams receive from the computer run the following:

1. 1. Inventory Control Sheet.
2. 2. Production Cost Sheet.
3. 3. Production Results (Shipped, Rejected, Actual Machine Breakdowns, etc.)
4. Summary Results for All Teams including:
   a. Units Produced, Orders Lost, Units Rejected, Units Inventoried; Scheduling Errors.
   b. Costs.
   c. Standing to Date (comparing the average cost per unit for each team).

In addition the game umpire receives from the computer a complete notation of all errors and a labor matrix at the end of each period of play.

Final Written and Oral Reports

The student teams are required to turn in a final written report, and at a critique discussion each team explains its system and its primary strategies, as well as the things it would do differently if it should play the game again.

Meets Vance Criteria

After eleven years the game is still going strong, with student and faculty satisfaction. And, as far as I have been able to determine, the game meets all of Stanley Vance's criteria. The game is realistic, understandable, flexible, and purposeful, and certainly the students live the game while they are playing it.