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The Production Dice Game: An Active Learning Classroom Exercise and Spreadsheet Simulation

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Abstract. The basic production dice game is a powerful active learning exercise that has been extensively used in both undergraduate and graduate operations management classes as well as in numerous executive seminars and workshops. This paper goes beyond the basic model and demonstrates how eight additional models can be utilized to clearly illustrate the impact of dependency and variability on output and work-in-process inventory in balanced processes. Four additional models demonstrate the impact of dependency and variability in unbalanced processes and the importance of developing appropriate buffer and material release policies. This paper also illustrates how spreadsheet simulation can be used to reinforce the results generated in the classroom. The simulation results yield estimates of output and inventory for each model and clearly show the impact of dependency and variability on system performance.

Keywords: production dice game, spreadsheet simulation, active learning, dependency, variability, balanced plants, unbalanced plants.

1. Introduction

Some students have difficulty relating to, and maintaining a high level of interest in, Operations Management courses. Lecture-based classes exacerbate the problem of generating interesting and valuable learning experiences for the students. Garvin (1991) suggests that in the traditional lecture mode of classroom instruction, as much as fifty percent of the lecture material is forgotten within a few months. As emphasized by Heineke and Meile (1995), learning is best (and the most fun) when the learner is actively engaged with the material. Thus, a good alternative to traditional classroom lectures is active learning where the student actively participates in a structured exercise, game, or simulation designed to develop understanding of key concepts.

This paper describes how a stimulating hands-on classroom simulation known as the production dice game can be modified to illustrate several important operations management principles. The production dice game was introduced in the first edition of *The Goal* by Goldratt (1984) and more fully explained by Umble and Srikanth (1990). This paper expands upon these previous works to demonstrate how the production dice game can be modified to illustrate and specify (1) the impact of dependency and variability on throughput and work-in-process inventory in balanced plants, and (2) key managerial issues in unbalanced plants.

Ragsdale (2001) has reported that students respond favorably to the use of spreadsheet-based simulations. More recently, Johnson and Drougas (2002) demonstrated how the basic production dice game can be effectively utilized to provide an Excel-based introduction to the topic of simulation. This paper illustrates how Excel spreadsheet simulation analysis can also be utilized to validate the general relationships observed during the manual production dice game simulation, derive valid statistical estimates of key parameters, and generate sufficient statistical data to conduct significance tests between the parameters of different dice game models. Appendix A describes how the authors sequence and utilize this material in a one-semester undergraduate core course in Operations Management.

2. The Basic Production Dice Game Setup

The basic production dice game models a simple production process where material is processed sequentially through several workstations. Depending on the number of students in the class, several independent production lines of between four and eight workstations should be formed. Each student usually runs one workstation. However, if needed, one or more students may be used to run a second workstation. The basic production dice game used in this paper follows the structure originally described in Umble and Srikanth (1990). The authors decided not to use the production dice game model described by Goldratt in the *Goal* (1984) because that model has no starting work-in-process inventory. A basic setup with six workstations is illustrated in Figure 1. As also shown in Figure 1 below, except for the first workstation, each workstation maintains work-in-process inventory. The first workstation takes material from raw material stores, processes the material, and passes it to the work-in-process inventory storage area for station two. Workshop station two eventually processes and moves the material to station three, etc. When a unit of material has been processed by the last workstation, it becomes system output.