Batching and Other Flow Interruptions: Setup Times and the Economic Order Quantity Model

Up to this point, we were working under the assumption that during every X units of time, one flow unit would enter the process and one flow unit would leave the process. We defined X as the process cycle time. In the scooter example of Chapter 4, we established a cycle time of three minutes in conjunction with Table 4.3, allowing us to fulfill demand of 700 scooters per week.

In an ideal process, a cycle time of three minutes would imply that every resource receives one flow unit as an input each three-minute interval and creates one flow unit of output each three-minute interval. Such a smooth and constant flow of units is the dream of any operations manager, yet it is rarely feasible in practice. There are several reasons for why the smooth process flow is interrupted, the most important ones being setups and variability in processing times or quality levels. The focus of this chapter is on setups, which are an important characteristic of batch-flow operations. Problems related to variability are discussed in Chapters 8 and 9. And quality problems are discussed in Chapter 10.

To discuss setups, we return to the Xootr production process. In particular, we consider the computer numerically controlled (CNC) milling machine which is responsible for making two types of parts on each Xootr—the steer support and two ribs (see Figure 7.1). The steer support attaches the Xootr's deck to the steering column, and the ribs help the deck support the weight of the rider. Once the milling machine starts producing one of these parts, it can produce them reasonably quickly. However, a considerable setup time, or changeover time, is needed before the production of each part type can begin. Our primary objective is to understand how setups like these influence the three basic performance measures of a process: inventory, flow rate, and flow time.