

# Chapter 5

## 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 the previous chapter, 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 6 and 7. And quality problems are discussed in Chapter 8.

Unlike mass production systems with their highly specialized tools, batch operations typically use general-purpose technology to produce a larger variety of products in production runs. Given the general nature of the production technology and the high level of product variety, the production resources in a batch-flow operation commonly have to be set up before beginning work on a specific product.

We define a production batch as a collection of flow units that are processed before the resource (usually the equipment being used at that step) needs to go through another setup. Such a setup might involve changing the equipment configuration from producing product A to producing product B (in which case, we also speak of a changeover time), an example common in low-volume, high-variety manufacturing. A setup also might be the result of some other, recurring flow interruption, such as breaks for workers or downtime for machines.