TAUBER INSTITUTE
FOR GLOBAL OPERATIONS
UNIVERSITY OF MICHIGAN

WDI PUBLISHING

note 1-429-081
May 3, 2010

Note on Variability, Buffers and Inventory

Most production systems are faced with the problem of variability. For example, customer demand for finished products may vary over time, as may the availability of raw materials and the processing capacity at various stages in the system. This note will discuss some of the types of variability, the consequences of variability, the role of inventory in systems with variability and possible responses to variability.

Introduction to Variability

In this note, *variability* refers to a variable rate for some process. There are two types of variability: *predictable* and *stochastic*.

As the term suggests, predictable variability is that which displays a regular or predictable pattern over time. For example, it is known that demand for electricity has an annual pattern as well as a daily pattern, and hospitals and clinics can anticipate seasonal spikes in allergy-related symptoms.

The second type of variability, stochastic variability, has no discernible pattern. For example, the number of customers arriving to a restaurant varies during the day in a manner that is partially predictable (lunch and dinner peaks can be anticipated) and partially unpredictable, or random. By *random* we mean that although the exact number of arriving customers is not known, we can characterize the number with some probability distribution (e.g., the normal distribution). This implies partial, but not complete, information regarding the number of customers to be served. Randomness in a productive system typically results in congestion, loss of capacity and increased delay, as will be illustrated by example.

Consider a system with parts arriving at a work station. We will use the term *part* to denote an entity arriving at the work station. Keep in mind that entities may be physical parts, work orders, files or (in service facilities) people. The concepts here are quite general in their applicability. The work station processes a part if one is available, and otherwise lies idle. Parts arrive at the facility and enter service if the work station is idle; otherwise, a line may form in front of the work station. To visualize this, it may help to imagine an ATM machine with arriving, and potentially waiting, banking customers.

Published by WDI Publishing, a division of the William Davidson Institute (WDI) at the University of Michigan.