

ECONOMIC ANALYSIS OF PRODUCTION BOTTLENECKS

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(Received 7 February 1995)

The management of bottlenecks has become a central topic in the planning and control of production systems. In this paper, we critically analyze bottlenecks from an economic perspective. Using a queueing network model, we demonstrate that bottlenecks are inevitable when there are differences in job arrival rates, processing rates, or costs of productive resources. These differences naturally lead to the creation of bottlenecks both for facilities design and demand planning problems. To evaluate bottlenecks from an economic perspective, we develop the notion of an "economic bottleneck," which defines resources as bottlenecks based on economic, rather than physical, characteristics.

AMS Nos.: 90B30, 90B50, 90B22

KEYWORDS: Manufacturing, bottlenecks, capacity design, demand management, economic analysis

1. INTRODUCTION

In this paper we critically analyze production bottlenecks from an economic perspective, addressing important facilities-design and demand-planning problems. Using a queueing network model, we demonstrate that production bottlenecks are inevitable when there are differences in job arrival rates, processing rates, or costs of productive resources. We further analyze the impact of capacity and demand decisions on the location and characteristics of bottlenecks.

The results of this analysis have a number of important managerial implications. We demonstrate that bottlenecks necessarily arise when costs (profits) are minimized (maximized) and that attempts to control bottlenecks by balancing production will usually be economically counterproductive. We introduce the notion of an "economic bottleneck," which defines resources as bottlenecks based on economic, rather than physical, characteristics. This definition provides the basis for making recommendations for managing and relieving bottlenecks in order to improve the economic performance of productive capacity.

Thus we address the capacity allocation problem from a different perspective than that of most work previously done. Although our Jackson network model of the shop-floor dynamics is simpler than some others, we are able to obtain closed-form expressions,