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The relative advantages of flexible versus designated manufacturing technologies

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Abstract

This paper analyzes the choice between flexible and designated manufacturing technologies when firms can choose the flexibility of their manufacturing systems. Firms can operate a *mix* of technologies, a flexible system to serve some consumers and a designated technology to serve others and can offer multiple products. For flexible systems to be preferred these must offer strong economies of scope and be capable of producing customized products that are largely indistinguishable from custom-built products. An increase in submarket size or in the willingness of consumers to pay for particular types of products encourages the use of designated technologies. © 2002 Elsevier Science B.V. All rights reserved.

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1. Introduction

Recent years have seen considerable advances in the application of flexible manufacturing systems. ‘Flexibility’ in this context refers to flexibility in product design through which manufacturers can adapt a base product to individual consumer requirements at very low additional unit costs: see, for example,

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Milgrom and Roberts (1990), Mansfield (1993). Specifically, a flexible manufacturing system is defined as:

a production unit capable of producing a range of discrete products with a minimum of manual intervention (US Office of Technology Assessment, 1984, p. 60).

Flexible systems are employed in the manufacture of an increasingly wide range of goods, from ceramic tiles to Levi jeans and custom shoes to data-warehousing. It is now being suggested that such flexibility will find a natural outlet as e-commerce continues to expand. For example, the *New York Times* recently stated:

What this means in practice is that rather than displaying the same set of pages to every visitor, a Web site would present different information to each customer based on the person's data profile. (*New York Times*, 'Internet Companies Learn how to Personalize Services', August 28, 2000).

With the advent of flexible manufacturing systems, technology choice becomes an important strategic issue. The adoption of flexible manufacturing confers advantages that are primarily based upon economies of scope but imposes penalties with respect to the additional set-up costs that are necessary to establish such flexible systems: see, for example, Chang (1993), Röller and Tombak (1990, 1993), Norman and Thisse (1999). The existing literature that attempts to address these strategic issues is limited in several respects. In particular, two important questions are not considered.

Given that a firm adopts a flexible manufacturing system

(i) How does it choose the range of products it should offer?

(ii) Will a firm wish to operate a mix of flexible and designated technologies?

Question (i) is related to much of the recent literature on product variety in horizontally differentiated industries and leads to another important question:

(iii) With endogenous technology choice will we see product agglomeration as, for example, is discussed in Hamilton et al. (1989) and Anderson and Neven (1990)?

This paper attempts to shed some light on these questions. Strategic choice of technology is analyzed using an address model that is familiar from the literature on horizontal product differentiation. Applications of this approach to flexible manufacturing have been developed by Eaton and Schmitt (1994) and Norman and Thisse (1999). They build on the seminal ideas of Hotelling (1929) that recognize the direct analogy that can be drawn between spatial models and models of product differentiation. MacLeod et al. (1988) show how this analogy has the potential for being applied directly to the strategic analysis of flexible manufacturing:

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