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Management Insights

Outsourcing to a Powerful Contract Manufacturer: The Effect of Learning by Doing
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The trend toward production outsourcing has created powerful contract manufacturers (CMs) in many industries. In the presence of a powerful, strategic CM in a setting where both the CM and the buyer (original equipment manufacturer [OEM]) learn by doing, the OEM may choose to engage in several interesting strategies, including partial outsourcing (the simultaneous employment of internal production and outsourcing), dynamic outsourcing (producing internally in one period and outsourcing in the next), and production for leverage (producing internally when at a cost disadvantage). Further, the CM may engage in low balling (selling to the OEM below cost). These and other results demonstrate how the consideration of long-term cost competitiveness in the presence of a powerful CM may lead to different outsourcing strategies than would be employed through a short-term cost-focused lens.

Pricing Software Upgrades: The Role of Product Improvement and User Costs
Ram Bala, Scott Carr

The computer software industry is an extreme example of rapid new product introduction. However, many consumers are sophisticated enough to anticipate the availability of upgrades in the future. This creates the possibility that consumers might either postpone purchase or buy early on and never upgrade. In response, many software producers offer special upgrade pricing to old customers in order to mitigate the effects of strategic consumer behavior. However, given that old customers might be higher willingness-to-pay customers, whether or not to offer this upgrade price is a challenging decision that firms have to make. The importance of this decision is magnified by the fact that every consumer who upgrades may also have to incur an additional cost of upgrading complementary hardware or drivers. Given this context, the optimal pricing strategy for the firm depends on both the level of product improvement and the value of upgrade cost. In particular, when upgrade costs are high, offering an upgrade price is not optimal only for an intermediate level of product improvement. The upgrade cost also affects the exact product improvement level at which upgrade pricing becomes the optimal strategy.

Optimal Allocation of Effort to Software Maintenance: A Queuing Theory Approach
Vidyadhar G. Kulkarni, Subodha Kumar, Vijay S. Mookerjee, Suresh P. Sethi

Almost all modern organizations depend on software to run their operations. As software becomes ingrained in their daily activities, its failures become increasingly critical. The quality of software is a combination of the quality of the software at the time of its release and subsequent efforts made to maintain the software during its useful life. Without maintenance, a software is in danger of quickly becoming obsolete. Not surprisingly, therefore, most models of the software development cycle explicitly incorporate the possibility of maintaining the software to improve its quality. To optimize software maintenance is a bottomline concern for organizations, particularly because it is a very costly activity—software companies in the United States spend more than US$70 billion annually on software maintenance. Clearly, therefore, there is a huge incentive to reduce the cost of software maintenance. In this paper, we present models to help optimize software maintenance within organizations. These models allow managers to compute the optimal allocation of resources to software maintenance. We also obtain the optimal batching size and mean service rate of maintenance requests by minimizing the total cost consisting of the cost of the server, the cost of waiting, and the fixed cost of maintenance, if applicable.

A Continuous-Review Inventory Model with Disruptions at Both Supplier and Retailer
Lian Qi, Zuo-Jun Max Shen, Lawrence V. Snyder

A retailer who faces random disruptions both internally and externally (from its supplier), disruptions at the retailer can have a more significant impact on the retailer's cost and demand fill rate than disruptions at

the supplier, even though most research on inventory models (even research that considers disruptions) ignores disruptions at the retailer. The authors' analytical study also reveals the impact of supplier and retailer disruptions on the optimal safety stock level held at the retailer to protect against supplier disruptions.

Patterns of AMT Utilization and Manufacturing Capabilities
Wenming Chung, Morgan Swink

Many have argued that Advanced Manufacturing Technologies (AMTs) enable manufacturing firms to enhance flexibility, quality, productivity, and lead time, hence reducing manufacturing costs and improving delivery speed. However, alternative theories have created a debate over the issue of whether manufacturing plants can compete on multiple capabilities or whether they must focus to compete. We investigate relationships between levels of AMT utilization, manufacturing capability attainment, and plant performance. We categorize the ATMs into three functional types: design AMT, manufacturing AMT, and administrative (or planning) AMT. We find that the capability gains associated with increased usage of all three types of AMT appear to be limited to delivery and flexibility, not cost. Our results also indicate no consistent positive association of performance with increased AMT utilization. Importantly, we find that a ''wrong'' pattern of AMT utilization might lead to worsened performance. Utilization of design AMT alone seems to be less effective than more holistic utilization programs. Managers need to carefully consider the requirements for integration of the various AMT types: utilization strategies should avoid incremental and isolated AMT acquisitions. They should seriously consider how AMT utilizations will serve to enable shifts in capabilities attainment, and associated changes to targeted market segments.

Optimal Ordering Policies for Stochastic Inventory Problems with Observed Information Delays
Alain Bensoussan, Metin Çakanyildirim, Qi Feng, Suresh P. Sethi

Information delays are common in supply chains due to a variety of reasons including technology and management issues. The authors provide a general framework to model information dynamics in procurement systems that allow for a delay to be observed at any time during its occurrence. The information flow under *inventory information delays* is naturally *non-crossing*, while that under *demand information delays* may *cross* over time. In either case, the base-stock policy remains optimal. Moreover, the optimal base-stock level depends on the status of the delay process, and the optimal cost increases in the magnitude of the delay experienced by the system. A tradeoff between inventory and up-to-date information is revealed. As a result, a longer delay of information experienced in the system calls for a larger procurement order. In other words, companies with slow-paced information systems are bound to keep more inventory to compensate for their pace.