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Management Insights

The Manufacturer's Incentive to Reduce Lead Times
Santiago Kraiselburd, Richard Pibernik, Ananth Raman

The prevailing wisdom in supply chain management says that all else remaining equal, managers should seek to make their supply chains more responsive. In other words, manufacturers should seek to reduce the leadtime to respond to orders from their retailers because this would allow them to reduce stockouts in the supply chain and, hence, would result in higher sales. However, under some circumstances, the opposite is possible. That is, increasing supply chain responsiveness (or reducing leadtimes) can lead to *lower* sales for the manufacturer. Two effects drive sales to be lower with shorter leadtimes: a ''safety stock ''effect (which comes from the idea that, if lead times are long, retailers must ''protect'' their service levels by keeping a large inventory, while short lead times decrease the need for such protection), and an ''effort effect'' (which is driven by the efforts that retailers exert to sell more products). As it turns out, these two effects interact in non intuitive ways, and must be considered before a decision to reduce lead times is implemented.

Real-Time Delay Estimation Based on Delay History in Many-Server Service Systems with Time-Varying Arrivals
Rouba Ibrahim, Ward Whitt

Waiting customers in service systems, such as a hospital emergency department or a call center, are typically unable to estimate their own delay. A long wait, coupled with feelings of uncertainty about the length of that wait, leads to poor service evaluation. For system managers, making delay announcements is a relatively inexpensive way of reducing customer uncertainty about delays, thereby improving customer satisfaction with the service provided. The authors investigate alternative ways to estimate, in real time, the delay of an arriving customer in a service system. These delay estimates may be used to make delay announcements. The authors focus especially on delay estimators exploiting recent customer delay history in the system. Delay-history-based estimators are appealing for complicated service systems because they do not exploit information about system parameters and therefore adjust automatically to changes in those parameters. The authors consider the realistic feature of time-varying arrival rates. They show that time-varying arrival rates can introduce significant estimation bias in delay-history-based delay estimators when the system experiences alternating periods of overload and underload. They introduce refined delay-history estimators that effectively cope with time-varying arrival rates together with non-exponential abandonment-time distributions, which are often observed in practice.

Competitive Pricing in a Multi-Product Multi-Attribute Environment
Soulaymane Kachani and Kyrylo Shmatov

In multi-product pricing problems, the pricing decisions for different products are interdependent due to the fact that the demand for one product may depend on the prices of other products produced by the same firm or its competitors. Thus, efficient pricing should account for cross-elasticities among products. The complexity of a pricing problem grows significantly as the number of products increases. As a result of this and the inability to make accurate demand predictions, in most practical settings, multi-product dynamic pricing problems are approximately solved by decoupling across products and solving a large number of single-product problems. In this paper, the authors propose a generic framework and approach to multi-product multi-attribute pricing, use general demand models and develop efficient price optimization algorithms that they have successfully tested and implemented in several industries.

Optimizing Customer Forecasts for Forecast-Commitment Contracts
Elizabeth J. Durango-Cohen, Candace A. Yano

Suppliers of customized products are seeking ways to work with customers to reduce excess production while simultaneously providing greater reliability of supply. Cohen and Yano propose a Forecast-Commitment (FC) contract that resembles what the ASIC manufacturer that motivated this study was already doing vis-à-vis information exchange with customers. But the contract also includes incentives for the parties to act in their mutual

interest. Under the contract, the customer provides a tentative order ("forecast") and must take delivery of at least an agreed-upon fraction of it. The supplier commits to a delivery quantity and pays a penalty to the customer both for deviations of the committed quantity from the tentative order and for deviations of the delivery quantity from the committed quantity (or the customer's demand if less). This paper addresses the customer's problem of what forecast to submit. The economic incentives in the contract cause customers to reduce their over-forecasting and suppliers to reduce their underproduction. As a consequence, the maximum possible profit is often achieved for the supply chain. The contract is also allows the supplier to treat customers differentially (by setting different penalties) depending upon the product's profit margin and the customer's historical truthfulness or ability to forecast accurately.

An Efficient and Robust Design for Transshipment Networks
Robert W. Lien, Seyed M.R. Iravani, Karen Smilowitz, Michal Tzur

Logistic costs in the United States continue to rise, and inventory costs account for approximately a third of total logistics cost. Even industries with stable demand patterns spend millions of dollars each year coping with uncertainty in customer demand and operating costs, leading to lost revenue, poor customer service, high inventory levels, and unrealized profits. Inventory transshipment, the practice of transferring stock among locations at the same echelon level, is a promising strategy to provide operational flexibility to mitigate the effects of demand uncertainty. Rather than relying solely on their own inventory or costly emergency replenishment from the warehouse, retailers can collaborate to overcome supply and demand mismatch. The effectiveness of transshipment is in part determined by the configuration of the underlying network, i.e., by defining which pairs of locations in the supply chain may transship inventory to each other. The authors introduce transshipment configurations in which every location is linked to two locations in a way that forms a loop, referred to as a chain configuration. They demonstrate the efficiency and robustness of chain configurations and characterize settings in which it is superior to other structures. They also provide managerial insights on preferred configurations for a variety of supply chain characteristics.

Shelf Space Management when Demand Depends on the Inventory Level
Opher Baron, Oded Berman, David Perry

Improving profitability in many businesses is tied to wise demand management. One critical factor that influences the demand is pricing. However, demand often depends on additional factors. Two such factors are: the shelf space allocated to a product and to its complement or supplement products; and the inventory level observed by customers. Most of the literature considered only one of the factors above in its analysis. The authors investigated the joint shelf space allocation and inventory control problem taking into account these two factors. They obtained closed form expressions for the profit rate for a large family of demand rate functions exhibiting both dependencies and showed that using these expressions one can solve the joint control problem. They also derived two managerial insights: (a) In some settings, it is important to capture both demand dependencies and that ignoring the dependency on the shelf space might be less harmful than ignoring the dependency on the inventory level. The latter can lead to profit losses of more than 6%. (b) Retailers should use their operational controls (e.g., reorder point) to promote higher demand products.

Optimal Control of Replenishment and Substitution in an Inventory System with Nonstationary Batch Demand
He Xu, David D. Yao, Shaohui Zheng

Substitution is a useful option in managing inventory systems. It provides a higher level of customer service, and may also reduce the inventory levels of products due to pooling effect. The authors study an inventory system in which a firm supplies demand using two mutually substitutable products over a selling season. The substitution model we consider combines the usual supplier-driven and customer-driven schemes, in that the firm may choose to offer substitution, at a discount price, to avoid lose sale when the product demanded is out of stock, or to promote another product even when the product demanded is available; whereas the customer may or may not accept the substitution when it is offered. The authors show that the optimal substitution follows a simple threshold rule. They also demonstrate that with the substitution option the system performance could be improved very significantly.

Pool-Point Distribution of Zero-Inventory Products
H. Neil Geismar, Milind Dawande, Chelliah Sriskandarajah

The extreme short shelf life of some products necessitates that little or no inventory of these products be maintained. Some well-known examples include biochemicals, ready concrete and adhesive chemicals

used for construction, and DVDs of new movies. Naturally, the functions of production and distribution must be tightly coordinated in such ''zero-inventory'' systems. In practice, pool-point (also known as hub-and-spoke) distribution is a popular approach to distribute such products. The authors address the efficient distribution of a zero-inventory product using multiple pool points and multiple trucks. Their analysis can be used to (a) minimize the time required for making all deliveries, (b) minimize the maximum lateness and the number of late deliveries when delivery deadlines are specified, and (c) determine the number of trucks and production rates.

A Bayesian Inventory Model Using Real-Time Condition Monitoring Information
Rong Li, Jennifer K. Ryan

A major challenge in improving the management of service parts inventories is a lack of coordination between machinery fault diagnosis and inventory decisions. This lack of coordination can lead to increased inventory costs as well as disruptions in production activity. The authors have developed optimal methods for incorporating real-time sensor information, obtained through condition monitoring, which can be a critical source of prognostic information, into the inventory management of service parts. Adaptive inventory policies such as these can help manufacturers to both increase machine availability and reduce inventory costs. In addition, the authors have developed easily implementable and broadly applicable heuristic policies that are of practical value to manufacturing firms, assisting them in taking advantage of condition monitoring technology to improve their after-sales service and to compete more effectively.

Facility Location: A Robust Optimization Approach
Opher Baron, Joseph Milner, Hussein Naseraldin

The authors apply Robust Optimization (RO) to a strategic level facility location problem on a network. They solve for the number of facilities, their location, and capacities. Because the quality of demand forecasts typically deteriorates with time one must acknowledge this uncertainty while making the above decisions. The recent advances in RO make it an especially suitable tool for solving such problems. The authors' extensive numerical study shows that realistic size problems can be solved using RO and that there might be a small but significant profit improvement as a result of a wise use of RO in solving such problems.