Research and Management Insights

Quality Testing and Product Rationing by Input Suppliers

Anil Arya, Ning Gong, Ram N.V. Ramanan

Customers attach great importance to information on a product's quality when making purchase decisions. Recognizing this, regulatory bodies on occasion mandate and enforce quality standards. In other instances, attempts at regulation fail. The recent experience in California, whose residents voted down Proposition 37 that would have mandated labeling genetically engineered food, is a case in point. In such cases, reporting on product quality is voluntary and left to the discretion of the seller. Although no quality report may be prescribed, the ability of the firm to drive product prices by advertising quality selectively implies that it does not abstain from quality testing. Recognizing this, customers tread with caution. When the seller is silent on quality, they suspect the seller has something to hide, so they discount the product's quality. The only way for the seller to avoid this discount is to engage in even more quality testing in the hope of obtaining a favorable test result. Of course, as soon as customers suspect additional testing, any silence is viewed with greater suspicion and discounted even more. This leads to a vicious cycle of excessive quality testing and discounting. Anil Arya, Ning Gong, and Ram Ramanan find that this vicious cycle leads the firm to adopt a different approach, one entailing production cuts. By producing and selling fewer units, the firm, in effect, minimizes the scale of the whole problem. It convinces customers that the firm's advantage from quality testing is reduced, thus making it less likely to test for quality. Convinced of a more equal information footing, then, customers are less skeptical of product quality, reducing the need for excessive quality testing.

Advertising in Asymmetric Competing Supply Chains

Bin Liu, Gangshu (George) Cai, Andy A. Tsay

Advertising is a crucial tool for demand creation and market expansion. When a manufacturer uses a retailer as a channel for reaching end customers, the advertising strategy takes on an additional dimension: which party will perform the advertising to end customers. By comparing manufacturer advertising and retailer advertising in two competing supply chains, Bin Liu, Gangshu Cai, and Andy Tsay discover that firms, especially smaller retailers, can benefit from showing restraint in their advertising when product substitutability is high. Cost sharing arrangements ("cooperative advertising"), which decouple the execution of the advertising from its funding, offers a way to adjust the incentives of the various entities. However, the authors find that firms – especially the retailers in these competitive supply chain settings – should be wary of cooperative advertising. The advertising subsidy might quietly trigger a disadvantageous change in some other term of the supply contract. These adjustments could have the counterproductive net effect of intensifying the competition. Perhaps for this reason, in practice some firms prefer to bear the full costs of their own advertising. This research compares the implications of all these configurations of advertising strategy for overall supply chain efficiency and consumer welfare.

Shareholder Value Effects of Voluntary Emissions Reduction

Brian W. Jacobs

Studies of the relationship between emissions reduction and firm financial performance report mixed results. Brian Jacobs considers potential sources of this ambiguity by examining corporate announcements of voluntary emission reduction (VER) from 1990 to 2009, and estimating the financial performance impact by measuring the stock market reaction associated with such announcements. Evidence shows that the market reaction to VER significantly decreased over time, from marginally positive in the 1990s to marginally negative in the 2000s. This changing reaction over time highlights the importance of evaluating the financial impact of any VER in current context rather than relying on past findings. The evidence also demonstrates that the market reaction is more positive if the reduction is for greenhouse gas rather than other emissions types. In light of the increasing concern with greenhouse gases, this finding should be welcome news for managers. Last, the market reaction is more positive for VER announcements that are pledges of intent

rather than realized achievements of VER. Managers contemplating VER might find benefit (and at least no harm) in announcing their intent to reduce emissions rather than waiting until they have achieved the reduction.

Of Physics and Factory Physics
Mark L. Spearman

Factory Physics is a text that appeared in 1996 and sought to provide a systematic framework to describe the behavior of manufacturing systems. Like "real" physics, factory physics is stated as a set of "laws" about the way production-inventory systems behave but unlike real physics, these laws do not follow from a single unifying framework. Spearman motivates such a framework by considering a simple production base stock system and discovers a relation that is similar to the Heisenberg Uncertainty Principle of quantum mechanics. Such relations are characteristic of special pairs of variables that come from the "Principle of Least Action" that underlies virtually all fundamental physics. Spearman then formulates a Least Action model of a production-inventory system that explains the factory physics "law" that there are only three "buffers" to mitigate variability: backorder time, inventory, and extra capacity. Results include a simple relation between these buffers: that the standard deviation of net-inventory times the standard deviation of production can never be below half the demand variance and that the usual methods to control production are a special case of the Least Action formulation.

The Impact of Complexity on Knowledge Transfer in Manufacturing Networks
Markus Lang, Patricia Deflorin, Helmut Dietl, Eric Lucas

Many companies organize their manufacturing activities as a distributed network of multiple production plants. A key management issue is the transfer of production knowledge within such a network. This knowledge can be built up within each plant or it can be transferred from a central unit, the lead factory. Using a computational model, Markus Lang, Patricia Deflorin, Helmut Dietl, and Eric Lucas examine when it is beneficial to create production knowledge within a lead factory and transfer it to geographically dispersed plants. They demonstrate that the complexity of the production process moderates the trade-off generated through the knowledge transfer between a positive cost-saving effect due to fewer adaptations in each plant, and a negative transfer cost effect due to the costly knowledge transfer itself. For production processes with low complexity, knowledge transfer can engender superior network performance. Here, an optimal extent of knowledge transfer exists, and thus, a complete knowledge transfer is not performance maximizing. For production processes with medium to high complexity, performance is reduced rather than enhanced through knowledge transfer so that it may be optimal not to transfer any knowledge from the lead factory to the plants. While the authors analyze knowledge transfer within a manufacturing network, their insights are transferable to other settings that consist of a knowledge sending- and receiving unit.

Balancing Revenues and Repair Costs under Partial Information about Product Reliability
Chao Ding, Paat Rusmevichientong, Huseyin Topaloglu

Many companies face the challenge of selling products under warranty coverage with only a limited understanding of the product reliability. Only after products are introduced into the market and customer returns occur, the company starts to understand how reliable the products are. In such situations, there is an important dynamic decision-making problem facing the companies. Given the current returns observed for a certain product, should a company continue selling the product and try to understand the product reliability better, or should it stop selling the product and possibly replace it with an alternative option? Chao Ding, Paat Rusmevichientong, and Huseyin Topaloglu answer this question by analyzing an optimal stopping problem with embedded learning features in it. Since the problem requires learning and keeping track of failure rates from different causes, the resulting model is a dynamic program with a high-dimensional state variable. The authors develop bounds on the high-dimensional value function in the dynamic program and propose approximate policies motivated by the bounds.

Committed versus Contingent Pricing under Competition
Zizhuo Wang, Ming Hu

Should firms set prices responsively to uncertain market conditions in a competitive environment? Zizhuo Wang and Ming Hu answer this question by studying a duopoly model with demand uncertainty where each firm can either commit to a price ex ante, or price contingently after the demand uncertainty realizes. They identify a clear tradeoff between committed and contingent pricing strategies and show that at equilibrium, asymmetric strategic choices may arise in which one firm sets

committed price while the other one sets price contingently. Such an asymmetric equilibrium tends to emerge when capacity is ampler, products are less differentiated and demand uncertainty is lower. The authors also show that the firm with larger capacity tends to be the one that chooses committed pricing. Managers are cautioned by this research that responsive price changes under aggressive competition of less differentiated products can result in profit-killing discounting. To fight the competition, at the strategic level, firms should focus on shifting as much as possible to exclusive products that cannot easily be substituted. At the operational level, with more differentiated products, firms then can better enjoy contingent pricing by dynamically responding to market conditions. Otherwise, with more homogenous products, committed pricing may be preferable.

The strategic role of third-party marketplaces in retailing
Benny Mantin, Harish Krishnan, Tirtha Dhar

The growth of the online retailer Amazon has attracted attention to its dual-format retailing model: it acts as a traditional merchant (buying and reselling goods) and it also provides a platform for third party sellers to interact directly with buyers. Benny Mantin, Harish Krishnan, and Tirtha Dhar argue that by operating a third-party marketplace, the retailer gains an edge over manufacturers in the negotiation process. This insight can help explain why other major retailers—such as Walmart and Sears—have also launched similar third party platforms. The manufacturers, who are worse off when retailers open third-party marketplaces, should attempt to limit sales through such retailers' third-party platforms. Indeed, the authors observe a growing number of firms who ban sales of their products on third-party marketplaces or threaten to completely stop dealing with dual-format retailers like Amazon.

Vehicle Supply Chains in Humanitarian Operations: Decentralization, Operational Mix and Earmarked Funding
Maria Besiou, Alfonso J. Pedraza-Martinez, Luk N. Van Wassenhove

International humanitarian organizations (IHOs) use centralized, decentralized, or hybrid vehicle procurement to provide vehicles to their programs. A vehicle supply chain (VSC) with centralized procurement has the lowest cost when an IHO implements development and disaster response programs simultaneously. However, a hybrid VSC that combines centralized procurement for development programs

with local procurement for disaster response has the greatest service level. This is explained by the multiple procurement sources that are available in the hybrid VSC. Therefore IHO's strategic decision to implement more (fewer) disaster programs in the future should determine the vehicle procurement sources. Earmarked funding creates constraints that affect operational performance. In a decentralized VSC with earmarked funding, the service level is reduced and can be worse than in other VSC structures. This is explained by the delays experienced by the IHO to relocate vehicles funded by different donors from development to disaster response programs. In view of the tendency toward greater earmarked funding—since donors seem to have more confidence when they can impose strict constraints on how their funds are used—this may have a counterproductive outcome.

Inventory Control with a Fixed Cost and a Piecewise Linear Convex Cost
Ye Lu, Miao Song

For the multi-period setting, the optimal inventory control policy can be too complicated to be implemented in practice. Ye Lu and Miao Song outline the structure of the optimal policy and propose a practically implementable heuristic policy which consists of a critical point (below which it is optimal to produce and above which it is optimal not to produce) and well-structured optimal produce-up-to levels. Its close-to-optimal performance is supported by theoretical properties and verified by extensive numerical studies.

The Impact of Modular Assembly on Supply Chain Efficiency
Tianjun Feng, Fuqiang Zhang

The practice of modular assembly has been increasingly used in industry. In the modular assembly approach, the individual component suppliers are centralized to produce pre-assembled modules; in addition, there is a production time shift from the manufacturer stage to the supplier stage. Tianjun Feng and Fuqiang Zhang study the impact of the modular approach on inventory management in a decentralized assembly system. They show that by adopting the modular approach, the manufacturer can reduce its own inventory and therefore incur a lower operating cost. They also find that the system efficiency will also benefit from the modular approach in general. These findings help explain the increasing prevalence of modular assembly in recent years. However, the supplier could be worse off under certain situations, which suggests that the

manufacturer may need to provide incentives to the suppliers in order to implement the modular approach.

Fairness in Selling to the Newsvendor
Xiaole Wu, Julie Niederhoff

Xiaole Wu and Julie Niederhoff study how fairness affects a two-stage supplier-retailer transaction under uncertain demand conditions. Compared to prior literature, they allow for a wider range of probabilistic demand distributions and also allow the degree and definition of fairness to assume a broader range of preferences. They find that if the retailer's ideal allocation to the supplier is not sufficiently large (if the retailer is mostly self-serving), then the retailer's fairness alone makes no difference to system efficiency. Instead, in this case, the supplier works with the retailer's preferences to maintain the system's usual outcomes. Only when the retailer's ideal allocation to the supplier is above a threshold, determined by system parameters, can the retailer's fairness concern improve the system efficiency for sufficiently high demand uncertainty. In order for the retailer's fairness concern to improve expected profits of both parties compared to the traditional supply chain case (win-win), the demand uncertainty must be sufficiently high, the retailer cannot be too averse to disadvantageous inequity, and his ideal allocation to the supplier must fall within a specific range.

Assortment Optimization under the Multinomial Logit Model with Random Choice Parameters
Paat Rusmevichientong, David Shmoys, Chaoxu Tong, Huseyin Topaloglu

Finding the right assortment of products to offer to customers is a difficult problem faced by many firms. Offering a wide assortment may allow capturing a large market share, but offering a wide assortment may also mean including products with smaller margins into the mix and these products may cannibalize on the sales of the other products, decreasing the overall profitability of the assortment. Furthermore, if there are multiple market segments, each having different preferences for the products, then the firm needs to simultaneously consider the preferences of all market segments. Paat Rusmevichientong, David Shmoys, Chaoxu Tong, and Huseyin Topaloglu consider assortment optimization problems with multiple customer segments. Although the problem of finding the revenue-maximizing assortment is tractable when there is a single customer segment, they show that the problem becomes difficult under multiple customer segments. The authors investigate special classes of assortments that provide provably good performance guarantees.