

## Research and Management Insights

### Supply-Chain Research Opportunities with the Poor as Suppliers or Distributors in Developing Countries

ManMohan S. Sodhi, Christopher S. Tang

How can supply chain design alleviate poverty? This is the question that Sodhi and Tang seek to answer while providing a starting point for research. Supply chains can source from the poor as “upstream suppliers” of products or services or use them as “downstream distributors” of finished goods. One challenge would be the large number of small transactions and therefore the huge transaction costs these poor suppliers or distributors who lack access to information technology as well as market power. Meeting this challenge would require building supply chains around ‘social’ business models that seek both profits and poverty alleviation. Increasingly, many supply chains are being built with the poor as suppliers or distributors to overcome these challenges. Sodhi and Tang report this new phenomenon of supply chains with the poor as suppliers or distributors in developing countries and identify OM research opportunities. They also provide some stylized models to serve as potential seeds for modeling-based research in this area.

### Capacity Planning with Financial and Operational Hedging in Low Cost Countries

Lijian Chen, Shanling Li, Letian Wang

Lijian Chen, Shanling Li, and Letian Wang examine how operational hedging and financial hedging can help sustain cost advantages when operating in low-cost countries and the role that each hedge plays in mitigating demand and exchange rate risk. They first present a general model to examine how a risk-averse MNC uses operational and/or financial hedges to mitigate operational and financial risks by contracting multiple suppliers in multiple countries. When hedging the exchange rate, the MNC is either risk-neutral or risk-averse despite the speculative positions exist. The analytical results show that the firm’s risk attitude and adopted hedges determine the optimal utility and optimal capacity level. When the demands and exchange rates are strongly correlated, the MNCs

will reach the same capacity solutions and obtain the same optimal utilities.

### Designing Efficient Infrastructural Investment and Asset Transfer Mechanisms in Humanitarian Supply Chains

Shantanu Bhattacharya, Sameer Hasija, Luk N. Van Wassenhove

Shantanu Bhattacharya, Sameer Hasija, and Luk N. Van Wassenhove analyze the efficacy of different asset transfer mechanisms and provide policy recommendations for the design of humanitarian supply chain structures. Their study aims to design mechanisms to satisfy constraints faced by aid programs in the field (earmarking of donations, autonomous decision-making by individual aid programs), and maximize the efficiency of humanitarian supply chains, with a specific focus on whether the centralized system can be replicated. They show that allowing aid programs the flexibility of transferring primary resources improves the efficiency of the system by yielding greater social welfare than when this flexibility does not exist. More importantly, they show that a central entity that can acquire primary resources from one program and sell them to the other program can further improve system efficiency by providing a mechanism that facilitates the transfer of primary resources and eliminates losses from gaming. They find that outcomes with centralized resource transfer but decentralized infrastructural investments by the aid programs are the same as with a completely centralized system where both resource transfer and infrastructural investments are centralized.

### Sequencing and Scheduling Appointments with Potential Call-In Patients

Rachel R. Chen, Lawrence W. Robinson

Clinics need to be able to book routine patients in advance, while recognizing that same-day patients might call in the morning for an appointment later that day and that the number of same-day patients is unpredictable. Rachel Chen and Lawrence Robinson finds the optimal sequence and appointment times for a mixture of routine and potential same-day

patients. They show that it is often optimal to reserve the first few appointments for potential same-day patients, because at least a few of them are likely to call in, and those who do will be more likely to show up. Routine patients are scheduled next as a single block, followed in turn by the remaining same-day patients. This policy is easy to compute and performs well. The authors extend their basic model to include an appointment delay cost for same-day patients that reflects their desire to be seen as soon as possible. Rounding appointment times to discrete intervals (*e.g.*, the nearest five minutes) leads to minimal loss in performance. This problem is amenable to being solved through Microsoft Excel, once the patient sequence has been determined.

### **The Design and Introduction of Product Lines When Consumer Valuations are Uncertain** Eyal Bialogorsky, Oded Koenigsberg

Introducing new product to the market is one of the managers' biggest challenges. This problem intensifies when managers have to introduce multiple products (product lines) into the market. One of the reasons for this challenge is the fact that in the early stages of the research and development process managers have uncertainty about consumers respond to their products. Later when the product is ready and they have more information, managers have fewer levers to respond. Eyal Bialogorsky and Oded Koenigsberg study this problem and characterize the trade-offs that managers are facing. They draw the pros and cons of each introduction strategy and compare between the different strategies. Specifically, they find the link between the amounts of uncertainty in the market to the recommended product introduction strategy.

### **Benefactors and Beneficiaries: The Effects of Giving and Receiving on Cost-Coalitional Problems**

Ana Meca, Greys Sošić

Ana Meca and Greys Sošić study settings in which firms collaborate in their cost-reducing efforts. Their analysis focuses on scenarios in which there exist benefactors firms whose participation in an alliance always contributes to the savings of all alliance members. There also exist beneficiaries firms whose cost decrease in such an alliance. Inclusion of benefactors in such collaborative alliance is, thus, a desirable outcome, as it may lead to cost savings of all alliance members. The authors show how firms may distribute cost of the all-inclusive alliance in a stable way that discourage defections and sustains cooperation of all firms, and they describe how beneficiaries may

use "giving" a share of their savings (which induces "receiving" of savings on the benefactors' side) to motivate benefactors to cooperate in cost-reducing efforts.

### **End-of-Life Inventory Problem with Phase-out Returns**

M. Pourakbar, E. van der Laan, R. Dekker

The service parts' end-of-life phase starts right after the cessation of their production and continues until the last service contract expires. Placing a final order is a popular countermeasure in this phase. M. Pourakbar, E. van der Laan, and R. Dekker study the end-of-life inventory problem for a capital-intensive product for which the availability of parts in order to deliver a prompt service in case of failure is critical. Three sources of parts acquisition are considered, namely, final order, repair of defective parts and phase-out returns. Phase-out returns occur when a customer ends the use of a product and returns it to the OEM where the OEM can use it as a source for parts acquisition. The main decisions for the OEM in such a problem are the optimal final order quantity and how to manage the repair operation. The authors show that in determining the optimal timing of triggering the repair operation the time remaining till the end of the horizon and the amount of serviceable and repairable items in stock should be taken into account. Moreover, the value of phase-out information is highlighted. It is also shown that traditional repair policies, namely push and pull, might perform poorly in the final phase.

### **Managing Supply Risk for Vertically Differentiated Co-Products**

Saurabh Bansal, Sandra Transchel

Saurabh Bansal and Sandra Transchel show that manufacturing technology and customers' substitution behavior determine firms' substitution and inventory-withholding strategies. In many high-tech production systems, multiple products with varying quality levels are obtained simultaneously in uncontrollable fractions. This lack of production-control leads to supply-demand mismatches. The authors show that the conventional practice of downgrading high-end units by the firm to meet all unmet demand of lower-end products is not optimal. Customers may be flexible in their purchase decisions – when their preferred product is out of stock, they may purchase a more expensive product. Two mechanisms exist for firms to exploit this behavior. First, to ensure that unmet demand of inflexible customers is not completely lost, firms should satisfy a part of that demand by downgrading higher-end units. Subsequently, firms should

announce the stockout and let the remaining customers choose to purchase a more expensive product. Second, firms should selectively withhold inventory of low-end products to divert their demand to higher-end products. The optimal downgrading and inventory withholding policies change during product-line's life-cycle as prices decline, more capacity is available, and technology improves. Firms should perform no downgrading in the beginning of the life-cycle, increase the downgrading level during the middle stages, and perform complete downgrading at the end of the life-cycle. Simultaneously, firms should withhold a progressively smaller fraction of low-end inventory.

### **Power Structure and Profitability in Assembly Supply Chains**

Lucy Gongtao Chen, Ding Ding, Jihong Ou

The conventional wisdom is that it is better for a firm to possess more power in the supply chain, which has been verified for serial systems under several settings. Little attention, however, has been received on this issue for assembly systems where besides the vertical interaction between a component supplier and the assembler, there is also the indirect interaction between the suppliers. Do firms in assembly systems always do better with more power? Should they yield power in certain scenarios? If yes, under what scenarios? To fill the void in literature, Lucy Gongtao Chen, Ding Ding, and Jihong Ou study two power regimes: single power regime (SPR) where a more powerful firm has the power to decide only the price but not the quantity and dual power regime (DPR) in which a more powerful firm can decide both the price and quantity – we show that a firm should always strive to be the most powerful one in an assembly system. However, if it cannot maintain such a dominant position (e.g., two suppliers are equally powerful, or the assembler is weaker than at least one of the suppliers), then surprisingly, it should sometimes yield the power to its trading partner, depending on the system parameters. The authors' results also suggest that a firm may not always be better off with both pricing and quantity power. Further, while merging the suppliers into a mega supplier to make decisions jointly can benefit all firms sometimes, it is not always the case.

### **Randomization Approaches for Network Revenue Management with Customer Choice Behavior**

Sumit Kunnumkal

Network revenue management finds applications in industries ranging from airlines to hotels to rental cars to media advertising. With the growing

presence of online sales channels, customers have the opportunity to choose from a large number of fare-products in making their purchasing decisions. As a result, modeling customer choice in network revenue management has gained increasing importance over the years. A difficulty with choice based network revenue management is that computational tractability is limited to certain special choice models, most notably the multinomial logit choice model. Sumit Kunnumkal proposes solution methods that remain tractable over a larger class of random utility models. Computational studies indicate that the proposed methods can improve upon existing benchmark solution methods by around 2–3%.

### **Enabling Opportunism: Revenue Sharing when Sales Revenues are Unobservable**

H. Sebastian Heese, Eda Kemahlioglu-Ziya

Firms that constitute a supply chain make decisions based on their individual incentives, which are rarely aligned with those of the overall supply chain. One way this misalignment manifests itself is in the purchasing decisions of retailers. When suppliers offer their products to retailers at wholesale prices above their own cost, retailers will purchase less than would be optimal for the supply chain. Revenue-sharing contracts, where suppliers charge a lower wholesale price but then share sales revenues with retailers, can alleviate this problem. However, in settings where it is difficult for suppliers to observe and confirm actual sales, suppliers have often been hesitant to use such contracts, as retailers have both the ability and the incentive to underreport their sales revenues. When implementing revenue-sharing contracts, suppliers often couple them with rather strict auditing policies and penalty schemes to completely avoid such underreporting. However, Sebastian Heese and Eda Kemahlioglu-Ziya show that a complete elimination of retailer opportunism is misguided, and suppliers may actually increase their profits by designing audit mechanisms that curb cheating, but do not fully eliminate it.

### **Integrality in Stochastic Inventory Models**

Wei Chen, Milind Dawande, Ganesh Janakiraman

To allow for a calculus-based analysis, most existing studies on optimal policies for stochastic inventory control problems allow inventories and order quantities to be real-valued. In practice, however, order quantity decisions are typically integer-valued and so are demands. For static as well as dynamic optimization models for stochastic inventory control, a funda-

mental question arises: When the starting inventory levels are integer-valued and all demands are integer-valued random variables, for what kind of inventory problems do there exist integral optimal order quantities, even if we allow them to be real valued? Wei Chen, Milind Dawande, and Ganesh Janakiraman

present two approaches to answer this question in the affirmative for dynamic as well as static rolling-horizon versions of several well-known models: the newsvendor problem and its multi-period extension, a single-product multi-echelon assembly network, and a two-product capacitated model.