

## Research and Management Insights

### The Strategy-Focused Factory in Turbulent Times

Hendrik Brumme, Daniel Simonovich, Wickham Skinner, Luk N. Van Wassenhove

With over half a million reprints, “The Focused Factory” (Skinner 1974) and closely related articles in the *Harvard Business Review*, gave birth to the field of manufacturing strategy forty years ago. The objective of a focused factory is to make production strategy-centric by focusing a plant’s physical features, processes, technology and infrastructure each strictly on the same competitive business priority. Few unfocused factories outperform competitors because they attempt to do well in a too broad mix of products, markets and technologies at the same time and fail to fulfill the specific key tasks required for competing successfully. But focus is elusive simply because markets, products, technologies, and corporate strategy are constantly evolving and thereby demand changes to a factory’s key tasks. So how can the focus be achieved and sustained? This is inherently challenging because factory operations are stubbornly resistant to change as processes, equipment, capacity capability, and infrastructures such as information systems, scheduling, worker skills and attitudes all tend to be resilient and complex to change. This is a serious dilemma for managers of strategy-focused factories and it is to that dilemma that this opinion article is addressed: when, why, what and how to change with respect to focus with a minimum of disruption and a maximum competitive success.

Hendrik Brumme, Daniel Simonovich, Wickham Skinner, and Luk Van Wassenhove present new ideas and understandings about focused production operations developed from insights derived from an historical analysis of the evolution of Hewlett-Packard’s (HP) award winning plant for computer servers in Germany, which went through a series of focused factories over the years, moving from an innovation factory to an operational excellence factory and finally to a solutions factory. Using this example, we provide clues for the right timing of focus changes and discuss critical structural and infrastructural changes required during the focus transitions as well as cross-functional coordination and leadership challenge. The authors’ assertion is that production operations constitute a system that can adapt to

disruptive change by using the levers of manufacturing policies to stay focused on a limited but absolutely essential task which creates strategic advantage. Focus is here to stay but dynamic environmental conditions may require focus transitions. Planning and managing those transitions is a subject that merits a lot more research effort from our community.

### Long-Term Contracting: The Role of Private Information in Dynamic Supply Risk Management

Long Gao

Supply risk information is often private and evolves dynamically over time. Long Gao studies how to use such information to stock inventory for risk mitigation. He shows that the optimal contract is semi-stationary: it distorts order quantity only in the initial period; the optimal payment compensates production cost but concedes real information rent only at the contracting stage. By committing to the optimal contract, the buyer can leverage repeated interactions, overcome information asymmetry, and coordinate the channel. The author also demonstrates that the revenue sharing contract can implement the optimal contract.

### Managing the Performance Trade-Offs from Partner Integration: Implications of Contract Choice in R&D Projects

Alan MacCormack, Anant Mishra

Formal contracts in R&D projects are often incompletely specified given they are developed and signed in the initial stages of projects when requirements are not fully understood. While relational contracting can fill critical gaps in formal contracts, by reducing information asymmetry and aligning the incentives between a firm and its partners, we know little about how formal and relational contracts interact, or the mechanisms through which they jointly impact performance outcomes. Alan MacCormack and Anant Mishra examine how the choice of a formal contract in an R&D project impacts the relationship between relational contracting and partnering performance. They focus on one specific aspect of relational contracting - the level of partner integration, which captures the extent to which a firm and its partners

engage in open communication, the sharing of intellectual property, and joint action on project tasks. Using data from 172 R&D projects, the authors highlight the tradeoffs associated with greater partner integration under different types of contract—namely, fixed price, time & materials, and performance-based contracts. They show that greater partner integration is associated with increased project costs for all contract choices, but associated with higher product quality only when choosing more flexible time & materials or performance-based contracts. Furthermore, the association with quality exists only when the choice of formal contract is aligned with the objectives of the partnering relationship. The findings suggest it is critical that firms align their choice of formal and relational contracts, to ensure effective execution in partnered R&D projects.

### **Bounding Optimal Expected Revenues for Assortment Optimization under Mixtures of Multinomial Logits**

Jacob Feldman, Huseyin Topaloglu

When developing optimization models to find the revenue-maximizing assortment of products to offer to consumers, it is customary to use a choice model that describes how consumers choose within the offered assortment. On the one hand, the choice model should be sophisticated enough to capture the details of consumer choice process. On the other hand, the choice model should be simple enough to ensure that the optimization model that finds the revenue-maximizing assortment of products can be solved efficiently. Mixture of multinomial logits is a flexible choice model that can capture a variety of choice patterns, but the problem of finding the revenue-maximizing assortment of products is intractable when consumers choose according to a mixture of multinomial logits. In “Bounding Optimal Expected Revenues for Assortment Optimization under Mixtures of Multinomial Logits,” Jacob Feldman and Huseyin Topaloglu compute upper bounds on the optimal revenue when consumers choose according to a mixture of multinomial logits. By comparing the upper bound on the optimal revenue with the revenue from an assortment obtained by an approximate solution strategy, one can understand the optimality gap of the assortment on hand.

### **Two Backorder Compensation Mechanisms in Inventory Systems with Impatient Customers**

Jian Chen, Shuo Huang, Refael Hassin, Nan Zhang

When facing shortage in a stochastic-demand inventory system, strategic customers may choose to wait or leave, partly determined by their heterogeneous

impatience factors. On the other hand, to retain customers during stockout period, firms may offer different types of discount to compensate customers who are willing to wait. These compensation mechanisms also affect customers’ wait or leave decisions, and significantly influence firms’ profits. How to simultaneously optimize inventory policy and compensation policy? How does compensation policy affect a firm’s performance and customers’ surplus? Jian Chen, Shuo Huang, Refael Hassin, and Nan Zhang propose two interesting compensation mechanisms during shortages: uniform compensation and priority auction. They obtain the optimal stockout price and base stock level under each mechanism. They find when and how much a priority auction can outperform a uniform compensation. Compared with uniform compensation, auction mechanism benefits customers with relatively lower or higher impatience factors. The authors also show that the disclosure of the state of queue to customers can increase the firm’s profit.

### **The Role of Contract Expirations in Service Parts Management**

Çerağ Pinçe, J. B. G. Frenk, Rommert Dekker

The majority of after-sales service providers manage their service parts inventories by focusing on the availability of service parts. This approach, combined with automatic replenishment systems, leads to reactive inventory control policies where stock levels are adjusted only after a service contract expires. Çerağ Pinçe, Hans Frenk, and Rommert Dekker address this problem by developing proactive inventory control policies taking into account future contract expirations. The key idea is to reduce the base stock level before the demand rate drops and let demand take away excess stock, while the availability of the service parts are controlled by a fill rate target or a backordering penalty. The authors find that if the base stock level is reduced at the right time to the right quantity, a single reduction yields most of the cost savings that can be achieved by multiple base stock reductions. Numerical experiments show that for typical service contract duration (1-5 years), the inventory policy choice mainly depends on the initial demand rate and amount of drop in demand rate. The single base stock adjustment is especially cost effective if the drop rate is expected to be high.

### **Optimal Expediting Policies for a Serial Inventory System with Stochastic Lead Time**

Chiwon Kim, Diego Klabjan, David Simchi-Levi

Leveraging an expedited delivery mode of outstanding orders at a higher cost in emergency situations is a viable option for supply chain managers. As supply

chains gain more complexity, expediting is used to mitigate variability in supply chain lead time in addition to variability in demand. Kim, Klabjan, and Simchi-Levi provide the optimal policy structure of dynamic ordering and expediting for a serial multi-echelon system under stochastic lead time and demand. The resultant policy is a variant of the base stock policy for both dynamic ordering at the supplier and expediting from intermediate installations to the final destination. The authors also identify the class of systems, called sequential systems, where the optimal policy is analytically applicable, and show structural results of base stock levels. An expediting base stock level naturally decreases as the corresponding expediting cost from a certain installation increases. However, the other expediting base stock levels are non-decreasing implying the increased need of expediting to compensate the reduced safety stock due to the increased expediting cost. The numerical study shows that higher variability in lead time and demand leads to higher effectiveness of expediting. After all, expediting under stochastic lead time is only possible if proper visibility is in place, and managers could leverage the results in deciding what information to extract through order tracking systems and how much to invest to estimate return on investment properly.

### **Scalable Dynamic Bid Prices for Network Revenue Management in Continuous Time**

Samuel Nathan Kirshner, Mikhail Nediak

In network revenue management problems, firms face demand for products comprised of various combinations of perishable resources. Due to demand uncertainty and the limited availability of the resources, firms control sales by choosing to accept or reject consumers' requests for products. Although the optimal control for the network revenue management problem can theoretically be computed through dynamic programming, the vast state space renders the problem intractable. In practice, firms utilize a control policy that compares the sum of the approximate value of the resources, which are called bid prices, with the revenue earned from the sale of the product. Samuel Nathan Kirshner, and Mikhail Nediak use cubic splines and second-order cone programming to produce efficient time-dependent bid prices in continuous time. The resulting approximate second-order cone program (ASOCP) significantly reduces the required number of variables and constraints compared to existing discrete-time approaches.

The ASOCP is tested against the state of the art discrete time-dependent bid price policy over randomly generated networks. The run-time of discrete time dynamic bid prices is shown to increase dramatically

as the capacity levels across the network increase in variability. On the other hand, the ASOCP algorithm timing is robust to variation in capacity, implying that the methodology is applicable to situations with frequent updating. The ASOCP is subsequently tested against re-optimized deterministic bid price policies on randomly generated and industrial airline networks. The ASOCP generates higher revenue compared to the re-optimized static bid price, demonstrating the practicality and scalability of the methodology.

### **A note on "Sourcing Decisions with Stochastic Supplier Reliability and Stochastic Demand"**

Christian van Delft, Jean-Philippe Vial

In 2009 Burke, Carillo and Vakharia (BCV) proposed a model to analyze the optimal choice of suppliers for a company facing an uncertain demand and unreliable suppliers. Van Delft and Vial revisit their model. They find a technical error, which invalidates their quadratic formula for the optimal profit and henceforth the suitable amount of diversification among the uncertain suppliers. The updated profit formula shows that the number of suppliers in the optimal bundle, as well as the individual orders, depend on the full distribution of the uncertain yield, and not just on the mean and variance of the yields. However, this correction does not fully refute the BCV's managerial insights: Van Delft and Vial elicit a special condition, depending on the orders to the suppliers and on the yield distributions, under which the BCV's results hold true.

### **Investing in a Shared Supplier in a Competitive Market: Stochastic Capacity Case**

Anyan Qi, Hyun-Soo Ahn, Amitabh Sinha

Anyan Qi, Hyun-Soo Ahn, and Amitabh Sinha investigate two capacity contract structures that firms may engage in when investing in expansion of a shared supplier's capacity: exclusive (the investing firm gets exclusive access to the invested capacity), and first-priority (one firm can access the unused portion of the other firm's invested capacity, if any). They characterize the equilibrium capacity investment outcomes, and identify firms' and supplier's capacity type preferences. They find that under certain conditions, a spillover effect occurs where one firm taps into the other firm's invested capacity, and analyze the impact of the spillover effect on the equilibrium outcomes.

The authors find that while spillover may suggest intensifying competition, it actually discourages firms' capacity investment, resulting in curbing of downstream competition. They also show that while the non-investing firm always prefers the first-priority capacity, the investing firm does not always want to

shut off the other firm's access to its leftover capacity, especially when allowing spillover induces the other firm not to invest. Managerially, therefore, firms considering investing in suppliers who also supply their competitors must consider the consequences of their investment via the lens of a multi-player game, rather than myopically focusing on increased access to capacity. Placing restrictions on the supplier that are too tight may backfire in the form of competitors also jumping in with their own investments.

### **Opportunism in Distribution Networks: The Role of Network Embeddedness and Dependence**

Maggie Chuoyan Dong, Zhiqiang Liu, Yimin Yu, Jin-Hui Zheng

Can a distributor's relationships with others in the distribution network influence its opportunism toward the network's dominant supplier? Using both survey data and analytical models, Maggie Chuoyan Dong, Zhiqiang Liu, Yimin Yu, and Jin-Hui Zheng show that a focal distributor's embeddedness in the distribution network does directly and indirectly

affect its opportunism toward the network's dominant supplier. They designate network embeddedness into relational and structural aspects, and in particular, they find that a distributor's relational embeddedness in the network curbs its opportunism when the network shares the supplier's values. They also show that a distributor's network centrality, as a form of structural embeddedness, promotes its opportunism. Moreover, these two aspects of network embeddedness vary the role of a focal distributor's dependence on the supplier in suppressing the distributor's opportunism, in that relational embeddedness magnifies such a role while network centrality buffers it. These findings offer an argument against the conventional wisdom that close relationships among distributors is a potential threat. These imply that suppliers should actively facilitate the development of strong ties among distributors and strengthen their own ties with distributors. The findings also suggest that suppliers should pay special attention to central distributors in their networks and take measures to prevent the existence of central ones.