Research and Management Insights

The Role of Operations Management across the Entrepreneurial Value Chain
Nitin Joglekar, Moren Lévesque

Technology commercialization and entrepreneurship are acknowledged engines of growth in most modern economies. However, they bring in unique managerial challenges. For instance, failure rates are astoundingly high during the first few years of a firm’s operations with countries such as Canada, Sweden or the United States reporting numbers ranging from 30% over the first two years to 60% over the first six years to as high as 80% over a decade. Joglekar and Lévesque offer production/operations management as a missing link in entrepreneurship research to help today’s entrepreneurs and managers make decisions that can potentially reduce the high failure rates that their business enterprises face in their early years. The authors identify similarities and gaps in research at the intersection of production/operations management and entrepreneurship with an eye towards developing managerially useful decisions models. These gaps are categorized in a framework involving the consideration of resources, routines and reputation that are often lacking, thus generating important tradeoffs, during the early development stages of a business enterprise.

Cooperating to Commercialize Technology: A Dynamic Model of Fairness Perceptions, Experience, and Cooperation
Elco van Burg, Kim E. van Oorschot

This study explores the development of ventures that cooperated with a university-owner of technology and thereby identifies different cooperation patterns in which perceptions of fairness influence the degree of cooperation. These perceptions also change over time, partly as a function of accumulated experience and learning. A system dynamics model integrates insights from existing literature with the empirical findings to reveal which cooperation mechanisms relate to venture development over time; leading to four different patterns which provide many practical insights. Van Burg and Van Oorschot show that university representatives and inexperienced entrepreneurs should recognize the effects of fairness perceptions on the degree of cooperation and venturing progress. Such perceptions might be improved through the careful management of learning, expectations, communication, and procedural consistency. Venturing teams should aim to include experienced entrepreneurs, who can smooth the process, especially if they have cooperated with the focal university before. The authors show that in many cases a vicious circle of decreased cooperation can be turned around through the early involvement of experienced team members.

Integration and Cospecialization of Emerging Complementary Technologies by Startups
Edward G. Anderson Jr., Geoffrey G. Parker

Startups find that they must often integrate their service or product with one or more complementary technologies. For example, startups in the energy storage industry (e.g. batteries) may invest in making their product more cost effective with a renewable power technology, such as wind or solar power. If they invest in integrating their technology with solar, however, much of that investment will not transfer to wind. The problem is especially challenging when the complementary technologies have uncertain cost reduction potentials. The entrepreneurship literature generally suggests that startups should focus any R&D investment as much as possible, but it does not treat the non-linear feedbacks through the market associated with complementary technologies. Research on mature firms, however, suggests that firms should invest in integrating with multiple complementary technologies, but ignores the budget and timing constraints faced by startups. Edward Anderson Jr. and Geoffrey Parker seek to extend the entrepreneurship literature by modeling startups’ entry decisions for markets with important complementary technologies. The results indicate that startups, until they are mature, should generally invest in integrating with only one complementary technology if they seek to maximize expected profit, even if the choice of which technology to integrate with becomes essentially “flipping a coin.”
This is because of the nonlinear returns to integration investment in the presence of complementary technologies. However, this focused strategy often does not yield the highest market share or the lowest likelihood of bankruptcy. If the startup is in an “easy” market with significant growth potential or low competition, they should—if they wish to maximize market share rather than expected profit—invest in integrating with multiple complementary technologies.

**Commercialization of Platform Technologies: Launch Timing and Versioning Strategy**

Hemant Bhargava, Byung Cho Kim, Daewon Sun

Internet-based information technologies have opened up numerous opportunities for startup ventures that connect two or more groups of participants through a platform product. One key question faced by entrepreneurs is the nature and timing of product variety: how many versions should be offered, when should each be launched, and how should each be priced. These questions are critical for entrepreneurs who grapple with the growth vs. profitability conflict. Hemant Bhargava, Byung Cho Kim, and Daewon Sun analyze these questions using economic models which feature two-sided networks, sequential unfolding of consumer and developer participation, and uncertainty regarding developer participation. They demonstrate that product versioning is especially attractive for platform products, but this attraction is mitigated by the additional cost of versioning, especially when developer participation and product success are uncertain. For startup firms, a deferred (or phased) expansion strategy is more likely to be ideal, while established firms with lower uncertainty face a clearer choice between expansion or not. But even for startup firms that face uncertainty in developer participation, early expansion can be desirable because the expanded user market can drive developer participation more strongly, thereby recovering the additional costs of product expansion.

**Entrepreneurial Firms and Downstream Alliance Partnerships: Impact of Portfolio Depth and Scope on Technology Innovation and Commercialization Success**

Manpreet Hora, Dev K. Dutta

Entrepreneurial firms in industries, such as biotech, broadly engage in intellectual capital development to usher in new technology. However, due to lack of knowledge and resources required for developing, manufacturing, marketing and distribution activities, these firms face difficulties in commercializing the technology. To overcome the challenge, entrepreneurial biotech firms tend to form a range of downstream alliance partnerships with pharmaceutical companies. However, little is known as to what factors enable these alliance partnerships to successfully commercialize a technology. Manpreet Hora and Dev Dutta study the role of depth and scope in alliance partnerships and find that both these factors influence successful steps towards commercialization, albeit in different ways. Depth, viewed as repeat alliances with a few partners, builds trust and reduces transaction costs. Scope, viewed as the breadth of the contractual agreements in an alliance, enables knowledge transfer and reduces development costs. Moreover, success is higher for entrepreneurial firms that incorporate both depth and scope in their alliance portfolios. Hence, it is important for entrepreneurial firms facing ongoing challenges in commercializing success to not only be prudent in building depth and scope in their alliance partnerships but also be cognizant of combining both, to achieve greater success.

**The Role of Operational Capabilities in Enhancing New Venture Survival: A Longitudinal Study**

Mohan V. Tatikonda, Siri A. Terjesen, Pankaj C. Patel, Vinit Parida

It is well known that most new ventures fail. Mohan Tatikonda, Siri Terjesen, Pankaj Patel, and Vinit Parida believe that new ventures have a much better chance of surviving and growing if they adopt an appropriate operations strategy. To test this belief, they analyzed 812 new manufacturing ventures over six years, finding that operational capabilities representing flexibility, profitability and productivity have exceptional influence on survival respectively in three new venture phases: start-up, growth and stability. In the first phase entrepreneurs should emphasize high inventory turnover to support customer responsiveness and preserve working capital for product development, market development and firm adaptability. In the second phase entrepreneurs should emphasize larger gross margins which generate internal working capital to resource the production ramp-up necessary to meet increasing demand. In the third phase entrepreneurs should emphasize employee productivity to help achieve sustainable volume production. These operational capabilities are always beneficial, but there is a notable heightened benefit of specific operational capabilities in specific phases. In all, the theory and results lead to a new phased-capabilities model of operations strategy for new ventures which significantly increases venture survival probabilities.
Operational Entrepreneurship: How Operations Management Research Can Advance Entrepreneurship
Dean A. Shepherd, Holger Patzelt

Entrepreneurs or managers of entrepreneurial firms act to pursue opportunities. They do this through (1) the recognition of an opportunity for someone with the knowledge and motivation required for such recognition (a.k.a third-person opportunity), (2) the evaluation of that opportunity to determine if it represents an opportunity for the specific entrepreneur (i.e. whether the opportunity for someone else [i.e a third person] represents an opportunity for him or her [first-person opportunity]), and (3) opportunity exploitation. This entrepreneurial process, in turn, has implications for value creation for the individual, firm, society, and environment. The effectiveness of this process can be enhanced by operations management tools. Specifically, by gaining a deeper understanding of operational entrepreneurship, entrepreneurs and managers of entrepreneurial firms can be more effective at (1) building or acquiring the knowledge and motivation necessary for opportunity recognition, (2) evaluations of recognized opportunities to determine if they represent an opportunity for the specific individual, and (3) the seeking and processing feedback from the exploitation of a current opportunity to inform the recognition and evaluation of subsequent opportunities.

Advancing Theory in Entrepreneurship from the Lens of Operations Management
Phillip Phan, Chester Chambers

The practices between Operations Management (OM) and Entrepreneurship (ENT) are not as disparate as the theories and topics suggest. OM is primarily concerned with the creation, management, and improvement of systems and processes that produce and/or deliver goods and services of economic or social value. ENT is concerned with the identification and creation of new opportunities for economic or social value creation. The improvement of process efficiency and the understanding of systems dynamics embed the inherent ability to identify new ways to deliver economic value, which can lead to new forms of businesses. For example, the use of technology to track the movement and usage of inventory more efficiency (RFID) reduces spoilage, inventory carrying costs and work-in-process capital. At the same time, the availability of the technology has also led to the creation of new payment methods for road and parking metering, and the delivery of real-time customized advertising to consumers. While the practice of OM is generally focused on the reduction of variability in systems to improve predictability and control, the practice of ENT is focused on the identification of uncertainty and sources of variability as sources of new opportunity. This seems like a contradiction in purpose but a closer examination suggests that the techniques, simulation, experiments, and hedging employed by OM can be applied to parsing the sources of variability that is predictable (and hence can represent opportunities for building sustainable business models) and that which is random (and hence assist entrepreneurs in avoiding business ideas that may be unsustainable). In sum, OM and ENT are potentially more connected in practice than they first appear. Entrepreneurs should carefully consider the techniques used by operations managers in the planning and execution of their venture ideas.

Knowledge Management for the Entrepreneurial Venture
Cheryl Gaimon, Jennifer Bailey

Gaimon and Bailey explore the performance-enhancing benefits of knowledge management for the entrepreneurial venture. Knowledge management is shown to change throughout four phases of the venture’s lifecycle. In phase one, knowledge is a key driver of entrepreneurial alertness and creativity, impacting the quality and quantity of opportunities. Alertness is improved by the entrepreneur’s congenital knowledge gleaned from experience with previous employers as well as through learning-by-doing from repeated entrepreneurial experiences. However, while knowledge represents the foundation for new ideas, it may also limit a person’s views and thereby inhibit creativity. In phase two, knowledge enables the entrepreneur to decide which opportunity to pursue. Knowledge transferred from the entrepreneur’s social network is instrumental for the decision to pursue an opportunity in ambiguous environments. In phase three, knowledge is managed during the development of the product or technology including analysis of exploration versus exploitation. Under some conditions exploitation follows or precedes exploration and the sequence is impacted by a risk-seeking versus risk-averse entrepreneur. In phase four, knowledge is shown to impact the market entry decision, survival, and the value at commercialization. In particular, the timing of market entry may be accelerated by accessing knowledge from collaborative alliances.
Operations Management Research and Impact Opportunities in Technology Commercialization and Entrepreneurship
Vish V. Krishnan

The field of Production and Operations Management (POM) could become much more relevant to the current challenges and concerns of managers in job-creating growth companies vital to our economies. POM at its core is about “doing more with less”, which is very well aligned with the context and needs of resource-constrained entrepreneurial companies. In this article, Krishnan discusses how the research paradigm of POM is and can be relevant to meeting the emerging challenges of growth companies of tomorrow. Specifically, the author examines how POM can help meet the needs of these organizations to become scalable and sustainable. The objective is to stimulate thought and discussion, and encourage early-stage POM scholars to seriously consider the contexts of technology commercialization, entrepreneurship, and growth companies as avenues for future research.

Integration of Global Knowledge Networks
Edward G. Anderson Jr., Geoffrey G. Parker

Outsourcing, offshoring, open-source and other distributed project arrangements between lead firms and their suppliers to perform knowledge work (e.g., engineering, programming, etc.) once required the suppliers to execute tasks that were very simple or did not require much interaction. However, recently these distributed arrangements have evolved into networks of allied companies that must work together in product, process, or service development or other similarly complex projects that require the coordination of highly-trained employees with significant tacit or “tribal” knowledge. This dispersion complicates the process of completing projects with high project coherence and quality from initial vision to customer delivery (called “integration” for short). In addition to cataloging the challenges in such arrangements, research on these issues has begun to offer some helpful tools such as contract and incentive design, organizational structure, work design, and information technology. However, many opportunities have not been widely researched and the authors identify gaps in the literature. Two areas in particular are worthy of special mention: One is how to organize human relations at the project level across firms and what training these human connections should receive. Another is exactly which sort of tools should be implemented within information systems that connect organizations.

Leveraging Open Innovation Using Intermediary Networks
Corey Billington, Rhoda Davidson

Corey Billington and Rhoda Davidson show that procurement currently has a much broader and more valuable role to play. The department best known for containing costs is in a prime position to accelerate innovation. Procurement chiefs have to be seen—and to see themselves—as “drivers of revenue through innovation.” Two emerging factors have initiated this opportunity: the effectiveness and growing acceptance of open innovation and the recent emergence of Internet-enabled intermediary networks, such as InnoCentive or Linked-In. Intermediary networks are essentially novel procurement structures. Such networks are becoming increasingly useful to managers because they are significantly less expensive and more effective than conventional mechanisms for addressing some problems. By using these networks companies can rapidly extend the boundaries of innovation search and essentially put millions of brains to work, making “the cloud” a special type of supplier. Managers that want to harness the power of open innovation through intermediary networks must develop internal processes for bringing codified and un-codified knowledge into their organization. The authors elaborate on these different processes in a step-by-step manner and provide managers with key performance indicators for measuring performance.

Team Dispersion, Information Technology, and Project Performance
Indranil Bardhan, Vish V. Krishnan, Shu Lin

The widespread adoption of internet and information technology-based applications has transformed the landscape of business project management. Companies increasingly distribute their projects across multiple geographic locations to realize time and cost savings from tapping a global workforce. However, the performance of distributed projects presents a major challenge for managers with the dispersion of team members having an adverse effect on project performance. A few leading firms have tapped technology as an enabler of communication to bridge the spatial distance among team members in distributed projects. However, the impact of these information technologies on project performance has not been empirically studied. Indranil Bardhan, Vish Krishnan, and Shu Lin use an empirically-tested model to show that (a) project team dispersion is associated with lower levels of project quality, on-time completion rate, and longer cycle times, and (b) information tech-
nology can mitigate the negative effect of team dispersion on project performance, especially in high information volume projects. Their findings have important implications for the growing practice of distributed project management in helping to realize the potential benefits of geographic distribution.

**Supply Chain Integration, Product Modularity and Market Valuation: Evidence from the Solar Energy Industry**
Jane Davies and Nitin Joglekar

Davies and Joglekar explore the value of a network of firms and show that supply chain effects are captured in the market valuations of the constituent firms in the network. In order to do so, they develop a method for simultaneously estimating firm and aggregated supply chain valuation. Their results indicate that capital markets endow firms deploying integrated supply chains with a higher market value than the rest. These results also identify tradeoffs that can occur between the use of product modularity, supply chain integration, and the production, storage, and delivery costs for firms in the solar energy industry. That is, the capital market recognizes that the use of product modularity and supply chain integration comes with a cost. Thus, an effective way to implement product modularity for solar energy firms is to combine it with supply chain integration when this would also reduce the cost of production.

**In-house Globalization: The Role of Globally Distributed Design and Product Architecture on Product Development Performance**
Bilal Gokpinar, Wallace J. Hopp, Seyed M. R. Iravani

Global distribution of product design and development efforts is a widespread phenomenon in today’s networked world. For many large product development organizations, the critical decision is not whether to distribute the design work or not, but rather how to distribute this in the most effective manner so that challenges and problems associated with globalized work do not offset the benefits. Focusing on operational issues resulting from the globalization of product development work, Gokpinar, Hopp, and Iravani investigate the effects of in-house globally distributed design on speed and accuracy of the product development process. They find that increasing the degree of global distribution of a design task makes it less likely to be completed on-time. Also, by introducing product architecture as a major factor in knowledge transmission across different geographic locations, they observe that increasing the global distribution of an architectural subsystem leads to higher error rates. Finally, they find that central subsystems in the product architecture are particularly vulnerable to this negative effect of global distribution.

**Failure Modes and Effects Analysis: An Evaluation of Group versus Individual Performance**
Héctor H. Guerrero, James R. Bradley

Failure Modes and Effects Analysis (FMEA) is a frequently used tool in process and product design. It has a long history of use and is a formally prescribed procedure by many prominent standards organizations. Additionally, it has become a popular and widely interpreted tool in Lean/Six Sigma (LSS) process improvement. Although it is commonly understood that FMEA analysis should be performed by groups of cross-functional individuals, it is often the case that FMEA analyses are performed by individuals. In this article, Héctor Guerrero, James Bradley investigate the quality of individual versus group performance by examining three FMEA ranking approaches: 1) by individuals, 2) by group consensus, and 3) by non-collaborative group input (or a synthesized distributed group ranking). Not surprisingly, it is found that groups outperform individuals. But, what is of real interest is that synthetic groups perform as well as group consensus. The implication of this result on the coordination of the design of products and processes amongst distributed organizations is very important. This is especially true given the increasingly common distribution of product design efforts, both in terms of geography and across different organizations. The distributed synthetic approach could lead to better product design and more efficient process improvement.

**Inter-organizational Quality Management: The Use of Contractual Incentives and Monitoring Mechanisms with Outsourced Manufacturing**
Sean M. Handley, John V. Gray

The use of contract manufacturers (CMs) is on the rise, and examples of quality-related incidents involving CMs are becoming increasingly prevalent. With a focus on outsourced production in FDA-regulated industries, the authors study the use and effectiveness of two inter-firm quality management practices: contractual penalties for external quality failures and quality audits of the CMs’ plants. Specifically, Sean Handley and John Gray investigate whether these two management practices are used in a complementary manner (i.e. in combination), and whether they have a synergistic effect on aligning the quality interests between brand-owning customers and their CMs. Interestingly, the results demonstrate that as firms place more severe external failure penalties in the
contracts with their CMs, they tend to perform less frequent quality audits of their CMs’ plants. The authors also find that both more severe external failure penalties and more frequent quality audits have a unique positive effect on the CMs’ perception of relative quality importance. Finally, there is some evidence to suggest that there are synergistic benefits to using the two practices in tandem. That is, the positive effect that each practice has on aligning quality interests is strengthened when the other practice is used as well.

Structuring Work Distribution for Global Product Development Organizations
Anshuman Tripathy, Steven D. Eppinger

As firms seek to expand their R&D activities across the globe, they face the difficult task of identifying the right engineering and design content to offshore. This content is easy to identify for those firms that offshore for specific competencies. For firms that seek to offshore for arbitrage benefits, offshoring modular tasks, which are loosely connected, is an easy decision. However, most firms find it very hard to identify such modular content. Instead, most development tasks are interconnected in complex ways, requiring significant coordination and information exchange with other tasks regardless of their locations. Tripathy and Eppinger propose a methodology for structuring the work distribution firms with such complex process architectures and apply the method to an industrial application. They employ the design structure matrix to identify the architecture of the development process and its work distribution and then use mathematical programming to propose an appropriate global assignment of the work. Interestingly, their analysis further shows that offshoring based on modularity is not always the right answer, and that firms should identify offshoring content to successively benefit from the learning effects from previous offshoring efforts.

The Effect of Learning and Integration Investment on Manufacturing Outsourcing Decisions: A Game Theoretic Approach
Wenli Xiao, Cheryl Gaimon

Buyer and supplier decision-making is fundamental to operations management. Xiao and Gaimon obtain important insights on this problem. First, if the value of current manufacturing experience on future product-process development capabilities is sufficient, the authors demonstrate that the buyer pursues a partial outsourcing strategy even if the marginal cost of outsourcing is less than the marginal cost of in-house production. Second, the authors recognize the importance of suppliers investing in integration process improvement (IPI) to reduce the buyer’s costs and attract outsourcing. A supplier’s investment in IPI includes creating specialized technology or re-designing the integration process. The authors show how the supplier’s investment in IPI impacts the buyer’s outsourcing decision as well as the supplier’s price. Third, the authors demonstrate the importance of manufacturing volume-based learning. If the supplier’s rate of learning increases, then the authors show that the buyer and supplier’s decisions lead both firms to earn higher profits. In contrast, if the buyer’s rate of learning increases, the buyer earns higher profit whereas the supplier’s profit is lower. Therefore, the buyer’s ability to leverage current manufacturing experience, the supplier’s investment in IPI, and the rates of volume-based learning have strategic consequences to both firms.