Martin K. Starr: A Visionary Proponent for System Integration, Modular Production, and Catastrophe Avoidance

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Martin K. Starr facilitated the creation of an identity for production and operations management (POM) as an academic discipline. This paper aims to summarize Starr’s substantial contributions to scholarly inquiry on system integration and interfunctional coordination, modular production, and catastrophe avoidance. Even after four decades, we describe how his legacy in these areas continues to define several major drivers of operations and supply chain management research and practice. Starr has influenced several generations of students, professors, and executives with his writings, teaching, and leadership roles in the POM community that include 32 years on the faculty of the Columbia School of Business, 15 years as Editor-in-Chief of Management Science, and presidency of the Production and Operations Management Society.

Key words: Martin (Marty) Kenneth Starr; production and operations management; system integration; interdisciplinary research; modular production; catastrophe and risk

1. The Emergence of Production and Operations Management (POM) as an Academic Discipline and System Integration

We describe the contributions and legacy of Martin K. Starr for his role in building the field of POM. We cover his intellectual contributions to the literature, teaching, and leadership. Starr entered the academic arena in 1953, with degrees from MIT and Columbia. This was a time when many breakthrough developments were taking place in production and operations management following the emergence and growth of industrial age corporations from 1880 to 1932 and mass production during the Second World War. However, it was not until after the Carnegie Corporation and the Ford Foundation’s recommendations to improve analytical approaches and research in 1959 that modern business education started to emerge. Notably, at that time, POM did not have an identity as a distinct academic disciple in universities, despite the accumulation of a massive body of new knowledge on production (Gupta and Starr 2006; Singhal, Singhal, and Starr 2007). This void created an opportunity for Elwood S. Buffa at UCLA to consolidate knowledge from various streams of POM into a coherent managerial framework in the first edition of his textbook, Modern Production Management (Buffa 1961).

Having read and taught using the Buffa text, Starr designed an introductory operations management course around it at Columbia. In 1964, he expanded the vision and extended the boundaries of POM with a systems-oriented textbook, Production Management: Systems and Synthesis (Starr 1964a). In his seminal textbook, Starr focused on interdependence of various components in the architecture of POM and on POM’s cross-functional interactions in organizations. This system-oriented textbook was translated into Hungarian, Portuguese, Romanian, Russian, and Spanish. Starr not only facilitated the creation of POM as a well-defined and coherent academic discipline, but also emphasized the existence of permeable bound-
aries between the subsystems and a strong need for integrating them. In the preface to his textbook, Starr wrote,

“The spirit of this book is embodied in the relationship of systems analysis to systems synthesis. The distinction between analysis and synthesis is neither esoteric nor academic. Analytic behavior follows what might be called principles of disassembly. It exists in terms of operations that involve division, dissection, classification, separation, partitioning, segmentation, and so forth. Thus, using analysis we proceed to take the production management domain apart. We study the pieces and attempt to improve them. Then, we reassemble the system, but because of interactions and dependencies between the parts it is quite possible that the reassembled production function will not be improved and may be impaired. Synthesis is required to put things back together again in a measurably ‘satisfactory’ way. To achieve this objective, it may be necessary to modify the results derived by analysis of isolated parts. Synthesizing behavior can be expressed as a set of (corollary) ‘principles of assembly’. . . Synthesis... can be identified with attitudes and activities that are common in architecture, art, and sculpture. Here, creativity thrives on overview abilities that take advantage of penetrating insights.”

Starr’s book also included chapters emphasizing and explaining POM’s interactions with finance and marketing. The concepts of cross-functional integration and permeable boundaries of POM came to the limelight three decades later when a renewed emphasis was given to the importance of boundary management in world class manufacturing (Giffi, Roth, and Seal 1990; Roth 1992). Stemming from information processing theory and the knowledge-based view, the theoretical and practical rationale for Starr’s early conceptions is this: “The competitive environment and the strategic manufacturing task have profound implications for the types of knowledge that a manufacturing organization requires. New knowledge requirements often come from outside the manufacturing function as companies competing to design successful products contend with different types of process technologies, materials and skill requirements. . . This evolution suggests that an open systems model of manufacturing, which requires an ongoing information exchange between the manufacturing functions and the external environment, may be more appropriate for operation in the twenty-first century. When it comes to integration, the set of manufacturing choices becomes an arsenal of new strategic weapons . . . For example, manufacturing, finance, marketing and product development may all have different plans for a new product, which when taken alone or combined without an overall structure, may be incompatible. Boundary management defines the way in which the strategy instruments ‘sound’ together. . . (It) will reshape the architecture of the manufacturing organization to an open systems design” (Giffi, Roth, and Seal 1990, p. 82).

The concept of permeable boundaries of POM also became important when globalization and vertical disintegration created a new paradigm for managing supply chains. Lee and Ng (1997), in their introduction to a special issue of Production and Operations Management on Global Supply Chain Management, pointed out that interdisciplinary perspectives, combined with the benefits of interorganizational coordination, were primarily responsible for the new paradigm in supply chain management. They noted, “It seems that the distinction between the so-called supply chain management today and traditional operations management lies in two dimensions of integration and coordination: organizational integration and flow coordination. The first dimension is in the integration of organizations to break the organizational boundaries. Hence, companies are seeking opportunities to overcome the company boundaries, working closely with their suppliers and customers. Companies are also overcoming the functional boundaries, so that the different disciplines and functions, such as manufacturing, distribution, marketing, accounting, information, and engineering, are better integrated” (p. 191).

Interdisciplinary and interorganizational research has now become a major focus of operations management. Carrillo (2005), Jain and Ramdas (2005), Mallick and Schroeder (2005), and Schmidt and Druehl (2005) build on the literature in marketing and engineering for their work on product development. Seshadri and Subrahmanyan (2005) edited a special issue of Production and Operations Management on risk management in operations. Seven papers in this special issue (Gans, Sethi, and Yan 2005; Hendricks and Singhal 2005; Kleindorfer and Saad 2005; Lederer and Mehta 2005; Martinez-de-Albeniz and Simchi-Levi 2005; Miller and Park 2005; and Sodhi 2005) either integrate concepts from finance and operations or modify concepts from finance in the context of operations. For a review of interdisciplinary and interorganizational research in operations management, see the article by Buhman, Kekre, and Singhal (2005).

The systems-oriented approach to POM has remained a constant in Starr’s works. In the preface to his most recent textbook, Foundations of Production and Operations Management, Starr (2006) writes, “The systems view integrates information, rejecting functional boundaries in pursuit of solutions to real problems. Isolation of functions within a company (referred to as ‘stovepipe organization’) produces poor decisions compared with the results of interdisciplinary teamwork.” It was not until the late 1980s that this perspec-
tive became conventional wisdom in western POM practices (Giffi, Roth, and Seal 1990).

2. Modular Production

In 1965, Starr articulated the concept of “modular production” in a pioneering article (Starr 1965a), “Modular production—A new concept,” published in the Harvard Business Review. The journal’s editors observed, “‘Modular Production’ is the name Martin K. Starr gives to a newly developing capacity to design and manufacture parts which can be combined in the maximum number of ways.” The paper evolved from Starr’s 1963 book, Product Design and Decision Theory (Starr 1963). The concept of modular production created opportunities for mass customization and operational agility and served as a driver of vertical disintegration of supply chains.

Starr (1965a) suggested that modular production, like the advent of interchangeable parts, was inevitable. Four decades later, consistent with Starr’s prophecy, the phrase “modular production” has become part of the business lexicon and the basic concepts that Starr articulated have become a part of modern business vernacular describing operational agility, cellular manufacturing, and mass customization. Most of the published papers (for example, Fredriksson 2006, Mikkola 2006, Patnayakuni, Rai, and Seth 2006, Persson and Ahlstrom 2006,Skipworth and Harrison 2006, and Thyssen, Israel, and Jorgensen 2006) and unpublished papers [http://esd.mit.edu/wps/2001.htm][http://www-innovation.jbs.cam.ac.uk/publications/reichhart_form.pdf] on modular production continue to cite Starr’s work. Starr (1965a) articulated the basic concept of modular production as follows:

- “The change . . . can be briefly described as the consumer’s demand for maximum productive variety (or maximum choice). To achieve this variety, what I call “modular” or “combinatorial” productive capacities—that is, capacities to design and manufacture parts which can be combined in numerous ways—are required, as well as compatible managerial abilities” (pp. 131–132).
- “The essence of the depicted capability is technological. The notion of high-volume, low-cost, automated mass production will eventually give way to adaptive automation capable of producing a sequence of unique outputs at no sacrifice of volume and at no significant increase in cost” (p. 135).
- “It is the essence of the modular concept to design, develop, and produce those parts which can be combined in the maximum number of ways” (p. 138).
- “One accent is on design; a second is on the exercise of adequate managerial controls” (p. 138).
- “To achieve differentiation, there will be small batches of units with separate setup charges. And yet, because of the technology and methodology employed, the total charges, including those for setup, can be significantly less than the total revenue obtained in the marketplace” (p. 135).

We point out that Starr brought to attention the issue of small batches and low set-up cost long before the Japanese companies made them popular in the rest of the world. Consistent with Starr’s prognosis, the concept of modular production has made an impact on five dimensions: accelerated innovation (technology), increased outsourcing coupled with vertical disintegration (supply chains), permeable boundaries of functions and integration of the system, mass customization (market), and modularity in services.

Accelerated Innovation

Modularization accelerates the pace of innovation, reduces cost, increases flexibility, and cuts time to market. Baldwin and Clark (1997, p. 86-87) observe, “Through the widespread adoption of modular designs, the computer industry has dramatically increased its rate of innovation. Modularity in use can spur innovation in design: the manufacturers can independently experiment with new products and concepts . . . and find ready consumer acceptance as long as their modules fit the standard dimensions. By delegating the manufacturing process to many separate suppliers, each one of which adds value, the assembler gains flexibility and cuts costs. That amounts to a refinement of the pattern of modularity already established in production.” Fine (2000, p. 217) observes, “Modularizing a product’s architecture breaks it down into simpler subsystems and often enables a faster development pace.” In the context of the defense industry, Fine (p. 217) adds, “Such modularization and outsourcing not only significantly reduces development times for defense suppliers but eases the way for frequent and profitable upgrades as more powerful imaging technology is developed.” In the context of outsourcing of medical imaging systems, Fine reports (p. 218) that the “suppliers have cut their time to market and stolen a march on some less resourceful competitors.” The observations of Baldwin and Clark and also those of Fine are consistent with Starr’s prediction: “The essence of the depicted capability is technological. The notion of high-volume, low-cost, automated mass production will eventually give way to adaptive automation capable of producing a sequence of unique outputs at no sacrifice of volume and at no significant increase in cost (Starr 1965a, p. 135)”.
Outsourcing and Vertical Disintegration in Supply Chains

Starr (1965a) observed, “The change represents a fundamental departure from prior conditions in the sense that previously one company’s ability to mass-produce identical items could be copied by other firms. But for modular production there are no patterns available with which to model and manage the production system. A great deal of innovation and creativity is called for, and with these will be found the inevitable partners, risk and uncertainty, and real vulnerability to astute competitive practices. . . . It is apparent that we are dealing with a situation that will involve fundamental changes in the enterprise” (p. 142).

Modular production has indeed led to fundamental changes in the way organizations function; and the changes are accompanied with “innovation and creativity,” “inevitable partners, risk and uncertainty, and real vulnerability to astute competitive practices” as Starr had forecasted. First, Baldwin and Clark (1997) observe, “As modularity becomes an established way of doing business, competition among module suppliers will intensify. Assemblers will look for the best-performing or lowest cost modules, spurring these increasingly sophisticated and independent suppliers into a race for innovation similar to the one already happening with computer modules (p. 87).” They added, “Modularity does more than accelerate the pace of change or heighten competitive pressures. It also transforms relations among companies. Module designers rapidly move in and out of joint ventures, technology alliances, subcontracts, employment agreements, and financial arrangements as they compete in a relentless race to innovate” (p. 88).

Second, modular production is one of the primary drivers of outsourcing and vertical disintegration. We describe two perspectives on this outcome. Christensen, Verlinden, and Westerman (2002) point out that interdependent product architectures predominate during periods when the product functionality is not yet good enough to meet the customers’ needs. When functionality surpasses the level of customers’ needs, customization for various market segments becomes a competitive weapon. This is accomplished by modular product designs because modularization facilitates innovation and creates additional options for speed, flexibility, and cost reduction. Christensen, Verlinden, and Westerman (2002, p. 965) note, “Modularity then enables independent, focused providers of individual pieces of value-added to thrive, because transactions cost-minimizing structured technical dialogue can occur. As a result, an industry which at one point was dominated by integrated firms becomes dominated by a population of specialized, non-integrated firms.”

This trend toward modular archetypes is also observed in modern B2B marketspaces (Rosenzweig and Roth 2007). These authors found three distinct groups of companies that are defined by the characteristics of their interactions with business partners using the Internet, which they labeled e-transactions, modular and integrator types. The modular group, in contrast to the other two types, had supply chain relationships that were more loosely coupled, short-to-medium term in duration, making it relatively easy to switch partners. Thus, while modular archetypes had made some investments in asset-specific relationships, they could easily reconfigure their supply chain to be responsive to changing business customer requirements.

Fine (2000, p. 216) offers another perspective on the relationship between modular production and vertical disintegration of supply chains, “Consider the dynamic forces at work: When the industry structure is vertical and the product architecture is integral, the forces of disintegration push toward a horizontal and modular configuration. These forces include: 1) The relentless entry of niche competitors hoping to pick off discrete industry segments 2) The challenge of keeping ahead of the competition across the many dimensions of technology and markets required by an integral system 3) The bureaucratic and organizational rigidities that often settle upon large established companies. These forces typically weaken the vertical giant and create pressure toward disintegration to a more horizontal, modular structure."

System Integration

After emphasizing permeable boundaries and integration of the system in his 1964 textbook, Starr returned to this theme in the context of modular production, “For those companies that will evolve successfully by maintaining or increasing their total share of a growing market, a new form of effort which will cut across many functional organizational areas is required. We can call this new orientation a ‘synthesis’ to distinguish it from ‘analysis,’ the euphemism which epitomizes the traditional production management approach” (Starr 1965a, pp. 132–135). He added, “What is required is the ability to manage a new kind of productivity. An appropriate organizational structure would provide greater responsiveness to the market. In such an organization, production would be in touch with consumers, with the contact mediated by the marketing function. An appropriate organization would also allow the production manager to respond with sensitive perception to developing technologies. To achieve such results, a much higher level of functional integration is called for. It is also quite clear that production management should once again participate in top management decision making.” We also point out that Starr emphasized the notion of focus on
Gupta and Roth: Martin K. Starr: A Visionary
Production and Operations Management 16(1), pp. 1–12, © 2007 Production and Operations Management Society

the customer long before Japan exported the total quality management evolution with this focus as its core. More than three decades later Baldwin and Clark (1997, p. 91) emphasized the same theme, “For those organizational processes to succeed, however, the output of the various decentralized teams (including the designers at partner companies) must be tightly integrated. As with a product, the key to integration in the organization is the visible information.” They added (p. 92), “The well-publicized problems of many computer companies have often been rooted in inadequate coordination of their development teams as they created new products. Less obvious, but equally important, are the problems that arise when teams fail to communicate the hidden information—the knowledge they develop about modular technology — with the rest of the organization. That lack of communication, we have found, causes organizations to commit the same costly mistakes over and over again.”

Mass Customization
Starr developed the concept of modular production as a response to “the consumer’s demand for maximum productive variety (or maximum choice)” and noted, “To achieve this variety, what I call “modular” or “combinatorial” productive capacities—that is, capacities to design and manufacture parts which can be combined in numerous ways—are required, as well as compatible managerial abilities” (Starr 1965a, p. 131–132). The “demand for variety” now has a more formal term, “mass customization.” Modularity remains a key to mass customization (Pine 1993; Feitzinger and Lee 1997). Mass customization, like modular production, has also quickly become a part of the business vocabulary and has been widely covered in the literature (Kotha 1995; Piller 2004).

Modularity in Services
Modularity has also become a basis for customizing and capability building in services. In the second edition of Production Management: Systems and Synthesis, Starr (1972, p 217–218) wrote about services and modularity, “A major factor in the development of new products and services is the ability to achieve the right level of innovation. We can begin to understand the nature of this problem by considering trees of strategic alternatives. . . . Thus, from the point of view of designing a restaurant, the relevant variables include: menu variety (both type of food and variety of offerings), food quality, service quality, atmosphere provided, and many other factors.” Starr shows a design tree reflecting 7200 different kinds of restaurants constructed of the various modules.

Twenty-five years later, Baldwin and Clark (1997, p. 88) noted, “In addition to products, a wide range of services are also being modularized—most notably in the financial services industry, where the process is far along. Nothing is easier to modularize than stocks and other securities. Financial services are purely intangible, having no hard surfaces, no difficult shapes, no electrical pins or wires, and no complex computer code. Because the science of finance is sophisticated and highly developed, these services are relatively easy to define, analyze, and split apart.” They can then be reconfigured into a wide variety of new offerings. They added, “The other result of the intrinsic modularity of financial instruments has been an enormous boost in innovation. By combining advanced scientific methods with high-speed computers, for example, designers can split up securities into smaller units that can then be reconfigured into derivative financial products. Such innovations have made global financial markets more fluid so that capital now flows easily even between countries with very different financial practices” (p. 88).

The conceptualization of modularization in services also provides the impetus for operational agility, “defined as the ability to excel simultaneously on operations capabilities of quality, delivery, flexibility and cost in a coordinated fashion” (Menor, Roth, and Mason 2001, p. 273). The 2000 Malcolm Baldrige Quality Program Criteria for Performance Excellence on Agility (NIST, 2000, pp. 3–4) states: “Success in globally competitive markets demands creating a capacity for rapid change and flexibility. . . . All aspects of time performance are increasingly important. . . . Time improvements often drive simultaneous improvements in organization, quality, cost, and productivity.”

The empirical results in the paper by Menor, Roth, and Mason (2001) demonstrate that agile banks had significantly higher levels integrating technologies than their nonagile counterparts, and in turn, had greater factor productivity and business sustainability. They conclude “Operationally agile banks apparently take a more holistic [systems] approach, with more highly integrated, cross-functional strategies. While higher investments in technology and capacity were typically associated with operational agility, perhaps even more striking was the agile group’s attention to understanding their customers and competitors and to cultivating a skilled and knowledgeable workforce. . . . Clearly, agile banks coordinate tightly marketing, human resources and operations practices, as conventional wisdom posits for delivery service excellence” (p. 288).

3. Catastrophe Avoidance
In his book, Management: A Modern Approach, Starr (1971b) devoted an entire chapter on planning for high-risk systems. In that chapter and in three of his earlier works, which include two books (Miller and...
Starr 1960; Miller and Starr 1967) and a paper in Management Science (Starr 1966), Starr described threshold-constrained models for dealing with the possibility of “catastrophic” outcomes. He listed the following characteristics of these models:

- The strategic sequence is speculative.
- Evolving environmental configurations are forecast with varying degrees of believability.
- Network branches associated with probabilities of “ruin” that are in excess of some value define a ruin-path, which must be avoided.

Ruin-paths are more likely to appear when a large percentage of total assets is involved in the planning decisions.

Starr described a mathematical model based on gambling theory and offered an important insight “What constitutes threat to one company may not be threat to another. The differentiating factors are the size of penalties, their probabilities of occurrence and the effects of vulnerabilities to such penalties. Even in a specific situation, two executives of the same company may disagree. Their difference of opinion can be traced to psychological, value-based considerations. At the root of this issue are lifetime attitudes concerning fundamental utilities. Given two companies with different circumstances, the problem becomes easier to visualize. Companies can be differentiated with respect to many relevant factors including their total assets and the percent of total assets that a plan puts at stake” (Starr 1966, p. B-134).

The models described by Starr can be used for maximizing profit subject to a ruin probability constraint or for minimizing ruin. The solution would discard plans that contain ruin- or catastrophe-prone nodes, that is, the plans, which exceed a certain level of probability of catastrophe. Starr pointed out that the analysis of such models would involve statistics of extremes (Gumbel 1958), and he referred to Borel (1962) for a fascinating discussion on a “reasonable level of safety” where a life was concerned. Consistently with his view of organizations, Starr emphasized that these models “require cutting across the nominal boundaries of an organization to integrate various functions such as finance, marketing and production within a single higher-order system” (Starr 1966 p. B-138).

Starr suggested that these models could be applied to floods, earthquakes, gamblers’ wagers, self-insurance, liquid reserves, breakeven points, and contests. Starr saw an increasing role of models in dealing with uncertainty (Starr 1971b, p. 32), “A... reason for the expanded use of models is that the amount of uncertainty with which management must deal has been increasing rapidly, along with this has come an increase in the consequences of errors. The uncertainty level has risen as product life has become shorter, technology more dynamic, and societal factors more forceful. The cost of errors has grown with national distribution of products, tighter profit margins, and increasing social penalties.” The roles of models in dealing with uncertainty and possibilities of catastrophes continues to expand even more rapidly with coordination and security of global supply chains, increasing complexities of products and organizations, and human-made and natural disasters. Se- shadri and Subrahmanyam (2005) point out that analysis of catastrophic risks has gained greater attention due to the widespread use of automated systems and the perceived vulnerability of digital and global operations to random events. Following 9/11, Starr (2001c, 2004b) refocused on this theme in the context of POM’s central role in managing safety and security.

4. The Teacher

The disciplines of management science and POM were still in their infancy when Starr started his career. However, these disciplines contained knowledge that could have a major impact on the way the economy and the organizations functioned. Starr became convinced that classroom teaching, executive development programs, and textbooks were critical vehicles for creating such an impact and building the field. Since then, he has authored or co-authored 24 books on production and operations management, operations research/management science, and statistics. Several of them have been translated into various languages.

In 1962, Martin Starr and David Miller published an intermediate-level text, Inventory Control: Theory and Practice (Starr and Miller 1962). It was the first textbook to introduce both mathematical theory and utilization of computers at a time when very few companies were using either for inventory management. In the preface of this book, Starr and Miller wrote that the book covered the “problems whose solutions have meaningful consequences in the practical applications of the theory” and that “for most inventory problems, mathematical analysis” was “the only way to find the optimal inventory policy,” (p. viii). This book was translated into French and Spanish.

Starr broke new grounds with his most favorite book, Management: A Modern Approach (Starr 1971b) in which he used the tools of operations research, management science, information theory, and statistics to explore the traditional view of management and organization theory. David Hertz, who was head of McKinsey’s Operations Research Consulting Office when the book was published, said that this was “one of the three books that he would take if he was isolated on a deserted island” (Hertz 1972). David B. Hertz made a reference to this book in his article Hertz...
Starr (1971), in which according to the editor of the *Innovation Magazine*, Hertz explains that Starr treats “quantitative techniques, however, he delves deeply into the management aspects of management science—such things as organization theory, concepts of planning and control, and communication of information. He also takes up specific management problems and shows how the theoretical concepts have been developed to solve the problems.”

Starr underlined the importance of people’s creative skills on the book’s dedication page, “At every management level myths exist to answer questions that no one has thought to ask. Myths reflect imagined constraints and objectives chosen by habit. The perceiver of myths discovers in them unexpected opportunities to create the future.”

On the increasing role of models in managing complex organizations, Starr (1971b, p. 28) observed, “While the scientific position is critical in building models, it has no parallel in the application of these models. The successful user must be both artist and scientist. In the past, *art and science have formed at least a colloidal mixture*—that is, they have never blended homogeneously. No neat aphorisms have been developed about how art and science can cooperate to become synergistic.” Today’s desktop computers as miniature devices to store and analyze massive data, powerful enterprise, resource planning software and the ubiquitous Internet, which together have enabled and facilitated tens of thousands of applications of management science methodology, were not on the horizon when Starr prophesied, “The future undoubtedly holds a more harmonious art-science relationship than now exists” (p. 28).

Starr coauthored three books on operations research/management science. *Executive Decisions and Operations Research* by Miller and Starr (1960) was translated into Portuguese, French, Italian, Japanese, and Spanish, and its second edition (Miller and Starr 1969) was translated into Polish also. The other two books are *The Practice of Management Science* (Starr and Stein 1976) and *Management Science: An Introduction* (Dannenbring and Starr 1981). The latter was translated into Spanish. Starr coauthored three books on statistics (Bowen and Starr 1982; Sobol and Starr 1983, 1993). Starr’s other books include *Product Design and Decision Theory* (Starr 1963), which was translated into French and Spanish; *The Structure of Human Decisions* (Miller and Starr 1967), which was translated into Japanese, Portuguese, and Spanish; *Systems Management of Operations* (Starr 1971a), which was translated into Spanish; second edition of *Production Management: Systems and Synthesis* (Starr 1972), which was translated into Spanish and Hungarian; *Operations Management* (Starr 1978), which was translated into Spanish; *Managing Production and Operations* (Starr 1989); *Global Corporate Alliances and the Competitive Edge: Strategies and Tactics for Management* (Starr 1991); *Operations Management: A Systems Approach* (Starr 1996); and *Production and Operations Management* (Starr 2004a). Starr (2002) is the Spanish version of the second edition of *Operations Management: A Systems Approach* (Starr, 2000), translated by Ana Muriel in collaboration with a team of Spanish academics.

Starr also wrote papers on a wide range of topics on POM education. These influential papers include the role of business schools in the United States (Starr 1976) (also translated in Japanese), various approaches for teaching management science (Starr 1970), primary drivers of the international POM curriculum (Starr 1997), on-line learning (Starr 2001b), and executive education (Starr 1969, 1993a–c, 2001a).

Along the way, Starr mentored many students and shaped their academic careers. For example, David C. Dannenbring (2006), Provost and Senior Vice President for Academic Affairs, Baruch College, The City University of New York, recalls, “When I began my doctoral program at Columbia University in fall 1967, I had intended to major in Accounting. Several of my colleagues in that class had chosen Columbia because of the presence of Marty and were majoring in Production Systems. . . . . He had a way of covering a topic that got us excited enough to spend many hours outside class exploring the nuances and depths of the material. It was as if he had opened a door, inviting us in to examine what lay beyond.” Dannenbring switched his major from Accounting to Production after discussions with Marty about career choices. Dannenbring further notes, “I actually got my first academic position as a result of Marty’s reputation. . . . . He has been a true mentor throughout much of my career, and for that I will be forever thankful.”

Starr’s teachings leave an everlasting impression on his students who remember him for a long time. Art Zuckerman, a 1987 graduate of Columbia University, describes (Hermes Magazine 1998) Starr’s class in operations research as “fascinating,” since it enabled him to “apply theory to reality.” Norman Faull (2006), Professor Graduate School of Business, University of Cape Town, Cape Town, South Africa, who attended one of Starr’s executive programs in South Africa in 1980, noted, “Several things amazed and impressed me: the unashamed mathematical challenging of the program delegates, the range of topics ‘seamlessly’ covered, the boyish optimism of the presentations, the wonderful case materials from Marty’s book, the engaged relationship with the class, and the raw decency of the man. I was in awe.” Similarly, Peter W. Robertson (2006), Vice President, Operations Planning, BlueScope Steel, Wollongong, Australia, notes that “in 1996 Starr lectured a class of 32 hardened, middle and senior managers (postgraduate students) of BHP Steel,
Australia. This was no small undertaking as Marty lectured, told relevant stories, coached, guided and capably answered a barrage of questions from this fairly uncompromising group. This went on for five full days, but Marty more than held his own and came through the ordeal with the unfettered admiration of his experienced and sometimes testy students. . . . “

Starr’s passion for mentoring and helping POM professionals has continued throughout his career. Alexander Reis Graeml (2006), Assistant Professor, Universidade Federal de Santa Catarina, Brazil, who met Marty for the first time in 2001 notes, “Marty has been one of my ‘intellectual gurus’. Some of his early studies on modular production and postponement, from the 1960’s, were important grounds on which I formulated my doctoral thesis, as they became even more relevant techniques in Internet times. But he’s also been a kind of ‘mentor’ to me. When I decided that I needed to spend some time at the Silicon Valley to better understand the Internet rationale, Marty’s support was essential in getting a visiting scholar’s position at Berkeley. His keen interests in helping younger researchers achieve tenure and his guidance to foreign PhD students should be highlighted as an important contribution to the establishment of an international community of researchers in the production and operations management field.”

5. Research
Starr’s more than 100 articles in diverse research and practice journals in several languages cover a variety of topics including product design, project management, systems engineering, intellectual property, knowledge management, and dynamics of marketing. Some of his most provocative ideas, which are presented next, are kernels for future research as POM departs from industrial age logic to the knowledge era (Roth 1996). Knowledge, customer orientation, and globalization of resources are increasingly central to competitiveness.

Mind versus brain in model implementation. Starr (1971c) used Eric Berne’s (1964) communication model (transactional analysis) to examine the potential differences in the “life styles” and attitudes of the model builder and the manager and observed, “The brain is an instrument for thinking; the mind a set of cognitive relations. The mind is politically oriented; the brain is used in attempting to achieve political objectives set by the mind. We speak of changing one’s mind, not one’s brain.”

Marketing. In 1964, when the field of marketing science was still in its infancy, Starr (1964b) outlined his vision for potential contributions of management science toward the development of a science of marketing. He argued that the marketing culture pre-vented adaptation of management science techniques and suggested a number of approaches to mitigate it. Starr and Rubinson (1978) used simulation to develop a Loyalty Group Segmentation model to segment consumers into loyalty groups for consumer package goods. They used a survey to measure consumer’s willingness to switch and empirical data to obtain a purchase probability vector that is unique to each loyalty group. Starr (1980) also studied the variety-seeking behavior of consumers and modified the Shannon entropy level measure (Shannon and Weaver 1949) to explain how holding and switching patterns of purchase behavior reflect consumer brand loyalty.

Artificial customers. In an article on the “construction of artificial consumers,” Starr (1965b) concluded, “This chapter was intended to demonstrate what a test market of the future may be like. . . . Interestingly enough, the weakness that prevents us from using this simulation approach at this moment of time is not one of methods and is not one of means. It is the fact that a revolution in information gathering techniques is required before we can move rapidly ahead.” The Internet is beginning to provide the revolution that Starr anticipated.

Global production and operations. Starr (1984) developed a global network model and identified factors that provide comparative advantage in international trade. Starr and Garber (1987) compared the difference between the performances of U.S. manufacturing plants of Japanese-owned and American-owned firms. They reported that the Japanese firms were characterized by scarcity behaviors with emphasis on husbanding resources and reduction of waste and that the scarcity-oriented value system elevated the importance of people as resources.

Starr’s other works cover productivity issues (Starr 1973, 1983), breakeven analysis under risk (Starr and Tapiero 1975), adoption of new technologies like flexible manufacturing systems (Starr and Biloski 1984), synchronized manufacturing (Ronen and Starr 1990), e-business (Starr 2003), and continuous innovation including round-the-clock project scheduling (Starr 1992).

6. Leadership Roles and Global Impact on Academia and Business
Starr served as Editor-in-Chief of Management Science from January 1967 to June 1982. Since the journal covered several disciplines, Starr created a departmental structure so that each autonomous departmental editor became responsible for processing papers submitted to that department and for making decisions on those papers. Management Science was perhaps the first leading journal in business to have such an editorial organization, and it became a model for
others. Although Management Science was already an established journal when Starr became its Editor-in-Chief, its standing rose further under his leadership. When Starr completed his term as Editor-in-Chief, the Institute of Management Sciences (TIMS), which published the journal, awarded him a “lifetime honorary membership” in TIMS, which was recognized and continued by its successor organization, INFORMS.

In June 1965, Starr started the “Free For All” column in Management Science. It continued until August 1970. The idea was to get top people in many fields akin to management science involved with expanding the horizons of the academics who were driving the field development. At the time, the field of management science and operations research (MS/OR) was still in its infancy and there were questions about its long-term viability as a discipline that could make a difference in managing organizations. Starr was able to attract senior executives and leading academics from MS/OR and other disciplines to contribute columns. They included Russell L. Ackoff, Kenneth E. Boulding, Timothy W. Costello, Robert L. Fromke, Erich P. Fromm, George W. Gershefski, Nicholas E. Golovin, Donald F. Heany, David B. Hertz, Ronald A. Howard, Peter V. Norden, Ivan Siroyezhen, Robert M. Thrall, Daniel Teichroew, Andrew Vazsonyi, Chi-Yuen Wu, and Sheldon S. Zalkind.

Starr himself contributed columns on such topics as articulation of ideas, what it takes to be a catalyst, Eric Berne’s Transaction Analysis as in “Games People Play,” concern with the growth of “non-scientific” literature on parapsychology, astrology, etc., adoption of the Metric System, science fiction literature as a precursor to simulation and conflict resolution, mathematical properties of history, ethics, and management science, and the role of management science in a service-oriented society.

Starr served as the president of the Production and Operations Management Society (POMS) in 1995 and is now the chair of its Council of Presidents. In 2003, he organized and founded the Operational Advantage Group within POMS to further collaboration between academics and practitioners in research, teaching, and publishing.

Peter W. Robertson (2006), Vice President, Operations Planning, BlueScope Steel, Wollongong, Australia, describes him as the “father of POMS in our region.” Henrique L. Correa (2006), Professor, FGV Business School, Fundacao Getulio Vargas, Sao Paulo, Brazil, observes, “Martin Starr’s work has been extremely influential in operations management in Latin America as in other regions of the world for the last four decades. Starr’s knowledge of the realities of Latin American operations started when he spent one year in Argentina, in the early sixties, advising Yacimientos Petroliferos Fiscales, the local state owned oil company on industrial organization and production management. One of the first comprehensive books on the operations management field made available in Brazil was a translation of Starr’s “Production Management: Systems and Synthesis” (Starr, 1964a) in the mid-sixties. Generations of POM practitioners and professors were then introduced to Starr’s “systems and synthesis approach” to operations management. Ever since the first translation, Starr’s books have continuously been translated and largely adopted not only in Brazil but in other countries in Latin America and have continued to be highly influential in the operations management thinking in the region.”

Starr has influenced the corporate world via his writings in practice-oriented journals, consulting assignments, and executive development programs and by serving on management boards of various corporations. Starr actually started his career working in industry before joining the faculty of Columbia University’s Graduate School of Business. William T. Moran (2006), while working at Young & Rubicam, Inc., in the 1950s, approached C. West Churchman to suggest someone who could employ operations research concepts to marketing and advertising. Moran (2006) recalls that “He (Churchman) suggested that I get in touch with a young scientist/engineer working in New York as a consultant to the oil refining industry—a Martin Starr—.” According to Moran, “Martin led us in developing a series of computerized analytical models. One, a model named natural Sales Projection Model, was the first to forecast sales of new product introductions prior to market introductions—based on test panel and consumer product test data. Next, he (Marty) was the conceptual and technical driving force in the development of the industry’s first simulation model for optimizing the selection of media vehicles and the allocation of advertising among them, called the High Assay Media Model. In fact, it was more than an “advertising media model,” as it really was a total marketing quantitative input and response model. Another was what is now called an agent-based dynamic simulation model of fundamental human behavior dubbed Consumeroid.” Starr consulted for Moran while he was at Young & Rubicam and later when Moran moved to Lever Brothers Company.

7. Enduring Passion and Pursuits

Starr has been bestowed with many honors and awards during his career. He was elected Fellow of the American Association for the Advancement of Science in 1969, Fellow of the Institute for Operations Research and Management Science in 2002, and Fellow of the Production and Operations Management Soci-
ety in 2003. In 1980, he was the recipient of the Distinguished Teaching Award at Columbia University’s Graduate School of Business. In 2006, POMS instituted the Martin K. Starr Excellence in Production and Operations Management Practice Award to recognize exceptional contributions to the POM field by practitioners.

He is currently Professor Emeritus in the Graduate School of Business at Columbia University, where he served from 1962 to 1996, and in the Crummer Graduate School of Business at Rollins College, where he served from 1996 to 2003. He continues to write, mentor young professionals, consult with companies, provide service to professional societies, and travel all over the world to expand the POM community and to raise its impact on organizations. He wants to continue to pursue the themes that have fascinated him for more than five decades. During a conversation Starr articulated his future priorities as follows. “Ideas that I would like to have explored further and may still pursue include Marketing Variety versus Production Diversity, which examines the cost-benefits of getting customers to perceive variety by having built in physical differences as compared to market-generated images of differentiation. In general, I remain convinced that the interaction of marketing and production, if understood, is a powerful advantage in competitive strategy. These days, I am interested in exploring the role of POM in securing safety against conscious acts of terror and acts of Nature that wreak havoc. Finally, from a pedagogical point of view, I would like to find a way to make POM and the systems approach to problem-solving a subject of interest that will be taught in high schools. Many college students never understand what the systems approach entails. As a result, when they go to work in both industry and government, they cannot bring that big view of the world around them into play. They also do not realize that POM is the study of how you do work of every kind including having fun. They think it only applies to 9 to 5 drudgery.”

Marty Starr lives in Winter Park (near Orlando), Florida, with his wife, Polly Starr. Norman Faull (2006), who had heard about Polly even before he met her, says, “My senior colleagues at the GSB would always talk about ‘Marty and Polly,’ as if they were Siamese twins. What they were attesting was what I would come to experience for myself: the twinkle-eyed partnership of two people who respect each other and respect the seriousness of their joint work on this planet. There is an endearing youthfulness about their curiosity of life and living. A Zulu proverb: ‘umuntu ungumuntu ngabantu,’ is often translated as ‘people are people through other people.’ Put differently, ‘I am human because I belong in a community with others.’ I am indeed richer for being part of a community with Marty and Polly.” Aren’t we all?

Acknowledgments

The authors express their appreciation for the information provided by many of Marty’s long-time professional colleagues. In particular, we acknowledge the contributions of Henrique Correa, David Dannenbring, Norman Faull, Afonso Flueray, Alexandre Graeml, William Moran, and Peter Robertson. The authors also thank Jaya Singhal and Kalyan Singhal for sharing their working paper on modular production (Singhal and Singhal 2006), which helped in drafting the section on modular production.

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