The Routledge Companion to Production and Operations Management

Martin K. Starr, Sushil K. Gupta

Conclusions

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Sushil K. Gupta, Martin K. Starr, Aleda Roth

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CONCLUSIONS
Evaluation and Prognostications for the POM Domain

Sushil K. Gupta, Martin K. Starr, and Aleda Roth

1 Summing Up the Accomplishments

POM, as it exists today, has treaded many eras and crossed many milestones during its amazing journey through eons of time beginning with the Stone Age (9300 BCE) to the Information Age (1950 CE). “Power” is the hub of all progress and development in the world. POM has witnessed, and has been a partner for transition from coal power to petroleum to atomic energy and now is a big player in the progress towards harnessing natural energy—the sun, the wind, and the storms. Readers are advised to re-read Chapter 1 of this book for more details.

The development of power sources has accelerated industrial progress that includes, among other things, manufacturing, transportation, electrification, and telecommunication. POM is transforming healthcare delivery systems, agriculture, hospitality, logistics, and disaster management. POM has even helped in improving commercial operations—marketing and retailing.

Tools of the trade such as forecasting, production planning, inventory management, scheduling, quality control, and facilities planning, have been shown to apply to a diverse set of operations; and to help with the development of strategic plans.

Along with growth in POM, the other management disciplines—accounting, finance, marketing, and human resources, etc.—grew side by side. POM has learnt to live and interact with these disciplines. Developments continue to take place in science and technology, product development, process capabilities, alternate sources of energy, interaction among different business partners for improved supply chains, logistics clusters, lean operations, and agile systems. Project Management is becoming an important area of development.

Data analytics and operations management are intimately connected. Data collection and data analysis capabilities are improving with developments in computer technology. POM also had its share of influence on military operations and is now influencing startup companies, nonprofit organizations, sustainability, and social responsibility. Human behavior has become an important topic of study since it plays an important role in the implementation of POM decisions and strategies.

The Routledge Collection, with the dedicated efforts and experiences of seventy authors spread across thirty-seven chapters divided into the book’s eight parts, is a remarkable compendium of POM progress through eons of time and reflections from an enigmatic future.
Conclusions, Evaluation, Prognostications

In the next two sections, we step into unknown and unchartered territory in order to reflect what POM can do. POM has slowly and steadily found its way into service industries. Section 2 is devoted to a discussion of how POM steps out of the manufacturing boundary and permeates in the service arena. In Section 3, we will sum up and integrate the POM domain in terms of the three major areas of the survey that we sent out to the authors of the POM Companion. This proverbial three-legged stool is supported by TRP—Teaching, Research, and Practice. The survey respondents offer their reflections of our TRP future.

2 Reflections on the New Service Economy

The aim of this section is to re-engage strategic thinking in service operations by examining several of the underlying forces that are reshaping service business environments and are influencing major discontinuities from business as usual. The rapidity of technological change, the accelerated growth and timeliness of information exchange and digital media, and the widening reach to customers anywhere and anytime, challenges traditional service operations strategy and at the same time affords unprecedented opportunities for creating new knowledge and changing mindsets about service research and practice. In fact, we now are on the cusp of a major paradigm shift that is irreversibly altering the landscape of businesses globally (Roth et al. 2016). The past decade has witnessed an unparalleled escalation of market, social, and technological forces leading to the new service economy. The new service norms are heightened levels of customer experience content in ordinary services offerings, the morphing of existing services and service sectors, the servitization of goods, the creation of entirely new business models, and much more.

Understanding this new service economy is essential, as it plays such a prominent role in the value-added in developed economies, and is increasingly making major inroads into the developing world as a major component of their gross domestic product (GDP). Value-added components of GDP are often classified into the respective contributions made by three broad sectors of an economy: services; industry (i.e., durable and nondurable goods, mining, energy production, and construction); and agriculture (i.e., agriculture, fishing, and forestry). For semantic clarity, the service sector is typically broken down into subsectors, including wholesale and retail trade, leisure and hospitality, utilities, transportation and warehousing, information and communications, financial activities, professional and business services, education, government, and all other private activities that are not goods-producing. In the pace-setting U.S. economy, services accounted for 80.1% of the jobs in 2014 (Bureau of Labor Statistics 2015). However, the value-added of the service sector to global GDP and related labor force participation was estimated to be 62.4% in 2015 and 43.1% in 2011, respectively. By contrast with services, similar statistics for the industrial “goods” sector were about half, i.e., 31.1% and 22.2%, respectively (Central Intelligence Agency 2016). While agriculture accounted for 6.5% of value-added, the labor force participation rate was relatively high at 34.6%. Nonetheless, a case can be made that the current economic classifications are somewhat outdated, as services are also an increasing component of both industrial and agricultural sectors.

While the service economy matters to most economies in the world in terms of employment and value-added percent of gross domestic product (GDP), these metrics do not reveal the depth of the evolutionary transformations and paradigm shifting undercurrents of creative destruction in traditional services. Arguably, over the past three decades, service operations have done a magnanimous job in advancing and solving both tactical and mid-term problems, such as revenue management, scheduling, capacity planning, service quality, etc. However, despite the urgency, much less research has been conducted in setting strategic directions for service sectors.
operations management. Service strategies are particularly valuable in creating resilient and adaptive delivery system designs, which are needed to tackle the implications of emerging issues for service research, teaching, practice, and policy.

In this context, this section highlights the following six evolutionary trends using the lens of service operations strategy and design for customer experience:

- The rise of the experience economy
- Increasing the service component of business to business (B2B) services
- Propelling new business models through technology-enabled, service encounters and platforms
- Finding symbiosis across service sectors
- Expanding sources of new service design and innovation
- Gaining momentum towards response service operations.

In our view, these forces typically remain well below the radar screen in current service operations strategy research. However, because of their evolutionary significance for advancing and steering the future course of service operations, more rigorous academic scrutiny is warranted.

These trends also reinforce the urgency of leapfrogging ahead of the curve by taking a more futuristic perspective of services. When compared to manufacturing, service operations strategy is still in its infancy. While there is some similarity with manufacturing strategy formulation, the strategic design of service delivery systems is inherently different and typically far more complex.

Classical service operations management distinguishes delivery of services from goods production on five interrelated dimensions: intangibility, customers as co-producers in the delivery system, heterogeneity, perishability, and simultaneity (Fitzsimmons et al. 2014; Heskett et al. 1990; Sasser et al. 1991).

First, service strategy must account for the inherently intangible nature of services, which creates a conundrum for design and execution. Services are concurrently difficult to copy, to patent, and to convey their value to customers and stakeholders. Take, for example, the following situation: how do service firms of different types design their operating systems to effectively handle customers’ implicit and explicit “feelings,” such as relief from pain or WOW effects, etc.? (See, for example, Baglieri and Karmarkar 2014; Voss et al. 2008; Roth and Menor 2003; Pine and Gilmore 1998.)

Second, customers are co-producers in service systems. When compared to their employees, service providers have much less control over the “quality” of customer input (Chase and Apte 2007; Roels et al. 2014). Therefore, strategic decisions need to be made regarding the physical and virtual design of the operating systems to account for variation in customers’ abilities, willingness, and appropriateness to participate in some or all parts of the service process (Froehle et al. 2007).

Third, service operations strategies must take into consideration the fact that the heterogeneity (e.g., the added system variation) in each service encounter interaction between customers and employees is different (Frei 2006). Notably, human factors play a significant role in understanding differences from customer to customer as well as among their employees (Chase and Dasu 2001; Dixon and Verma 2013; Secchi et al. forthcoming).

Fourth, many services like hotel rooms, airline seats, and doctor appointments are perishable in that they are subject to time-perishable capacity. As a result, designers must carefully develop approaches to ensure target utilization levels. Fifth, the notion of simultaneity in consumption and production implies that services cannot be stored or inventoried for use at a later date, so matching supply and demand is crucial (Fisher et al. 1994). Hence, when not occupied or in use at the allotted time, that particular revenue opportunity is gone forever; on the flip side, when demand exceeds available capacity, sales are also foregone.
As described above, each of the basic characteristics of services depend on the “appropriate” behavior of people within the operating systems and, especially, on the alignment of a myriad of customer and employee behavioral factors. Unlike marketing science, the human side of operations is not well understood in classical service operations strategy (Roth and Jackson 1995; Huete and Roth 1988; Roth et al. 1995), with perhaps some exceptions around the customer contact model (Chase 1981), employee job design, and technological adoption (Boyer et al. 2002; Hitt et al. 2002; Xue and Harker 2002). Yet today more than ever before, the interplay among the behavioral components, when combined with the dynamic interaction with market forces and the dizzying speed of technological progress, is game changing for service design and delivery. Take for example, the exploration of behavioral and design synergies between hospitality and healthcare services to improve the effectiveness of senior housing and care (Negrea 2016). Furthermore, the six evolutionary trends also impact the globalization of services between and among developed and emerging market countries. Consider, for example, that while the U.S. service sector holds 77.8% of the country’s GDP, the fastest compound annual growth within the service sector GDP from 2001–2012 was observed in China (10.9%), India (9%), and, at a distant third, Russia at 5.4% (Bhargava 2015). The rise of global services indicates even more service design complexity because of the cultural and business interchanges among customers, providers, and governments.

Given all of the above, there is a need to explore the evolutionary trends and their implications for service operations strategy and design for customer experience. The future is here.

3 TRP—The Three Legs of the POM Stool

We sent a survey (see the survey instrument in the Appendix) to the first author of each chapter with a request to forward the survey to their coauthors. We received thirty-four responses, a good response rate that enables us to draw meaningful conclusions. The survey was sent on June 23, 2016, with a response date of July 7, 2016, and most respondents met the deadline, which shows their enthusiasm for the Routledge project.

The responses that we received were incredible for two reasons. First and foremost, there was a major amount of agreement on what should be done in all three TRP areas. Second, these responses were uniformly in favor of significant change. While they did not all agree on the time frame, a major portion of the respondents did reject the status quo and proposed opportunities for future improvement and change. That is important because we are hearing the voices and goals both from future leaders of POM and those who have created the foundation these future leaders are building upon.

Teaching will be expanded to include POM Teaching and Learning (Section 3.1), since that title better encompasses the relevant system. Research will be expanded to include Research and Modeling (Section 3.2), because (again) that title provides a more complete view of the intended system. Finally, practice will be expanded to include public policy, thus, leading to a rewording as follows: New POM Practice Domains (Section 3.3). This change is for the same reasons as in the prior cases.

3.1 POM Teaching and Learning

The responses to the questions on POM teaching and learning can be grouped in the following categories:

• POM in business schools
• Curriculum
• Teaching material
• Technology/online (could be called pedagogy)
• Systems approach/interdisciplinary teaching
• Experiential learning.

3.1.1 POM in Business Schools

There is evidence of increased student interest in POM courses in the U.S. Of course, every trend is biased by the selected starting point. If we chose the decade of the 1960s (when jobs in manufacturing, especially those held by engineers with MBA’s were very attractive and widely respected), the present-day picture would not be as good. There is also evidence that the popularity of POM courses varies a great deal geographically. We believe that research is required to determine where POM courses are in demand and why they are favored in those locations. From such research, there may be useful information that can be transferred across borders.

The dynamics of the POM field of study must be understood as technological changes disrupt traditional present-day conceptions of how to make and deliver goods and services. The growing presence of artificial intelligence and robotics will affect many applications, with respondents noting in particular the effects on manufacturing, financial services, healthcare, and agriculture. It was noted that as manufacturing returns to the U.S. and Europe, the production aspects will again become important, although it will need to have a much stronger integration with the technology and management information system (MIS) areas, since so much of production will be automated.

Another factor that must be considered is the rebranding of POM as Supply Chain Management (SCM). There are manifest opinions about SCM being a subset, albeit of critical importance, of the POM field. Here too, research is warranted to determine how SCM deals with subjects such as quality (e.g., statistical quality control and Six Sigma) and process improvement (such as Kaizen, Poka-yoke, aggregate scheduling, job sequencing, and work shift assignments). In addition to finding out how various schools around the globe are dealing with SCM there are pragmatic issues about how it should be positioned.

Overall, we conclude that (presently) students prefer studying service systems to manufacturing. As a concentration, there is a low preference for POM. We believe that this is attributable to the (seemingly justified) belief that marketing and financial jobs enjoy more glamour and higher pay scales. Those MBA students who are inspired by POM topics (often via an SCM concentration) do well and go on to get good positions in industry. With new disruptive technologies, it may be possible for the POM field to return to the old days when corporate management placed highest value on engineers with MBA degrees.

3.1.2 Curriculum

Respondents indicated that POM courses dealing with process management are disappearing from the core, often being replaced by Supply Chain Management courses. In some business schools, POM teaching is restricted to a Decision Science approach to the Operations Management field. We also see POM teaching being extended to other domains including healthcare, service industries, and data analytics (OR and statistics), but such extensions do not appear to represent a widely accepted broad-based pattern.

There is a general feeling amongst respondents that POM is not being taught as well as it might be (poor curricula) at both business schools and engineering colleges. When students have a required POM course, they are seldom enthusiastic about going further with electives. Survey respondents suggested that the traditional POM curriculum does not inspire student excitement...
Conclusions, Evaluation, Prognostications

or career confidence. Perhaps this is reinforced because few curricula provide attractive electives. One respondent said that a relatively popular elective may result from POM and information technology working together.

Another respondent, emphasizing the role of information systems and service organizations, stated the following:

I think especially in the USA, we should be predominantly service oriented in our OM teaching and also move closer to Information Systems. Service operations depend more on the underlying information systems, than manufacturing operations. For example, in our modules on TQM, we should deal with quality control and TQM of customer databases as well as with quality control of corporate information systems. In service industries this is of the utmost importance.

Consider the comment that curriculum content is determined by extant published research with some sprinkling of academic ‘practice’ gleaned from cases, on-going research, and a smattering of consulting. For both undergraduate and MBA students, the ratio needs to change making ‘practice’ a larger part of the pie. How to achieve this state of affairs is a relevant research question. In the U.S., relatively few professors are deeply engaged in POM practice. This is unlike Europe, where there is institutional pressure to demonstrate application relevance.

It is stated that practice is often brought into the class through guest lecturers from industry, rather than first hand personal experiences. Further, textbook content (written by professors) is mostly academic, often times replete with techniques that are obsolete or embodied in available software. An innovative and path-breaking textbook would be viewed with alarm by teachers and their Ph.D. students who have been trained in the conventional wisdoms in the traditional ways.

To be effective, we need both mathematical techniques of POM and an understanding of the management practices of our practitioners, e.g., doctors, lawyers, and farmers. We should avoid POM teaching in which quantitative “silos” overwhelm qualitative ones. Support an integrative approach which provides linkages to strategy, finance, marketing, and other areas. Most MBA students now leave with an inadequate understanding and appreciation of what it means to manage and schedule work and processes, forecast, manage inventory and capacity strategically, improve processes, and integrate processes. Most shocking is that few POM courses teach students about the job of a Chief Operating Officer.

3.1.3 Teaching Materials

This section on Teaching Materials is meant to include curriculum matters while making an effort to take a bigger look at the issues involved. A number of respondents’ observations differ markedly. We conclude that some institutions have changed while others have not. This seems to indicate a need for research to determine who is doing what and how many of each kind prevail.

One respondent group observed that in the last three decades, significant changes have occurred in POM teaching. The responses stated that notable among these changes is an increased focus on applications rather than on methodology. These respondents (although not uniformly) went on to laud the use of online mechanisms for content delivery. Some also commended the integration of unique learning formats (technology based tools, gaming, simulations, and flipped classrooms) and the design of POM courses which integrate concepts from other functional areas (e.g., Marketing, Finance, and Entrepreneurship).

In contrast, another respondent group observed that POM teaching remains too grounded in traditional subject areas. Those respondents (uniformly) stated that delivery systems need major
transformation. For them, a significant percent of present POM teaching is based on past and increasingly archaic industry practices. This group derided outmoded case studies, saying that we need research and development of teaching materials for new and more relevant areas. Some said that POM teaching must now adapt materials for developed and developing countries.

Another respondent said that the optimal teaching style may depend on the characteristics of individuals in the student body—what type of jobs are various segments of the student body looking for? How many POM students will end up in consulting, or in general management, or as an entrepreneur in a home business, or on Wall Street in the finance world? Each scenario demands a calculated difference in what the optimal content of a POM course would be. An answer that cuts to the heart of the matter stated that we should focus on “teaching students to be operations managers” rather than focusing on “teaching students operations management.”

This same theme has appeared repeatedly which urges that we get students to analyze real operations (e.g., restaurants, hospital wards, retail outlets, manufacturing, etc.), and provide managers with a “consulting report” detailing their recommendations (technical aspects and their implementation) which must use techniques that students have discussed in class.

One respondent, who uses many different *Wall Street Journal* articles as mini-cases for class discussion and does not do much online, said,

> We really focus on doing the face-to-face, classroom interaction well, and I think there will continue to be a place for this. The students learn a lot though the in-class discussions and interactions that would be difficult to replace with a virtual classroom, given current technology.

### 3.1.4 Technology and Online

When it comes to teaching technology, some institutions have made a lot of progress, through the introduction of online and blended learning systems. How we teach is well served, but what we teach needs attention and revision. Another respondent stated that there are accelerating trends toward more active classrooms using technology in various new ways. Blending was mentioned as was “flipping the classroom.”

One respondent said that we must discourage students from sitting in our classrooms thumbing smartphones to find answers without interaction and discussion. Classes should be taught in a blended teaching manner using technology, videos, and case studies. Let us face the challenge of digitalization of education and share with each other new learning processes that characterize millennials. Pedagogical research should be done in order to understand which new teaching methodologies would be more appropriate to the new generations and for the newer subjects of POM.

Teaching online creates both challenges and opportunities. The opportunities include the ability to use multiple media (video cases, podcasts, hyperlinks to external sites, etc.) and these mixed pedagogy approaches appeal to different learners in multiple ways. Other opportunities are online assessment, e.g., multiple-choice questionnaires. The challenges include students gaming the system—cheating in online assessment—as well as ensuring and controlling that all students actually engage with the material.

One respondent strongly recommended computer based business games to teach both POM and SCM. The respondent stated,

> I also like to use Skype and WebEx to invite executives from all around the world to speak to our students without having to fly them in. This is a cheap and effective way
to provide students with the opportunity to both learn from real high level operations managers and also build their professional networks.

We should make much better use of blended teaching and normative experiential learning. Massive Open Online Courses (MOOCs) and Open Source content will become increasingly important and accessible, so universities will need to respond by adding value and keeping abreast with latest thinking. Next generation students will expect to learn very differently, and as a result, new ways of teaching will have to be developed. Gamification and business games have begun to replace traditional lectures.

In terms of delivery, we need to take advantage of blended teaching systems that utilize technology and social media wherever possible. Integration of lectures with smartphones and tablets is a trend that should pick up and accelerate within the next few years. Hands-on projects with real world companies are another trend that leading pedagogical programs will increasingly reflect over time.

### 3.1.5 Systems Approach/Interdisciplinary Teaching

To achieve the many benefits of using the systems approach, the teacher must illuminate the entire picture. This includes multiple goals, and all relevant drivers of the outcomes. We must invoke cross-disciplinary management of the problem rather than staying within one department. Operations management choices affect and are affected by choices made in other areas of the business. One respondent said,

> Because my managerial course was (for no good reason) scheduled as the last core (compulsory) course in our MBA program, I was forced to think about it more as a capstone course, which in hindsight has done a lot to improve it on this front!

We must not forget that our roots lie in the area of decision making. Mathematical models, which are more easily accessed with new technology, can still be used as tools to provide information as an input for a final decision.

Another respondent stated,

> Decisions are not made in a vacuum, but are driven by strategy, the markets, financial justifications, and such. At a minimum, such integration needs to be added. POM is critical yet I don’t think we link these decisions to current events and “relatable” issues.

Another person said that much of the POM teaching material is dated and does not reflect the convergence of functions. HR is still taught separately and should be much more closely related in a socio-technical systems approach, as should operations strategy and management accounting.

### 3.1.6 Experiential Learning

Several respondents said that classroom teaching of POM is important but so are current real life examples. In the words of one of the respondents, “Every student in almost every major should understand the impact of practicing POM approaches in solving business problems.” To meet this educational challenge, it would be useful to stress the role of experiential learning. The
students have to be given real-life examples and stories of how different approaches to POM have made significant differences in the outcome of organizations solving business problems. In other words, learning to do what needs to be done on the job. Ways of approaching this include mentoring, internships, group consulting projects, debates, and field trips. Cases might qualify if taught by teachers who have actual consulting experience that they can share in the classroom or online.

It is important to take students to visit organizations that practice using sound POM methods. Plant visits to disorganized companies may be illuminating for a brief period unless the project includes introducing good organizational systems. In that case, students get to deal with real problems and have an opportunity (longer term) to see real examples of POM thinking being implemented. They begin to understand the impact of POM methods. One respondent stated that “our research has shown that dialogue and reinforcement are critical for learning.” Another urged integrating POM experiences with other disciplines.

In this regard, it was noted that field trips which reflect POM operations across supply chains should be constructed. Research might be useful to define how best to do this kind of exercise. It comes to mind that class projects that bring suppliers and producers into the evaluation and judging process have been shown to be enjoyed by all participants in such an endeavor. In addition, POM field trips (to actual cross supply chain operations) ought to be an integral and regular part of the learning program. Some schools do this well, but they are in the minority.

The POM community needs to focus on the employability of POM students, which is often ignored, to attract students to the discipline. If certain courses such as supply chain management seem to be important to recruiters, then students will opt for them. Our field needs research to determine what managers in a variety of industries consider important in their employment profiles. The following comment is on target: “Recruiters want today’s MBA students to study POM topics in the context of new industries such as digital technology, new physical technologies, new types of services (such as belonging to the shared economy), marketplaces, and networks, and so on.” It seems like a good idea for POM researchers to find out what recruiters want today (in quite specific locales) and what they will likely be wanting the day after tomorrow.

3.2 Research and Modeling

For research projections, the responses can be divided into four interconnected groups: Models and Methodology, Interdisciplinary Research, Research Domains, and Publications Outlets.

3.2.1 Models and Methodology

Decision making needs to be bolstered with decision support systems that combine models and empirical studies. A number of times, it was urged that heuristic methods and systems dynamics be more broadly applied. Additionally, simulations were lauded by various people as permitting inclusion of a larger number of variables thereby achieving more complex models of realistic situations. Research on larger, integrated processes was suggested to aid in coping with the nature of complex adaptive systems. Technology users need to work closely with technology developers. It was stressed that each area of application has many unique uses of technologies.

Prescriptive (modeling) and descriptive (empirical) studies can be better coordinated and blended. We need research on how to blend these methodologies instead of choosing one or the other.

Here is a list of various disparate comments that were made about research methodology:
Conclusions, Evaluation, Prognostications

- Rigorous methodology is essential, but it must be open and applied to real problems.
- Methods that include behavioral elements as well as competition and strategic organizational choices (e.g., merger, entry, and exit) are needed.
- Longitudinal survey methods and behavioral testing for refinement of model assumptions are required.
- Can we learn anything from innovations in other fields such as medicine and biotechnology?
- Keep track of how many times “practice” followed POM prescriptions for implementation.
- Industry 4.0 methods should be understood and absorbed by POM.
- Quality control should be applied to customer databases and corporate information systems. This is particularly important for service industries.
- Multi-method systems (and triangulation) need to be developed, coordinated, used, tested, and improved. Blended methodologies and blended research methods are emerging with machine learning and operations analytics. (Note that triangulation is a powerful technique that facilitates validation of data through cross verification from two or more sources. In particular, it refers to the application and combination of several research methods in the study of the same phenomenon.)
- Supply chains information flows require methods to facilitate and enhance them. Knowledge outsourcing has complexity that does not exist in component flows.
- Environmental POM and Sustainability Methodologies are essential teaching and research topics that tend to get short shrift.

Contrary to the current hype, many of our survey respondents share the opinion that “Big Data” as a term will not survive for much longer. Data-based studies show the world as it is: there must be models that can show the direction to improvements (optimization is never mentioned). Predictive analytics (based on existing data) may show trends and is valuable.

3.2.2 Interdisciplinary Research

Many respondents mentioned an interest in interdisciplinary research as an avenue that must be expanded as it is necessary to build bridges among disciplines. Siloes in organizations and in journals inhibit interdisciplinary efforts. Collaborative research between functions in all kinds of organizations would provide needed insights. This might apply to better supply chain decisions and communication. Connections to IT and the cloud must be developed for OM (this was said in different ways by different respondents). Here, we cite statements from two respondents about interdisciplinary research:

There is a great push toward interdisciplinary research, though still difficult from a publishing standpoint as journals are ‘siloed’, Nevertheless, I think many of the contemporary research problems we see in practice can only be addressed through some type of interdisciplinary approach. How this is done and structured are certainly challenges. Along these lines, there is a greater push toward multi-method research to provide greater methodological rigor.

Our experience has shown that inter-disciplinary research can provide new and powerful insights into a domain. For example, rather than simply thinking about a farmer’s adoption of a technology, one thinks about the innovation network operating around that technology or suite of technologies. New technologies will open up opportunities for POM, but we need to be working with the technology developers and the technology users to have impact here.
3.2.3 Research Domains

More studies are needed that relate OM to entrepreneurship, POM cases connected to multi-disciplinary learning, and Omni-Channel Fulfillment methods. The impact of developments in advances, such as 3D printing, driverless cars, the Internet of Things (I of T), robotics, and artificial intelligence (AI) on POM, needs to be assessed. Several other research areas include waste management systems, agriculture, and processed food supply chains, methods that apply to shared economy applications. Better methods are needed for visualization and communication such as finding the best way to convey information in a picture (e.g., using diagrams) or understanding how software can be made more effective for visualization. This type of thinking is a relatively new area that must be supported because our brightest young scholars are telling us to “pay attention.” Methodology for the use of social networks needs to be developed.

3.2.4 Publications Outlet

One of the respondents mentioned the lack of high-quality journals (the respondent calls these “4* POM journals”) compared to other disciplines, writing,

This reduces the scope for REF return in OM, which has meant that universities have invested in departments, such as strategy and marketing, where they can get a higher REF return, so P/OM has suffered in attracting the investment, and credibility, it deserves.

The Research Excellence Framework (REF) is the successor to the Research Assessment Exercise, a method of assessing the research of British higher education institutions. It took place in 2014 to assess research carried out during the period 2008–2013 inclusive. The results were published on December 18, 2014.

3.3 New POM Practice Domains

Responses to POM practice are categorized in the following three groups: emerging areas, geographical expansion, and POM and the public sector.

3.3.1 Emerging Application Areas

The emerging area mentioned the most was that of disaster management. The second most notable mention was the use of cross-functional efforts; also termed as integration of POM with other areas by one of the respondents. This matches with what was mentioned in research as well. POM should develop applications to data products as compared to the traditional application to physical products. In the same vein is the feeling that POM should be used for the management of information flows.

There is a theme that runs across many answers to many parts of the survey: there can be greater application to non-profit and government sectors. Also, there is a need for assisting start-ups and engagement with a broader range of services, especially related to the sharing economy (e.g., Uber) and financial services.

Only mentioned once but still entirely relevant are: agriculture and processed food supply chain, Internet of Things, autonomous vehicle design and manufacture, office robotics, R&D, solid waste management, sustainability (especially reverse supply chains), risk management of supply chains, distributed manufacturing industry, political campaigns, and entertainment.
Finally, there is a European awareness of Industry 4.0, with one respondent mentioning the (related) idea of a circular economy. The circular economy is a generic term for an industrial economy that produces no waste and pollution, by design or intention, and in which material flows are of two types: biological nutrients, designed to reenter the biosphere safely, and technical nutrients, which are designed to circulate at high quality in the production system without entering the biosphere. This is in contrast to a Linear Economy, which is a take, make, and dispose model of production.

One respondent talks about the “dark side of supply chains,” which refers to things like counterfeiting products and the use of child labor.

### 3.3.2 Geographical Expansion

Many issues arose under various questions that relate to geography. The major one is the difference between developed and less developed countries for implementation differences often stemming from quite different approaches in a variety of cultures. One gets the feeling that these problems are glossed over even though they are blocking good communications along the supply chain. In the same regard, the visibility of supply chain partners is often not possible because of cultural issues and, consequently, supply chain risk is high and needs to be managed (e.g., risk management of supply chains).

There is a real need for public sector involvement of POM in developing countries because there is great waste (especially in poor countries). There are also serious issues concerning protection of knowledge transferred to developing countries.

POM techniques have greater clout in small countries if those smaller countries will allow applications. Two points about the smaller countries may be noted. First, a lack of managers with a POM education can be a major impediment to success. Second, these countries also often lack adequate infrastructure, which means that local laws can be overlooked and misunderstood.

Finally, and this is a cross-over between geography and teaching, we need more cases that reflect the realities of global supply chains. Of interest is the impact of new technology on emerging economies, for example, the use of drones and robots.

### 3.3.3 POM and the Public Sector

There are two interpretations that were made by respondents. First is the degree to which POM methods can be applied to the public sector. Second, how does public policy impact POM’s work in the private and the not-for-profit sectors?

#### 3.3.3.1 Regarding the First POM Interpretation

Although no one seems to have a plan for POM to get involved, most everyone thought it was logical for POM methods to be applied to many public sector applications. Some respondents believe it has already occurred to a limited degree and would like to see more applications of POM methods. This seems like an opportunity that we should research and even consider involving the Production and Operations Management Society (POMS) to promote public sector applications.

It is expected that POM will move into the public sector, but current usage is low. Public sector research requires non-traditional objective functions. Interest in non-traditional objective functions seems to be growing. It was also pointed out that public sector policy may need new insights about leadership in the public sector.

Military systems have been there for years. The field was born in war. It started as OR and whatever you call it, many POM methods are used by the military which is a public sector application. However, most (academic) research journals seem disinterested in applied work.
Two respondents had the following interesting comments: Research is needed to apply POM to NGOs and that will happen. Change the objective functions and develop multi-criteria objective functions. The National Academies have organized discussions of using POM for building peace in various hot spots. POM is moving into healthcare. See the South Korea Trauma Center Network (Cho et al. 2014).

3.3.3.2 Regarding the Second POM Involvement

The answer to the question, “How is POM as a field affected by public policy?” depends on which country we are we talking about. One respondent mentioned that “tariff structures and economic trading blocs” will affect many POM practices. That certainly includes the relevant supply chains. One said that Brexit will change the system that POM needs to deal with. Overall, the concern was with impact on practitioners. There was a good deal of concurrence that as researchers, we need to define the problems faced by practitioners.

Other issues raised included minimum wage laws, safety rules and regulations, supply chain identities, cybersecurity, and info flows across firms. Standardization by public policy can make a big difference (e.g., for pallets) as pallet standardization will increase speeds of delivery of services, improve product quality, and benefit the environment.

Additionally, it was stated that POM can play an important role with respect to energy policies and sustainability decisions. We should actively monitor trends in public policy since these decisions will impact research funding. Funding also impacts POM practitioners (for example, with respect to road, bridge, and building infrastructures, to health services, to military bases and logistics, and to bi-lateral trade). Will Triple Bottom Line (3BL) become institutionalized by public sector policy?

Finally, public sector policy may play a lesser role in a globalized world. Will UN policy affect POM? One reply said: 3BL will require greater accountability and will put more pressure on OM practitioners.

4 Conclusions

It was interesting to see the degree to which congruence and convergence occurred among the respondents of the survey. We tried to reflect (in general terms) who concurred with whom, and vice versa. Research is necessary in order to further develop the emerging patterns of agreement and to diagnose the causes and cures for disagreements.

For example, services and manufacturing are still vying for investment funds in different geopolitical settings. Services are becoming a more important sector of all economies. However, there are those who advocate being entirely committed to services with a zero-manufacturing base. Others proclaim that without manufacturing, a society is off-balance. The resolution of the ideal ratio will not be fixed in time. It is a dynamic parameter that varies over time according to geographic and technological factors. It shifts with the wealth of nations in their infrastructure and their institutional accomplishments in education and culture. There is no doubt about the fact that manufacturing will not disappear but it will change. As robotic technology emerges, new patterns will characterize global shifts. All people continue to need clothes and shoes to wear, but where will they be made in the next decade, by whom, and how?

It is likely that many new forms of fabrication will appear in the U.S. and Europe as well as Asia (and let us not overlook South America, Africa, and even the depths of outer space) to replace outsourcing with domestic sourcing. From each country’s point of view, there are only two forms of sourcing. Either make products locally (domestically) or in a different country where wage rates are so much lower that extra costs of transportation are irrelevant. This should
be a simple decision, if, and only if, you can prognosticate correctly the costs, prices, and demand levels of all consumer products.

Theoretical history is science fiction, another name for the prognostication of future events. History has many data points that indicate how the interests of the citizenry will play an important role. Advocates of Brexit exemplify this effect. Political leadership in many countries including the U.S. are determined to play an important role.

We sum up our findings by quoting some capstone conclusions of the broad field of respondents to our survey.

First, the POM field is outreaching to many application areas where operations research is well-known, statistical techniques are widely applied, data analytics has been increasingly applauded, but POM is relatively unknown. This tells us that how we in the field define ourselves, determines how others see us. It would help if a broader definition of operations management was developed. It must include manufacturing as presently practiced and as it is likely to be practiced in the future. But greater degrees of AI and automation using robotics will substantially impact services as well. It must include the evolving fields of services in hospitals and hospitality venues, in sports arenas and entertainment centers, in restaurants and theaters, museums and concert halls. It must also include stadiums and libraries as well as police stations and Courts of Law.

Second, POM principles in not-for-profit and government organizations are founded on different objective functions. POM is not wedded to the profit function. There are so many signs that it is growing up and getting wings. Otherwise, it would become irrelevant with cooperatives, volunteer-based organizations, and evolving organizational structures related to a sharing economy (e.g., Uber, AirBnB, Vizeat, etc.).

Third, we sensed the urgency of our respondents to develop robust POM approaches that can be used successfully under both developed and developing world perspectives. Following that, we found that while many concepts are evolving rapidly outside the current boundary of POM, they will have huge implications for POM in general. These trends include mobile-payment systems; FinTech—Smart: cities, homes, and service systems, the Internet of Things, wearable technologies, and the embedding of sensors in almost everything. More focus needs to be on “value-creation” in general and linkages with theories from other disciplines (e.g., Service-Dominant Logic from Marketing).

Finally, the development of any discipline requires constant guiding and monitoring. POM is no exception. There have been informal overseers and authorities to guide its development since the very beginning. The origins of various government and international agencies (e.g., U.S. Food and Drug Administration, and the International Organization for Standardization—ISO) can be traced back to the artisan craft guilds, beginning around 1500 CE that came into being for compliance of product standards in each trade. The current era also witnessed the creation of many professional organizations to foster research and practice in POM. Some of these include: the Production and Operations Management Society (POMS), the Manufacturing and Service Operations Management Society (MSOM), the European Operations Management Association (EuROMA), the American Production and Inventory Control Society (APICS), and the Japanese Operations Management and Strategy Association (JOMSA).

References and Bibliography


Appendix

Survey of the Contributors to the Routledge “Companion”

We will not use the typical 10-point scale. Please write us about each of these three major topics. We will do our best to analyze your meanings and use Delphi concepts to interpret your intent.

POM Teaching
Focus on some of the following issues.
Give an assessment of POM Teaching. Is the POM field being taught properly? Or, alternatively, what can be done to improve how we teach POM?
- In-class?
- On-line?
- Blended teaching systems?
- Using technology?

POM Research
What new research directions do you envisage for the POM research domain?
Methodologically
- Models (either or both: quantitative and qualitative)
- Empirical studies
- Blended methods
- Technology (Robotics, 3D printing, etc.)
- Big Data Analytics and Computing

POM Practice
The focus is at organizational, national, and international levels.
What are the emerging areas in which POM can be used? For example, applications of POM have been identified in many emerging fields in the “Companion.” These include, among others, disaster management, sports, agriculture, and telecommunications.

What are your views on the geographical expansion of POM practice? Can you apply this to Manufacturing and Service? Will there be geographic differentials in adoption of POM methods?

What is the role of public policy in POM’s future?
Will POM methods find their ways in the public sector (government and its agencies; e.g., public health, IRS, FEMA, UN, and WHO etc.) and nonprofit sector (e.g., Red Cross, NGOs, social, health, and educational services)?