Journal of Supply Chain Management Science

https://journals.open.tudelft.nl/jscms

http://dx.doi.org/10.18757/jscms.2020.1734

Supply Chain Management and Management Science: A Successful Marriage

Jafar Rezaei [a,*] , David L. Olson [b] , Joseph Sarkis [c]

[a] *Faculty of Technology, Policy and Management, Delft University of Technology, 2628 BX, Delft, The Netherlands*
[b] *College of Business Administration, University of Nebraska – Lincoln, Lincoln, NE 68588-0491, USA*
[c] *Foisie School of Business, Worcester Polytechnic Institute, 100 Institute Road, Worcester, MA 01609-2280, USA*

Published first: 30-06-2020

Abstract – The last century has witnessed extant studies on the applications of Management Science (MS) to a diverse set of Supply Chain Management (SCM) issues. This paper provides an overview of the contribution of MS within SCM. A framework is developed in this paper with a sampling of MS contributions to major SCM dimensions. Future research directions are presented.

Keywords: Management Science (MS); Supply Chain Management (SCM); Review paper

1. Management Science

Management Science (MS) is a field that develops and applies scientific and analytical methods for addressing managerial concerns. The principles of Scientific Management (Taylor 1911) supported the need and application of quantitative methods to the management discipline. The history of management sciences and operations research goes well into the early 20th century. Maybe the greatest progress in MS methods and tools occurred during a time of crisis. During World War II scientists from different disciplines were formed to develop and apply quantitative methods in support of military decision-making problems. These methods were later used in management decision-making, supporting the field's title of Management Science.

Although a field with significant history, the definitions for Management Science do vary. Ansoff and Brandenburg (1967) define Management Science as "a normative study of interdisciplinary systems involving human participants". The Institute for Operations Research and the Management Sciences (INFORMS) defines Management Science as "an interdisciplinary branch of applied mathematics, engineering and sciences that uses various scientific research-based principles, strategies, and analytical methods including mathematical modeling, statistics and algorithms to improve an organization's ability to enact rational and meaningful management decisions." Integrating scientific methods and modeling for solving management problems is needed for effective management science. To further this sentiment the following statement is provided: "Management Science itself is not the impressive array of tools that have been built up over the years (optimization, simulation, decision analysis, queuing, and so on) but rather the art of reasoning logically with formal models." (Powell 2001).

Management Science is synonymous with other terms such as Operations Research (Operational Research), Decision Sciences, and more recently, Business Analytics. Although there might be nuanced differences, these fields greatly overlap. Nonetheless MS is a very broad field of study with relatively ambiguous boundaries.

According to INFORMS, Management Science encompasses three levels of research:

- *Fundamental*: this level comprises three mathematical disciplines: probability, optimization, and dynamic systems theory.
- *Modeling*: this level concerns formulating models, gathering data, and analyzing them mathematically.

[*] Corresponding author. Email addresses: j.rezaei@tudelft.nl (J. Rezaei), dolson3@unl.edu (D.L. Olson), jsarkis@wpi.edu.

- *Application*: this level builds upon the other two levels to handle real-world problems.

While the fundamental level might be independent of management disciplines, the other two levels have a direct connection with one or more management disciplines and, sometimes, a particular problem. Management Science significantly contributes to marketing, financial management, operations management, human resource management, transportation, logistics, and supply chain management. In this paper, the focus would be on the contribution of Management Science within supply chain management (SCM).

2. Supply Chain Management

Supply chain management is not new, the practice may go back millennia. Yet, it is only recently that organizations have recognized it as a competitive weapon (Christopher 2011). SCM as a management and scientific field has existed for more than a century, even though the term supply chain management is more recent. Oliver and Webber (1982) were one of the first to use the term to refer to the integration of various business functions. Throughout these past few decades researchers have defined SCM differently. Some example definitions include:

"Supply chain management is defined as the systemic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole". (Mentzer et al. 2001).

"Supply Chain Management is the integration of key business processes from end user through original suppliers that provides products, services, and information that add value for customers and other stakeholders." (Lambert and Cooper 2000).

"Supply-chain management is the strategic, tactical, and operational decision making that optimizes supply-chain performance." (Fox et al. 2000).

"The management of upstream and downstream relationships with suppliers and customers in order to deliver superior customer value at less cost to the supply chain as a whole"(Christopher 2011).

A common theme in these and others definitions of SCM includes:

- Existence of at least two actors (a supplier and a customer);
- Existence of some elements of exchange (e.g. material, information);
- Coordination between the actors and business functions (e.g. marketing, production, finance);
- The coordination aims to reach one or more objectives (e.g. minimizing cost, increasing customer satisfaction).

There are different frameworks for Supply Chain Management (Cooper et al. 1997, Croom et al. 2000, Tan 2001, Chen and Paulraj 2004), one of the most widely used is the one proposed by Croom et al. (2000), where they reviewed the literature and considered different perspectives to classify the topics related to SCM. As it has been also mentioned by them, the list is not complete, so one may find other topics to be included in this table. However, it is comprehensive.

3. The contribution of Management Science in Supply Chain Management

Here, our goal is not to systematically review the literature, as for the contribution of MS in different components of SCM separate review papers can be written, and indeed there are several excellent review papers. In Table 1, we give some examples of the contribution of MS in SCM, using the SCM components introduced by Croom et al. (2000). These various contributions are meant to provide the reader with exemplary works, and are not exhaustive.

4. Recent Exemplary MS Works by SCM Topic

4.1. Strategic Management

Strategic supply chain design

Strategic supply chain design has been widely addressed. Recent papers include Ishfaq and Raja (2015) who applied decision trees and logistic regression to rural telemedicine network design, Mathiyazhagan et al. (2015)

Table 1. Main component bodies of Supply Chain Management

Topic	Supply Chain Function
Strategic Management	Strategic supply chain design
	Sourcing
	Make or buy
	Supply network design
	Strategic alliances
	Strategic supplier segmentation
	Capability development
	Strategic purchasing
Logistics	Information integration
	Cross docking
	Capacity planning
	Distribution channel management
	Reverse logistics
Marketing	Customer service management
	Efficient replenishment
	After sales service
Relationship Development	Suppliers
	Vendor Managed Inventory (VMI)
	Partnership sourcing
	Partnership assessment
	JIT, MRP, lean and agile
Organizational Behavior	Human resources management
	Organizational structure
Risk management	Supplier selection
	Simulation modeling
	Business scorecard
	Risk matrices
Sustainability	Can be considered in all SC functions

who used the analytic hierarchy process (AHP) to implement green supply chain management, and Huang et al. (2009) who used game theory and a genetic algorithm to model coordination of greenhouse gas emissions.

Sourcing

Sourcing is a critically important function. Modeling support considering multiple criteria are widely suggested, including data envelopment analysis (DEA) by Talluri and Narasimhan (2004), PROMETHEE by Araz and Ozkarahan (2007), as well as AHP support to quality function deployment (QFD) by Xie et al. (2011). The tradeoffs between global and local sourcing were addressed by Boute and Van Mieghem (2014). Strategic issues in supplier selection were addressed by Sarkis (2003) using analytical network process (ANP), Rezaei and Davoodi (2011) using multi-objective optimization (MOOP), Amid et al. (2006) using fuzzy MOOP, and Sevkli (2010) using fuzzy ELECTRE.

Make-or-buy decisions

Make-or-buy decisions have been modeled through use of AHP by (van de Water and van Peet 2006). Chang et al. (2013) used dynamic and integer programming to aid make-to-order manufacturing scheduling.

Supply network design

Supply network design has been modeled numerous times and in numerous ways. (Shu et al. 2015) provide a complex nonlinear integer programming model of multi-echelon inventory management jointly optimizing warehouse location, warehouse-retailer assignments, inventory replenishment schedules, and safety stock level decisions. The model was proposed to be solved by a cutting-plane mathematical programming model. Garg et al. (2015) proposed a multi-criteria optimization model to manage environmental issues in supply chain network design. Nickel et al. (2012) gave a stochastic mixed-integer linear programming model, Wang et al. (2011) a MOOP model, and Ghorbani et al. (2014) a fuzzy goal programming model.

Strategic alliances

Strategic alliances have proven to be difficult to successfully implement (Vanpoucke and Vereecke 2010). The difficulty of analysis arises due to the dynamic nature of supply chain relationships. Modeling strategic alliances has been addressed by (Song and Panayides 2002) using game theory, and by Famuyiwa et al. (2008) using fuzzy goal programming. Jain et al. (2009) reviewed modeling applications of dynamic supply chains to include agent technology, petri nets, fuzzy logic, and data mining.

Strategic supplier segmentation

Strategic supplier segmentation has shown to be a crucial supply chain management activity for companies work with a large number of suppliers. Suppliers are segmented to a manageable number of groups and different strategies are formulated to manage different segments rather than individual suppliers. Supplier segmentation has been modeled by fuzzy AHP (Rezaei and Ortt 2013a), fuzzy logic (Rezaei and Ortt 2013b), best worst method (Rezaei et al. 2015), PROMETHEE and MAUT and AHP (Segura and Maroto 2017), and also using multi-objective programming (Neumüller et al. 2016).

Capability development

Capability development, which is critical for competitive advantage building within supply chains has been addressed. Singh Srai and Gregory (2008) developed a configuration definition and mapping approach and compared configuration mapping tools. Bhaskaran and Krishnan (2009) provided a formulation of the impact of joint product development. Security issues, an important capability, within supply chains was modeled by Li (2014) using AHP. Sequential capability development has also been recently introduced with a mix use of structural equation modeling and ANP (Dangol et al. 2015).

Strategic purchasing

Strategic purchasing is growing in importance with the need to quickly respond to changes in demand. Yeung (2008) found that strategic supply management improves on-time shipments, reduces operating costs, improves customer satisfaction and improves business performance. Nair et al. (2015) examined strategic and operational criteria appropriate for supplier selection and monitoring, applying a path model to assess survey data, finding positive impact for specific criteria. Cachon and Swinney (2011) applied a game theoretic model to quick response production capabilities in the fast-moving fashion industry.

4.2. Logistics

Integration of materials and information

Integration of materials and information is critical to successful supply chain logistics. Hozak and Hill (2009) found that technology such as RFID along with internal planning and control have a positive impact on supply chain performance. Lu et al. (2013) modeled a web-based information platform in the semiconductor industry which mitigated the bullwhip effect. (Zhang et al. 2015) provided an integration model of supply chain partner integration in managing material, information, knowledge, and financial flows.

Cross-docking

Cross-docking was analytically modeled by (Waller et al. 2006), while Larbi et al. (2011) used heuristic algorithms. Shi et al. (2013) applied discrete-event simulation along with robust optimization and bootstrapping to JIT in the automotive industry including cross docking. Abouee-Mehrizi et al. (2013) used mixed integer linear programming to determine the number and location of cross-docks to assign retailers to suppliers. Shi et al. (2014) used a multi-response optimization model with response surface methodology to an auto parts supply chain design. Mohtashami (2015) applied a genetic algorithm to a cross-docking model to reduce warehouse space requirements, inventory management costs, and turnaround times.

Capacity planning

Capacity planning is to manage the production and supply capacity of individual companies and the supply chain as a whole. It was addressed through stochastic integer programming by Hood et al. (2003). Jayaraman (2006) used a mathematical programming model for aggregate production planning and control in long-range planning of a closed-loop supply chain. Chao et al. (2009) applied stochastic modeling for a telecom industry capacity expansion problem. Jodlbauer and Reitner (2012) used integer programming to obtain a capacity feasible production plan considering alternative routings, safety stock, lot splitting, and lot summarization. Wang et al. (2013) used a fuzzy goal programming model for a high tech manufacturing capacity requirements planning model. Çetinkaya et al. (2009) developed a mixed-integer optimization model for inventory and transportation decisions in Frito-Lay's outbound supply chain.

Distribution channel management

Distribution channel management is managing activities which involve delivering products and services to the customers through distribution partners. It was modeled by (Seifert et al. 2006) to integrate virtual stores with direct and indirect distribution channels. Huang et al. (2009) developed a dynamic system model for supply chain distribution considering risk management. Paksoy et al. (2012) used fuzzy AHP and fuzzy TOPSIS. Davis et al. (2014) modeled allocation of inventory risk in a two-stage supply chain considering channel efficiency and profit distribution.

Reverse logistics

Reverse logistics is defined as "planning, implementing, and controlling the efficient and effective flow and storage of goods, services and related information between the point of consumption and the point of origin for economical or environmental purposes" (Rezaei 2015a). Salema et al. (2007) proposed a generic optimization model for reverse distribution network, minimizing the total cost of the network while considering capacity limits, multi-product management and uncertainty on product demands and returns. Niknejad and Petrovic (2014) formulated a mixed integer programming problem for reverse logistics and solved it using a two-phase fuzzy mixed integer optimization algorithm. For reviewing quantitative models for reverse logistics we refer to review papers (Fleischmann et al. 1997, Rezaei 2015a, Bazan et al. 2016, Govindan et al. 2015b).

4.3. Marketing

Customer service management

Customer service management is considered as one of the most important aspects of supply chain management as it manages the point where is the ultimate goal of a supply chain, customer. Satisfied customers for a supply chain prove success. It was modeled by Cheung et al. (2003) using case-based reasoning and adaptive time-series. Ren and Zhou (2008) used a queuing model to coordinate staffing in a call center involved with outsourcing considering service quality maintenance.

Efficient replenishment

Efficient replenishment is about using the organization's resources and skills in the most proper way to replenish the required materials. It was dealt with by Lin et al. (2009) using an heuristic algorithm to obtain more efficient replenishment by determining better production cycle and product life cycle.

After sales service

After sales service can be considered as part of customer relationship management which concerns all the activities which happen after a product or service is sold or offered. It was addressed by Deshpande et al. (2003) through an inventory model for analysis of part attributes and performance of after-sales service. Kurata and Nam (2010) applied analytical modeling and game theory to this issue.

4.4. Relationship Development

Supplier development

Supplier development is a strategic activity to improve suppliers' capabilities and willingness to cooperate. It was modeled by Bai and Sarkis (2010) using rough set theory, while Fu et al. (2012) used grey-based DEMATEL. Supplier development co-investment, by both supplier and buyer, has also been recently studied from a game theoretic perspective (Bai and Sarkis 2016).

VMI

VMI, vendor managed inventory, is a major means of tying suppliers to retailers. Within this context Ryu et al. (2013) used a fractal-based approach to inventory management for coordination of inventory policies across supply chains. Alftan et al. (2015) introduced an operations model for retail replenishment collaboration. Borade and Sweeney (2015) presented a decision support system based on a genetic algorithm for a VMI supply chain. Jiang et al. (2015) used nonlinear mixed integer Nash bargaining model for a joint inventory supply chain. Investigation of this topic can also occur in different stages of supply chain management, for example in logistics and delivery modeling of optimal routes for VMI setting has been completed (Park et al. 2016). Çetinkaya and Lee (2000) used analytical modeling to consider VMI in stock replenishment and shipment scheduling.

Partnership sourcing

Partnership sourcing was addressed by Jain et al. (2009) who applied agent technology, petri nets, fuzzy logic and data mining to support dynamic supply chain supplier-buyer relationships. Bai and Sarkis (2012) used neighborhood rough set theory for identification and selection of performance measures for desired sourcing outcomes. Rezaei (2015b) used assignment models to aid linking suppliers and buyers.

Partnership assessment

Partnership assessment is important since it focuses on the relationship performance between a buyer and supplier. This relational view was modeled by Piltan and Sowlati (2016) used ANP to evaluate partnership. Chen and Wu (2010) used a systematic procedure to evaluate an automobile manufacturer–distributor partnership. They used Interpretive Structure Modeling (ISM) and ANP for partnership evaluation.

JIT, MRP, lean and agile

JIT, MRP, lean and agile are important technologies and approaches supporting efficient assembly operations, impacting logistics operations. (Hsu et al. 2006) developed an optimization model for stocking quantity identification in an assemble-to-order domain. Kojima et al. (2008) provided modeling to evaluate performance of supply chains in the JIT environment using discrete-time Markov processes. Tsai (2011) developed a production and shipment model incorporating learning effects in an inventory situation involving deteriorating items.

4.5. Organizational Behavior

Human resources management

Human resources management modeling was given by Schultz et al. (2010), using an optimal and a heuristic rearrangement of workers to increase throughput. Größler and Zock (2010) used system dynamics modeling for a German logistics provider's recruiting and training process. Swenseth and Olson (2014) applied a simulation model for analysis of a human resources supply chain.

Organizational structure

Organizational structure was considered in a nonlinear constrained optimization problem evaluating performance of a serial manufacturing and supply system by Liu et al. (2004). Lamsal et al. (2016) considered the organizational structure of an agricultural system for harvesting logistics in the United States.

4.6. Risk Management

Supply chains face intense turbulence and uncertainty from a variety of sources. Wagner and Bode (2008) surveyed German executives, finding that supply chain performance was negatively impacted by demand side and supply risks, as opposed to less impact from risks from regulation, legal matters, bureaucracy and infrastructure, or even catastrophe. But all of these sources can impact supply chain operations. Huang et al. (2009) used a dynamic system model (based on queuing, with simulation for validation) to assess the impact of disruptive events on supply chains. Olson (2009) outlined the use of three categories of management science modeling to support supply chains (specifically the function of outsourcing evaluation). These models included multi-criteria selection models, simulation models for risk assessment from multiple sources, and balanced scorecard analysis for performance assessment in dealing with risks. Demand uncertainty was modeled by Sodhi and Tang (2009) through linear programming extensions considering demand uncertainty and cash flows. Wu et al. (2014) used maximin models to evaluate supply chain efficiency with respect to risk.

Supplier selection

Supplier selection modeling was addressed in Wu and Olson (2008a) using stochastic dominance and data envelopment analysis (DEA). These same authors presented simulation models for vendor selection (Wu and Olson 2008b). Wu and Olson (2010) applied DEA in vendor selection models considering value at risk. Olson and Wu (2011) presented outsourcing risk through scenario analysis. Outsourcing risk was considered in Wu et al. (2013) through fuzzy multi-objective programming. Analytical multiple criteria models for supplier selection have been extensively used for green supplier selection (Govindan et al. 2015a).

Simulation

Simulation has been widely applied to evaluate risk, due to its probabilistic nature. Canbolat et al. (2008) gave a sourcing risk assessment model in the US automotive field, focusing on risk factors obtained from literature review and interviews. Peng et al. (2014) proposed a system dynamics model for disaster relief supply chains.

Balanced scorecards

Balanced scorecards were proposed by Zimmermann and Seuring (2009) for automobile supply chains. Lee et al. (2015) gave a semantic web-based supplier discovery system matching supplier capabilities with buyer requirements. Brulhart and Moncef (2015) used balanced scorecards to evaluate financial and non-financial performance in a supply chain.

Risk matrices

Risk matrices were applied by Yang (2010) to evaluate risk factors in the Taiwan shipping industry. Cagliano et al. (2012) developed a risk identification and analysis model for manufacturing supply chains.

Overall a broad review of quantitative models for supply chain risk management has been developed with a network analysis identifying various sub-fields within this topic. Sustainability was an emergent risk management topic (Fahimnia et al. 2015).

4.7. Sustainability

Sustainability is perhaps the youngest topic in this field, which has been considered as an important aspect of almost all functions discussed above. Here we refer to a few examples of considering sustainability dimensions in Supply chain functions. (Rezaei et al. 2016) used BWM for sustainable supplier selection, while (Trapp and Sarkis 2016) used an optimization model for sustainable supplier development.

5. Conclusion

Management science support for supply chain management is widespread. Modeling has supported strategic management in many areas, two broad categories being analysis of core competencies and of global strategy. Analytical modeling support has also been applied to many logistics decisions, as well as to marketing decisions. Models have supported relationship development, usually through system design implementing software of various kinds. In the organizational behavior area, models have been proposed to more efficiently manage human resources.

Support to the area of risk management is especially rich, due to the challenge of operating in dynamic environments with unforeseen challenges. This field usually involves probabilistic data. A variety of management science tools have been applied. Supplier selection often involves multiple criteria, calling for tradeoff analysis. Most risk management problems involve probabilistic data, with many stochastic models being applied. Monitoring performance is important, and balanced scorecards offer a means to measure performance on multiple dimensions. Risk matrices perform similar service focusing on risk management.

Reviewing the literature of SCM, Croom et al. (2000) found that the majority of studies in the field are 'descriptive' (67%). These studies facilitate 'prescriptive' studies, which currently have a lower share (33%). It is evident that MS has significantly contributed 'physical' problems in SCM such as inventory management, network and distribution planning, however there are relatively fewer studies in 'soft' problems such as trust and commitment or knowledge transfer. This is partly due to lack of proper MS tools for such problems, and partly due to the traditional dominance of qualitative studies in these parts of SCM. We think that one major future direction would be to devise more appropriate tools for these problems. Given the complex nature of SCM problems, traditional optimization tools might require significant enhancement or may not be applicable, flexible learning, artificial intelligence tools might better capture the complexity of emergent SCM problems. The research and use of MS tools new and old still has a fertile field to plow in the SCM discipline.

References

Abouee-Mehrizi, H., Berman, O. and Baharnemati, M. R. (2013) 'Designing Production-Inventory-Transportation Systems with Capacitated Cross-Docks', *Transportation Science,* 48(1), 121-135.

Alftan, A., Kaipia, R., Loikkanen, L. and Spens, K. (2015) 'Centralised grocery supply chain planning: improved exception management', *International Journal of Physical Distribution & Logistics Management,* 45(3), 237-259.

Amid, A., Ghodsypour, S. and O'Brien, C. (2006) 'Fuzzy multiobjective linear model for supplier selection in a supply chain', *International Journal of Production Economics*, 104(2), 394-407.

Ansoff, H. I. and Brandenburg, R. C. (1967) 'A Program of Research in Business Planning', *Management Science,* 13(6), B-219-B-239.

Araz, C. and Ozkarahan, I. (2007) 'Supplier evaluation and management system for strategic sourcing based on a new multicriteria sorting procedure', *International Journal of Production Economics,* 106(2), 585-606.

Bai, C. and Sarkis, J. (2010) 'Green supplier development: analytical evaluation using rough set theory', *Journal of Cleaner Production*, 18(12), 1200-1210.

Bai, C. and Sarkis, J. (2012) 'Supply-chain performance-measurement system management using neighbourhood rough sets', *International Journal of Production Research,* 50(9), 2484-2500.

Bai, C. and Sarkis, J. (2016) 'Supplier development investment strategies: A game theoretic evaluation', *Annals of Operations Research,* 240(2), 583–615.

Bazan, E., Jaber, M. Y. and Zanoni, S. (2016) 'A review of mathematical inventory models for reverse logistics and the future of its modeling: An environmental perspective', *Applied Mathematical Modelling*, 40(5), 4151-4178.

Bhaskaran, S. R. and Krishnan, V. (2009) 'Effort, revenue, and cost sharing mechanisms for collaborative new product development', *Management Science,* 55(7), 1152-1169.

Borade, A. B. and Sweeney, E. (2015) 'Decision support system for vendor managed inventory supply chain: a case study', *International Journal of Production Research*, 53(16), 4789-4818.

Boute, R. N. and Van Mieghem, J. A. (2014) 'Global Dual Sourcing and Order Smoothing: The Impact of Capacity and Lead Times', *Management Science,* 61(9), 2080-2099.

Brulhart, F. and Moncef, B. (2015) 'Causal linkages between supply chain management practices and performance', *Journal of Manufacturing Technology Management,* 26(5), 678-702.

Cachon, G. P. and Swinney, R. (2011) 'The value of fast fashion: Quick response, enhanced design, and strategic consumer behavior', *Management Science,* 57(4), 778-795.

Cagliano, A. C., De Marco, A., Grimaldi, S. and Rafele, C. (2012) 'An integrated approach to supply chain risk analysis', *Journal of risk research,* 15(7), 817-840.

Canbolat, Y. B., Gupta, G., Matera, S. and Chelst, K. (2008) 'Analysing risk in sourcing design and manufacture of components and sub-systems to emerging markets', *International Journal of Production Research,* 46(18), 5145-5164.

Çetinkaya, S. and Lee, C.-Y. (2000) 'Stock Replenishment and Shipment Scheduling for Vendor-Managed Inventory Systems', *Management Science,* 46(2), 217-232.

Çetinkaya, S., Üster, H., Easwaran, G. and Keskin, B. B. (2009) 'An integrated outbound logistics model for Frito-Lay: Coordinating aggregate-level production and distribution decisions', *Interfaces,* 39(5), 460-475.

Chang, Y.-C., Chang, K.-H. and Chang, T.-K. (2013) 'Applied column generation-based approach to solve supply chain scheduling problems', *International Journal of Production Research,* 51(13), 4070-4086.

Chao, X., Chen, H. and Zheng, S. (2009) 'Dynamic capacity expansion for a service firm with capacity deterioration and supply uncertainty', *Operations research,* 57(1), 82-93.

Chen, I. J. and Paulraj, A. (2004) 'Understanding supply chain management: critical research and a theoretical framework', *International Journal of Production Research,* 42(1), 131-163.

Chen, S. P. and Wu, W. Y. (2010) 'A systematic procedure to evaluate an automobile manufacturer–distributor partnership', *European Journal of Operational Research,* 205(3), 687-698.

Cheung, C. F., Lee, W., Wang, W., Chu, K. and To, S. (2003) 'A multi-perspective knowledge-based system for customer service management', *Expert Systems with Applications,* 24(4), 457-470.

Christopher, M. (2011) *Logistics and Supply Chain Management,* 4 ed., Harlow, UK: Financial Times Series, Pearson Education Limited.

Cooper, M. C., Lambert, D. M. and Pagh, J. D. (1997) 'Supply chain management: more than a new name for logistics', *The international journal of logistics management,* 8(1), 1-14.

Croom, S., Romano, P. and Giannakis, M. (2000) 'Supply chain management: an analytical framework for critical literature review', *European Journal of Purchasing & Supply Management,* 6(1), 67-83.

Dangol, R., Bahl, M. and Karpak, B. (2015) 'Timing cooperative relationships with sequential capability development process to reduce capability development trade-offs', *International Journal of Production Economics,* 169, 179-189.

Davis, A. M., Katok, E. and Santamaría, N. (2014) 'Push, pull, or both? A behavioral study of how the allocation of inventory risk affects channel efficiency', *Management Science,* 60(11), 2666-2683.

Deshpande, V., Cohen, M. A. and Donohue, K. (2003) 'An empirical study of service differentiation for weapon system service parts', *Operations research,* 51(4), 518-530.

Fahimnia, B., Tang, C. S., Davarzani, H. and Sarkis, J. (2015) 'Quantitative models for managing supply chain risks: A review', *European Journal of Operational Research,* 247(1), 1-15.

Famuyiwa, O., Monplaisir, L. and Nepal, B. (2008) 'An integrated fuzzy-goal-programming-based framework for selecting suppliers in strategic alliance formation', *International Journal of Production Economics,* 113(2), 862-875.

Fleischmann, M., Bloemhof-Ruwaard, J. M., Dekker, R., Van der Laan, E., Van Nunen, J. A. and Van Wassenhove, L. N. (1997) 'Quantitative models for reverse logistics: A review', *European Journal of Operational Research,* 103(1), 1-17.

Fox, M. S., Barbuceanu, M. and Teigen, R. (2000) 'Agent-oriented supply-chain management', *International Journal of Flexible manufacturing systems,* 12(2-3), 165-188.

Fu, X., Zhu, Q. and Sarkis, J. (2012) 'Evaluating green supplier development programs at a telecommunications systems provider', *International Journal of Production Economics,* 140(1), 357-367.

Garg, K., Kannan, D., Diabat, A. and Jha, P. (2015) 'A multi-criteria optimization approach to manage environmental issues in closed loop supply chain network design', *Journal of Cleaner Production,* 100, 297-314.

Ghorbani, M., Arabzad, S. M. and Tavakkoli-Moghaddam, R. (2014) 'A multi-objective fuzzy goal programming model for reverse supply chain design', *International Journal of Operational Research,* 19(2), 141-153.

Govindan, K., Rajendran, S., Sarkis, J. and Murugesan, P. (2015a) 'Multi criteria decision making approaches for green supplier evaluation and selection: a literature review', *Journal of Cleaner Production,* 98, 66-83.

Govindan, K., Soleimani, H. and Kannan, D. (2015b) 'Reverse logistics and closed-loop supply chain: A comprehensive review to explore the future', *European Journal of Operational Research,* 240(3), 603-626.

Größler, A. and Zock, A. (2010) 'Supporting long-term workforce planning with a dynamic aging chain model: A case study from the service industry', *Human Resource Management,* 49(5), 829-848.

Hood, S. J., Bermon, S. and Barahona, F. (2003) 'Capacity planning under demand uncertainty for semiconductor manufacturing', *Semiconductor Manufacturing, IEEE Transactions on,* 16(2), 273-280.

Hozak, K. and Hill, J. A. (2009) 'Issues and opportunities regarding replanning and rescheduling frequencies', *International Journal of Production Research,* 47(18), 4955-4970.

Hsu, V. N., Lee, C. Y. and So, K. C. (2006) 'Optimal component stocking policy for assemble-to-order systems with lead-time-dependent component and product pricing', *Management Science,* 52(3), 337-351.

Huang, H.-Y., Chou, Y.-C. and Chang, S. (2009) 'A dynamic system model for proactive control of dynamic events in full-load states of manufacturing chains', *International Journal of Production Research,* 47(9), 2485-2506.

Ishfaq, R. and Raja, U. (2015) 'Bridging the Healthcare Access Divide: A Strategic Planning Model for Rural Telemedicine Network', *Decision Sciences,* 46(4), 755-790.

Jain, V., Wadhwa, S. and Deshmukh, S. (2009) 'Select supplier-related issues in modelling a dynamic supply chain: potential, challenges and direction for future research', *International Journal of Production Research*, 47(11), 3013-3039.

Jayaraman, V. (2006) 'Production planning for closed-loop supply chains with product recovery and reuse: an analytical approach', *International Journal of Production Research,* 44(5), 981-998.

Jiang, N., Zhang, L. L. and Yu, Y. (2015) 'Optimizing cooperative advertizing, profit sharing, and inventory policies in a VMI supply chain: a nash bargaining model and hybrid algorithm', *IEEE Transactions on Engineering Management,* 62(4), 449-461.

Jodlbauer, H. and Reitner, S. (2012) 'Material and capacity requirements planning with dynamic lead times', *International Journal of Production Research*, 50(16), 4477-4492.

Kojima, M., Nakashima, K. and Ohno, K. (2008) 'Performance evaluation of SCM in JIT environment', *International Journal of Production Economics*, 115(2), 439-443.

Kurata, H. and Nam, S.-H. (2010) 'After-sales service competition in a supply chain: Optimization of customer satisfaction level or profit or both?', *International Journal of Production Economics,* 127(1), 136-146.

Lambert, D. M. and Cooper, M. C. (2000) 'Issues in Supply Chain Management', *Industrial Marketing Management,* 29(1), 65-83.

Lamsal, K., Jones, P. C. and Thomas, B. W. (2016) 'Harvest logistics in agricultural systems with multiple, independent producers and no on-farm storage', *Computers & Industrial Engineering,* 91, 129-138.

Larbi, R., Alpan, G., Baptiste, P. and Penz, B. (2011) 'Scheduling cross docking operations under full, partial and no information on inbound arrivals', *Computers & Operations Research,* 38(6), 889-900.

Lee, J., Jung, K., Kim, B. H., Peng, Y. and Cho, H. (2015) 'Semantic web-based supplier discovery system for building a long-term supply chain', *International Journal of Computer Integrated Manufacturing,* 28(2), 155-169.

Li, T.-S. (2014) 'Establishing an integrated framework for security capability development in a supply chain', *International Journal of Logistics Research and Applications*, 17(4), 283-303.

Lin, Y., Yu, J. C. and Wang, K.-J. (2009) 'An efficient replenishment model of deteriorating items for a supplier–buyer partnership in hi-tech industry', *Production Planning and Control,* 20(5), 431-444.

Liu, L., Liu, X. and Yao, D. D. (2004) 'Analysis and optimization of a multistage inventory-queue system', *Management Science,* 50(3), 365-380.

Lu, C.-C., Tsai, K.-M., Chen, J.-H. and Lee, W.-T. (2013) 'Mitigating the Bullwhip Effect in the Supply Chain of Semiconductor Assembly and Testing Through an Inter-business Information Platform', *International Journal of Electronic Business Management*, 11(3), 202.

Mathiyazhagan, K., Diabat, A., Al-Refaie, A. and Xu, L. (2015) 'Application of analytical hierarchy process to evaluate pressures to implement green supply chain management', *Journal of Cleaner Production,* 107, 229-236.

Mentzer, J. T., DeWitt, W., Keebler, J. S., Min, S., Nix, N. W., Smith, C. D. and Zacharia, Z. G. (2001) 'Defining supply chain management', *Journal of Business Logistics,* 22(2), 1-25.

Mohtashami, A. (2015) 'A novel dynamic genetic algorithm-based method for vehicle scheduling in cross docking systems with frequent unloading operation', *Computers & Industrial Engineering,* 90, 221-240.

Nair, A., Jayaram, J. and Das, A. (2015) 'Strategic purchasing participation, supplier selection, supplier evaluation and purchasing performance', *International Journal of Production Research,* 53(20), 6263-6278.

Neumüller, C., Lasch, R. and Kellner, F. (2016) 'Integrating sustainability into strategic supplier portfolio selection', *Management Decision,* 54(1), 194-221.

Nickel, S., Saldanha-da-Gama, F. and Ziegler, H.-P. (2012) 'A multi-stage stochastic supply network design problem with financial decisions and risk management', *Omega,* 40(5), 511-524.

Niknejad, A. and Petrovic, D. (2014) 'Optimisation of integrated reverse logistics networks with different product recovery routes', *European Journal of Operational Research,* 238(1), 143-154.

Oliver, R. K. and Webber, M. D. (1982) 'Supply-chain management: logistics catches up with strategy', *Outlook,* 5(1), 42-47.

Olson, D. L. (2009) 'Risk management models for supply chain outsourcing', *Conradi Research Review*, 15.

Olson, D. L. and Wu, D. (2011) 'Risk management models for supply chain: a scenario analysis of outsourcing to China', *Supply Chain Management: An International Journal,* 16(6), 401-408.

Paksoy, T., Pehlivan, N. Y. and Kahraman, C. (2012) 'Organizational strategy development in distribution channel management using fuzzy AHP and hierarchical fuzzy TOPSIS', *Expert Systems with Applications,* 39(3), 2822-2841.

Park, Y.-B., Yoo, J.-S. and Park, H.-S. (2016) 'A genetic algorithm for the vendor-managed inventory routing problem with lost sales', *Expert Systems with Applications,* 53, 149-159.

Peng, M., Peng, Y. and Chen, H. (2014) 'Post-seismic supply chain risk management: A system dynamics disruption analysis approach for inventory and logistics planning', *Computers & Operations Research,* 42, 14-24.

Piltan, M. and Sowlati, T. (2016) 'A multi-criteria decision support model for evaluating the performance of partnerships', *Expert Systems with Applications,* 45, 373-384.

Powell, S. G. (2001) 'Teaching Modeling in Management Science', *INFORMS Transactions on Education,* 1(2), 62-67.

Ren, Z. J. and Zhou, Y.-P. (2008) 'Call center outsourcing: Coordinating staffing level and service quality', *Management Science,* 54(2), 369-383.

Rezaei, J. (2015a) 'A Systematic Review of Multi-criteria Decision-making Applications in Reverse Logistics', *Transportation Research Procedia,* 10, 766-776.

Rezaei, J. (2015b) 'A two-way approach to supply chain partner selection', *International Journal of Production Research,* 53(16), 4888-4902.

Rezaei, J. and Davoodi, M. (2011) 'Multi-objective models for lot-sizing with supplier selection', *International Journal of Production Economics,* 130(1), 77-86.

Rezaei, J., Nispeling, T., Sarkis, J. and Tavasszy, L. (2016) 'A supplier selection life cycle approach integrating traditional and environmental criteria using the best worst method', *Journal of Cleaner Production,* 135, 577-588.

Rezaei, J. and Ortt, R. (2013a) 'Multi-criteria supplier segmentation using a fuzzy preference relations based AHP', *European Journal of Operational Research,* 225(1), 75-84.

Rezaei, J. and Ortt, R. (2013b) 'Supplier segmentation using fuzzy logic', *Industrial Marketing Management,* 42(4), 507-517.

Rezaei, J., Wang, J. and Tavasszy, L. (2015) 'Linking supplier development to supplier segmentation using Best Worst Method', *Expert Systems with Applications,* 42(23), 9152-9164.

Ryu, K., Moon, I., Oh, S. and Jung, M. (2013) 'A fractal echelon approach for inventory management in supply chain networks', *International Journal of Production Economics,* 143(2), 316-326.

Salema, M. I. G., Barbosa-Povoa, A. P. and Novais, A. Q. (2007) 'An optimization model for the design of a capacitated multi-product reverse logistics network with uncertainty', *European Journal of Operational Research,* 179(3), 1063-1077.

Sarkis, J. (2003) 'A strategic decision framework for green supply chain management', *Journal of Cleaner Production,* 11(4), 397-409.

Schultz, K. L., Schoenherr, T. and Nembhard, D. (2010) 'An example and a proposal concerning the correlation of worker processing times in parallel tasks', *Management Science,* 56(1), 176-191.

Segura, M. and Maroto, C. (2017) 'A multiple criteria supplier segmentation using outranking and value function methods', *Expert Systems with Applications,* 69, 87-100.

Seifert, R. W., Thonemann, U. W. and Sieke, M. A. (2006) 'Integrating direct and indirect sales channels under decentralized decision-making', *International Journal of Production Economics,* 103(1), 209-229.

Sevkli, M. (2010) 'An application of the fuzzy ELECTRE method for supplier selection', *International Journal of Production Research,* 48(12), 3393-3405.

Shi, W., Liu, Z., Shang, J. and Cui, Y. (2013) 'Multi-criteria robust design of a JIT-based cross-docking distribution center for an auto parts supply chain', *European Journal of Operational Research,* 229(3), 695-706.

Shi, W., Shang, J., Liu, Z. and Zuo, X. (2014) 'Optimal design of the auto parts supply chain for JIT operations: sequential bifurcation factor screening and multi-response surface methodology', *European Journal of Operational Research,* 236(2), 664-676.

Shu, J., Wu, T. and Zhang, K. (2015) 'Warehouse location and two-echelon inventory management with concave operating cost', *International Journal of Production Research,* 53(9), 2718-2729.

Singh Srai, J. and Gregory, M. (2008) 'A supply network configuration perspective on international supply chain development', *International Journal of Operations & Production Management,* 28(5), 386-411.

Sodhi, M. S. and Tang, C. S. (2009) 'Modeling supply-chain planning under demand uncertainty using stochastic programming: A survey motivated by asset–liability management', *International Journal of Production Economics,* 121(2), 728-738.

Song, D.-W. and Panayides, P. M. (2002) 'A conceptual application of cooperative game theory to liner shipping strategic alliances', *Maritime Policy & Management,* 29(3), 285-301.

Swenseth, S. R. and Olson, D. L. (2014) 'Simulation model of professional service personnel inventory', *International Journal of Services and Operations Management,* 19(4), 451-467.

Talluri, S. and Narasimhan, R. (2004) 'A methodology for strategic sourcing', *European Journal of Operational Research,* 154(1), 236-250.

Tan, K. C. (2001) 'A framework of supply chain management literature', *European Journal of Purchasing & Supply Management,* 7(1), 39-48.

Taylor, F. W. (1911) *The Principles of Scientific Management,* New York, NY, USA and London, UK: Harper & Brothers Publishers.

Trapp, A. C. and Sarkis, J. (2016) 'Identifying Robust portfolios of suppliers: a sustainability selection and development perspective', *Journal of Cleaner Production,* 112, Part 3, 2088-2100.

Tsai, D.-M. (2011) 'An optimal production and shipment policy for a single-vendor single-buyer integrated system with both learning effect and deteriorating items', *International Journal of Production Research,* 49(3), 903-922.

van de Water, H. and van Peet, H. P. (2006) 'A decision support model based on the Analytic Hierarchy Process for the Make or Buy decision in manufacturing', *Journal of Purchasing and Supply Management,* 12(5), 258-271.

Vanpoucke, E. and Vereecke, A. (2010) 'The predictive value of behavioural characteristics on the success of strategic alliances', *International Journal of Production Research,* 48(22), 6715-6738.

Wagner, S. M. and Bode, C. (2008) 'An empirical examination of supply chain performance along several dimensions of risk', *Journal of Business Logistics,* 29(1), 307-325.

Waller, M. A., Cassady, C. R. and Ozment, J. (2006) 'Impact of cross-docking on inventory in a decentralized retail supply chain', *Transportation Research Part E: Logistics and Transportation Review,* 42(5), 359-382.

Wang, E.-J., Su, T.-S., Tsai, D.-M. and Lin, C.-Y. (2013) 'Fuzzy multiple-goal programming for analysing outsourcing cost-effectiveness in hi-tech manufacturing', *International Journal of Production Research,* 51(13), 3920-3944.

Wang, F., Lai, X. and Shi, N. (2011) 'A multi-objective optimization for green supply chain network design', *Decision Support Systems,* 51(2), 262-269.

Wu, D. and Olson, D. L. (2008a) 'A comparison of stochastic dominance and stochastic DEA for vendor evaluation', *International Journal of Production Research,* 46(8), 2313-2327.

Wu, D. and Olson, D. L. (2008b) 'Supply chain risk, simulation, and vendor selection', *International Journal of Production Economics,* 114(2), 646-655.

Wu, D., Wu, D. D., Zhang, Y. and Olson, D. L. (2013) 'Supply chain outsourcing risk using an integrated stochastic-fuzzy optimization approach', *Information Sciences,* 235, 242-258.

Wu, D. D., Luo, C. and Olson, D. L. (2014) 'Efficiency evaluation for supply chains using maximin decision support', *IEEE Transactions on Systems, Man, and Cybernetics: Systems,* 44(8), 1088-1097.

Wu, D. D. and Olson, D. (2010) 'Enterprise risk management: a DEA VaR approach in vendor selection', *International Journal of Production Research,* 48(16), 4919-4932.

Xie, C., Anumba, C. J., Lee, T.-R., Ho, W., Dey, P. K. and Lockström, M. (2011) 'Strategic sourcing: a combined QFD and AHP approach in manufacturing', *Supply Chain Management: An International Journal,* 16(6), 446-461.

Yang, Y.-C. (2010) 'Impact of the container security initiative on Taiwan's shipping industry', *Maritime Policy & Management,* 37(7), 699-722.

Yeung, A. C. (2008) 'Strategic supply management, quality initiatives, and organizational performance', *Journal of Operations Management,* 26(4), 490-502.

Zhang, C., Gunasekaran, A. and Wang, W. Y. C. (2015) 'A comprehensive model for supply chain integration', *Benchmarking: An International Journal,* 22(6), 1141-1157.

Zimmermann, K. and Seuring, S. (2009) 'Two case studies on developing, implementing and evaluating a balanced scorecard in distribution channel dyads', *International Journal of Logistics: Research and Applications,* 12(1), 63-81.