Risk management and coordination in service supply chains: information, logistics and outsourcing

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Abstract:

A service supply chain, which is a system formed by a network of suppliers, service designers, service providers, and other service partners, aims to transfer available scarce resources into services and deliver them to satisfy customer needs. It is a known fact that service supply chain management is playing a more and more important role in modern economies. However, the unique features of service supply chains also create new challenges that call for proper management of the respective operations. In particular, how to coordinate a service supply chain with risk considerations is a critical issue. In this paper, we concisely examine coordination and risk management challenges in service supply chain systems. We also introduce the technical papers featured in the special issue.

Keywords: Service supply chain management, risk management, coordination, information, supply contracts, logistics services, service outsourcing, information management.

1. Introduction

In recent years, we have witnessed a dramatic growth of service based industries all around the world. Undoubtedly, service supply chain management is a pertinent issue in modern business. In traditional physical product based supply chain systems, supply chain management is concerned with the management of both forward and reverse flows of physical products and related flows of information and funds. However, a pure service supply chain differs dramatically from the traditional physical product supply chain because the “service product” cannot be inventorized, customers are highly

involved in the service process, and the assessment of the service quality can be highly subjective (Wang et al. 2015). As a result, new dimensions of supply chain risk emerge, and traditional decisions including production, replenishment, warehousing, scheduling and quality control are taking new performance measures. In fact, a pure service supply chain system can be defined as a network of suppliers, service designers, service providers and other service partners that transfer scarce resources into services (or servitised products) and deliver them to customers. Coordinating a service supply chain requires both innovative operational strategies and new analytical models. In particular, we believe that logistics services, use of information, and service outsourcing are all critical topics in service supply chain management.

Motivated by the importance of service supply chain coordination and risk management, we thereby organize this Journal of Operational Research Society special issue on "Risk management and coordination in service supply chains: information, logistics and outsourcing". In the following sections, we concisely discuss each major topic and introduce the papers featured in this special issue one by one.

2. Logistics Services

Logistics services, both forward and reverse (Ramos and Oliveira 2011), are critical to supply chain operations. It is well-known that inventory control, location selection and transportation management are the three major dimensions of logistics. Recently, Lulli et al. (2011) explore a case study on network service design in Italy. The authors develop a mathematical optimization model for the optimal service network design for freight railway transportation. By implementing a tabu search based procedure, a solution scheme is proposed and numerical results show that it outperforms the existing practice. Smith et al. (2013) study a location problem for public service applications. They develop hierarchical models with efficiency criteria to facilitate the generation of scenario choices. Other related recent studies include the optimal presort loading problem in commercial bulk mail

services (Lim et al. 2015), and the optimal quality control in logistics service supply chains with risk attitude considerations (Liu and Wang 2015). Notice that the above studies mainly focus on improving logistics services without consideration of the coordination of the whole supply chain. In the domain of logistics service supply chain coordination, only a few studies are reported in the literature. For example, Wu and Dan (2009) discuss the supply chain coordination issue with a third party logistics service provider. They show that a revenue sharing contract can help achieve win-win coordination. Liu et al. (2013) study the quality supervision and coordination challenges in logistics service supply chain systems. The authors consider a multi-period setting and develop a model for a three-echelon logistics service supply chain. Zhao et al. (2014) investigate the channel coordination challenge in supply chains with a logistics service level dependent demand. The authors formulate the problem as a differential game, and propose the use of a cost-sharing contract to achieve supply chain coordination.

This special issue also features several papers related to logistics services and we review them as follows. In the paper "The Impact of Fleet Size on Performance-Based Incentive Management" Mirzahosseinian, Piplani and Jin study the reliability improvement of the respective system. The authors consider a single-echelon repairable inventory control model. They find that the component reliability in their formulation is a function of service rate and fleet size. They then build a principal-agent model to assess the impact brought by the fleet size on the design of the performance-based incentive. In the paper "Transaction Cost Analysis of Supply Chain Logistics Services: Firm-Based versus Port-Based", Liu, Wang, Yao and Yue study the inter-firm transactions and related risks in logistics service supply chains. They construct a transaction cost frontier model under the port-focal supply chain framework. They develop several critical insights and propose that the industrialization of logistics would lead to the growth of port-focal urbanization. In another paper, entitled "Option Contracts: A Solution for Overloading Problems in the Delivery Service Supply Chain", Liu, Gou, Alwan and Liang explore the online retailing business in the presence of a delivery service provider. The authors develop their basic model based on the classic newsvendor

inventory setting. They derive the delivery service provider's optimal capacity and argue that the service overloading problem is unavoidable because the delivery service cannot be stocked in advance. To overcome the overloading challenges, the authors propose a novel option contract. In "Product Damage and Free Sampling: A Newsvendor Model with Passive and Proactive Self-Consumption", Liu studies the self-consumption issue in retailing where the retailer itself consumes the inventory due to promotion activities (proactive consumption) or inventory damage issue (passive consumption). To be specific, the author explores the optimal inventory ordering policy in the presence of both passive and proactive self-consumption and shows that the optimal policy can take up to three different formats. The situations under which self-consumption is beneficial for the retailer are also identified. In the paper entitled "Loss-Averse Newsvendor Problem with Supply Risk", Ma, Xue, Zhao and Zeng investigate the inventory decision of a supplier (modelled as a newsvendor) facing both demand and supply uncertainties. They explicitly examine how the level of loss aversion, the demand uncertainty, and the supply uncertainty affect the optimal inventory decision. They reveal that the optimal ordering quantity decreases with the level of loss aversion. They also argue that the supply side uncertainty is more influential than the demand side uncertainty in affecting the supplier's utility.

3. Service Outsourcing

Outsourcing is a very important topic in service supply chain coordination and risk management. In the literature, Benjaafar et al. (2007) examine outsourcing via service competition. The authors explore how supplier competition may act as a way to improve the respective supply service quality. Gopal et al. (2011) explore how coordination within the project team and between the service supplier and client affects software quality. They find that the client side coordination and supplier side coordination can positively influence software quality. Su and Levin (2011) discuss the global multi-sourcing strategy in information technology (IT) service outsourcing. Benaroch et al. (2012)

study how the outsourcing of high-skill and low-skill processes relates to demand uncertainty. Interestingly, the authors show that the chance of outsourcing increases with demand uncertainty for the high-skill process but decreases with demand uncertainty for the low-skill process. Feng (2012) investigates the optimal multiple-sourcing supplier selection problem in service outsourcing. The authors formulate the problem as a bi-objective zero-one linear programming problem and develop a branch-and-bound algorithm to help identify the optimal supplier portfolio.

Outsourcing involves a high degree of risk (Lee et al. 2012; Wang 2013). In the literature, risk management for service outsourcing has been explored in various studies. For example, Liao and Ho (2014) investigate the risk assessment scheme for healthcare units that outsource the biomedical waste disposal tasks to outside service providers. The authors conduct the failure mode and effect analysis and identify the important factors that help healthcare companies to select the waste disposal service providers. Samantra et al. (2014) apply the fuzzy decision-making approach to conduct risk analysis in IT outsourcing. They focus on a case in India and develop a qualitative risk assessment model for IT service outsourcing. Most recently, Cong and Chen (2015) construct a novel dynamic algorithm to assess IT outsourcing risk. The authors derive their algorithm based on the transaction cost theory. They prove by computational studies that their proposed algorithm outperforms various other methods reported in the literature.

This special issue includes many studies related to service outsourcing. In the paper “Entry and Exit of Service Providers under Cost Uncertainty: A Real Options Approach”, Shi studies a service provider’s decisions on “entry and exit” with respect to two types of service outsourcing contracts. One service contract has a flexible duration for the service provider to terminate the contract at any time point whereas the other service contract only provides a fixed duration. The author assumes that there exists a service transaction cost uncertainty, and reveals how this uncertainty affects the service provider’s decisions on entry and exit as well as on the contract type selection. In “Service Quality, Outsourcing and Upward Channel Decentralization”, Wu formulates an analytical model to uncover the benefits of upward channel decentralization for a firm choosing service outsourcing. The author

connects consumer behaviour to service quality and shows that the company's service outsourcing strategy hinges highly on the distribution function of the "consumer's marginal willingness to pay". Li, Guan and Mukhopadhyay discuss upstream outsourcing in their paper entitled "The Impact of Decision Timing on the Suppliers' Interactions: Simultaneous Moves versus Sequential Moves". The authors consider the case in which an assembler delegates production to two random yield suppliers. They generate insights by comparing the scenario when two suppliers move simultaneously with that when they move sequentially in terms of their production quantity decisions. In particular, they show that both suppliers produce more components under the sequential-move scenario than the simultaneous-move counterpart. They also interestingly demonstrate that it is beneficial to the supply chain system if the higher-cost supplier is granted the right to make the production quantity decision first. In "Design Outsourcing in the Fashion Supply Chain: OEM vs. ODM", Shen, Li, Dong and Quan examine how the commonly-seen "design outsourcing" practice affects the performance of fashion supply chains. The authors compare the impacts brought by design outsourcing on the OEM fashion supply chain with that on the ODM fashion supply chain. They also show that a profit sharing contract can help coordinate the fashion supply chain when outsourcing design whereas revenue sharing and buyback contracts cannot.

4. Use of Information

Information sharing is a well-advocated measure to enhance supply chain efficiency. In service supply chain management, Demirkan and Cheng (2008) conduct an interesting analysis on an application service supply chain with information sharing. They explore different channel coordination schemes including both information sharing and risk sharing between the application service provider and the application infrastructure provider. They identify mechanisms to coordinate the service supply chain. In particular, they find that it is more effective to delegate the supply chain coordination task to an agent that is closer to the market. In call centre operations, Hasij et al. (2008)

explore the function of various contracts in service operations, such as the pay-per-call contract and the service-level commitment contract. The authors consider the setting that there exists information asymmetry between the client firms and vendors. They demonstrate how the aforementioned contracts can be combined to facilitate the operations of the call centre supply chain under information asymmetry. In this special issue, Li and Li explore service outsourcing with cost information asymmetry in the paper entitled "Optimal Service Contract under Cost Information Symmetry/Asymmetry". Considering a service seller consigns the service to a reseller (called "service vendor"), they first examine the situation in which the service vendor's service cost is known to the service seller (the information symmetric case) and then the situation in which the vendor's service cost is unknown to the service seller (the information asymmetric case). They derive the optimal contracts under both situations and compare the findings in these two cases to generate insights. Then, in the paper "Signalling Effect of Daily Deal Promotion for a Start-Up Service Provider", Zhao, Wang and Gan investigate whether a temporary daily deal promotion scheme should be provided by a new start-up service provider. They interestingly reveal that the promotion commission related charge by the daily deal site and the discount level offered by the service provider itself are crucial in signalling unobservable quality level of the service provider. The authors show that in the presence of a two-part tariff scheme, a high-quality service provider can signal its quality level by providing daily deals. They also further compare the performance of the revenue sharing scheme and the two-part tariff scheme.

5. Game-Theoretic Analysis

Game theory has been widely applied to examine the strategic interaction between and across different players in service supply chains. In the scope of incentive alignment contracting, Canakoglu and Bilgic (2007) conduct a study on a two-stage telecommunication supply chain system assuming technology dependent demand. They employ game theory to examine both the profit sharing contract

and the quantity discount contract in this service supply chain. Forgionne and Guo (2009) examine via game theory the supply chain coordination challenge in the electricity industry. They derive the market equilibrium with the use of electricity market data. Roels et al. (2010) investigate the contracting game in collaborative services. They focus on contracts such as the fixed-fee contract and the performance-based contract. They reveal the analytical considerations that one should have in the selection of the right service contract. Oliveira et al. (2013) investigate the optimal contract design in the electricity industry so as to achieve supply chain coordination. The authors show that there exist multiple equilibria in this supply contracting game and a two-part tariff contract is the best contract choice. Recently, Zha et al. (2015) study service supply chain coordination with the consideration of an effort-induced demand function. The authors formulate the problem as a Stackelberg game and show that the use of a cost sharing contract can help to coordinate the service supply chain.

Game theory has also been applied to explore competition issues in service supply chains (Bashyam 2000; Bernstein and Federgruen 2004; Allon and Federgruen 2007; Chiu et al. 2014; Ma and Kauffman 2014). For instance, Bernstein and Federgruen (2007) discuss the supply chain coordination mechanism in the presence of service and price competition. Zhang et al. (2009) examine the price competition with service level commitment in web services. They study the competition between two web service providers and identify the equilibrium prices and service levels. DiPalantino et al. (2011) study the competition and contracting structures in the service industry. They show that competition will be intensified if the service providers offer service level guarantees. In the healthcare service industry, Andritsos and Tang (2014) study via game theory how introducing competition via private hospitals affects healthcare services. They counter-intuitively show that the public hospital can be benefited by the introduction of a private hospital.

In this special issue, many papers have applied game theory in their analysis. For example, in “The Impact of Power Structure on the Retail Service Supply Chain with an O2O Mixed Channel”, Chen, Wang and Jiang study the optimal pricing decision and power structure issues in O2O retail

supply chain systems. They model the supply chain under three settings: the supplier-led, retailer-led and Nash-game ones. The authors identify the optimal pricing decision for each setting and generate valuable insights by systematically comparing among the three scenarios. In "Offering a Downgraded Service to Enhance Profit", Li, Chen and Chen develop a novel model to answer whether a service provider should offer a downgraded service, in addition to its regular good service. The authors show that providing the downgraded service is a wise strategy only when it is competitively efficient. They also identify the equilibrium in which both the good service and the downgraded service co-exist. In "Dominance, Bargaining Power and Service Platform Performance", Zhang, Zha, Yue and Hua explore the situation in which a hotel faces two kinds of customers. The first kind of customers will book directly via the hotel front desk whereas the second kind of customers will book via a service platform. They demonstrate how the wholesale pricing contract can lead to Pareto optimality.

6. Risk Analysis

Service supply chain systems face all sources of uncertainty and disruptions. For example, demand disturbance brings challenges to the electricity utility service industry as well as workforce management in service supply chains (Lee at al. 2009). Undoubtedly, risk analysis is an important part of proper service supply chain management. In the literature, Choi (2013) investigates the service charging issue for consumer returns under the mass customization program. He specifically highlights how the risk aversion level of the service provider affects the optimal service charging policy. Sen and Raghu (2013) explore the optimal incentive design for IT services. They show that risk is a critical factor and the traditional mechanism that treats IT services as independent is optimal only when the customer and the service provider are both risk-neutral. Notice that Wang and Banks (2011) suggest combining game theory and risk analysis together to explore operations management problem. For instance, Xiao et al. (2012) study a service supply chain with risk averse agents. They

consider the adoption of the service commitment strategy and explore the corresponding service-price equilibrium. Selviaridis and Norrman (2014) examine the performance-based contract in service supply chains with the focal point on financial risk. They believe that the performance-based contract can help allocate risk among the service supply chain parties. They also suggest methods for service providers to manage financial risk associated with the performance-based contract.

This special issue also features a few risk analysis related studies. In "Sell through a Local Retailer or Operate Your Own Store? Channel Structure and Risk Analysis", Niu, Liu and Wang study an interesting situation in which sellers can sell the product by themselves or via other resellers (e.g., retailers). They consider a supply chain system with two manufacturers and two retailers facing the chain-to-chain competition. They identify a threshold policy for the manufacturers to choose the optimal channel structure. They also study the impacts brought by the contract termination risk on the supply chain. Govindan and Jepsen investigate the risk assessment scheme for the service supplier in the paper entitled "Supplier Risk Assessment Based on Trapezoidal Intuitionistic Fuzzy Numbers and ELECTRE TRI-C: A Case Illustration Involving Service Suppliers". They demonstrate through a case study how a practical service supplier risk assessment scheme can be established. In their proposed framework, methods like ELECTRE (ELimination Et Choix Traduisant la REalité) and MCDA (multiple-criteria decision analysis) are employed.

7. Concluding Remarks

In the above sections, we have reviewed areas related to service supply chain coordination and risk management. We have also concisely described each paper featured in this special issue. Table 1 summarizes the scope, the critical issue, and the important tools/models/concepts associated with each paper. From Table 1, we can see that service supply chain management is very broad and covers many important issues. It also relates to different kinds of problems and analytical models.

To conclude, we believe that this special issue has highlighted several crucial and pertinent areas on coordination and risk management in service supply chains. We believe these featured papers will lay the foundation for future studies on service supply chain management.

Table 1. Features of the Papers in this Special Issue

(Risk management: R; coordination: C; logistics: L; outsourcing: O; information: I)

Paper	Scope	Service Issues Addressed	Important Models/Tools/Concepts Employed
Mirzahosseinian, Piplani, Jin	C, L	Fleet size and performance-based incentives	Base stock policy, reliability
Liu, Wang, Yao, Yue	R, L	Transaction cost analysis of logistics services with applications to port governance	Transaction cost, frontier optimization
Liu, Gou, Alwan, Liang	C, L	Delivery service supply chains with online retailers	Supply contracts, newsvendor model
Liu	R, L	Proactive and passive self-consumption in retailing	Newsvendor model, additive and multiplicative demands
Ma, Xue, Zhao, Zeng	R, L	Loss-averse seller in the presence of demand and supply uncertainties	Newsvendor model, loss aversion, supply uncertainty, demand uncertainty
Shi	C, O	Service outsourcing contract selection	Real options, cost uncertainty, Brownian motion, supply contracts
Wu	C, O	Service outsourcing and upward channel decentralization	Game theory, consumer behaviors
Li, Guan, Mukhopadhyay	C, O	Decision sequence in upstream outsourcing problems	Game theory, decision sequence
Shen, Li, Dong, Quan	C, O	Design outsourcing in fashion supply chains	Game theory, supply contracts, OEM, ODM
Li & Li	C, I, O	Optimal outsourcing service contracts	Optimal menu of contracts, information asymmetry
Zhao, Wang, Gan	C, I	Signalling effect of daily deal promotion for start-up service providers	Game theory, supply contracts,
Chen, Wang, Jiang	C	Optimal pricing and power structure influence in O2O retail service supply chains	Game theory, supply contracts, channel leadership
Li, Chen, Chen	C	When to offer downgraded services	Game theory, supply contracts
Zhang, Zha, Yue, Hua	C	Hotel reservation service management with a third party service platform	Game theory, newsvendor model, bargaining power
Niu, Liu, Wang	R, C	Channel structures and risk analysis in two manufacturers two retailer network	Game theory, channel structures, termination risk
Govindan, Jepsen	R	Service supplier risk assessment	MCDA, ELECTRE, fuzzy number

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