Service-Dominant Logic for Managing the Logistics-Manufacturing Interface: A Case Study

Abstract

Purpose - The purpose of this paper is to investigate the management of the logistics-manufacturing interface between the manufacturer and its logistics service provider from the perspective of the service-dominant (S-D) logic.

Design/methodology - The approach adopted is that of abductive reasoning through case study: data is primarily gleaned from semi-structured in-depth interviews. Field visits and secondary documentation are used to ensure data validity.

Findings - The results show that the interface can be categorized into three levels: *design interface* between products and logistic services, *process interface* between manufacturing processes and service-offering processes, and *information interface* between manufacturing information systems and logistics information systems. The results also indicate that ten foundational premises of S-D logic, especially service-focused, customer-oriented, and rational views can be applied in defining and managing these interfaces.

Research limitations/implications - This research contributes not only to the theory of S-D logic and managing interface, but also provides managers with guidelines of applying S-D logic to build a service-focused, customer-oriented and relational logic to effectively manage the logistics-manufacturing interface. However, the research is limited to the context of automotive and logistics industries.

Originality/value - Three levels of logistics-manufacturing interface, including design, process and information are identified, and S-D logic is applied to identify and manage the interface.

Keywords - Interface; service-dominant logic; logistics services; automotive industry; China

Paper type - Research paper

Introduction

In order to improve operational performance and focus on core competency, there are many manufacturers (such as General Motors (Howard *et al*., 2006), Nissan (Ogle, 2008), Saab (Larsson, 2002)) in the automotive industry are outsourcing their logistics activities to third-party logistics (3PL) service providers (Holweg and Miemczyk, 2003; Göl and Çatay, 2007; Klingenberg and Boksma, 2010; Reeves et al., 2010; Rahman *et al*., 2013). However, it is always a challenging and complex task for both companies to efficiently and effectively manage the interfaces, a common ground by which to connect the processes of both 3PL provider and the manufacturer, to increase the success of logistics outsourcing (Hartmann and de Grahl, 2012; Tronvoll, 2012). In fact, if badly managed, it could create a bottleneck of information and assets between the manufacturer and the 3PL provider (Stefansson and Russell, 2008). Close collaboration to co-create value has thus become a key success factor in the logistics service provision (Juga *et al*., 2010; Lusch *et al*., 2010; Yazdanparast *et al*., 2010).

The concept of value co-creation is one of the foundational premises (FPs) of service-dominant (S-D) logic proposed by Vargo and Lusch (2004). The development of the S-D logic is based on the understandings of the changing focus of marketing theory, from tangibles to intangibles, from producers of physical goods to consumers as co-producer (Vargo and Lusch, 2004). The S-D logic has been regarded as a new lens or perspective for seeing the economic and social world (Vargo, 2011) with focus on value propositions (Kowalkowski, 2011; Ng *et al*., 2012), which is different from the traditional microeconomics view of the so-called goods-dominant logic (G-D logic, Vargo and Lusch, 2008a, 2008b) with more focus on goods manufacturing. Another essential difference between S-D logic and G-D logic is that, service is regarded as the fundamental basis of exchange not goods, and goods act as distribution mechanism for service provision rather than ends in themselves (Vargo and Lusch, 2004).

The S-D logic is initiated and now widely applied in marketing area (Ingenbleek, P.T.M., 2014), and also has been extended to other fields, including public transport (Gebauer *et al*., 2010), retailing (Beitelspacher *et al*., 2012), procurement (Dobrzykowski *et al*., 2012), service innovation (Edvardsson and Tronvoll, 2013), self-service (Hilton and Hughes, 2013), tourism management (FitzPatrick *et al*., 2013), operations management (Smith *et al*., 2013); However, its application in logistics/supply chain is still at early stage (Lusch *et al*., 2010; Yazdanparast *et al*., 2010; Tokman and Beitelspacher, 2011). Particularly in managing the logistics-manufacturing interfaces, the S-D logic can serve to facilitate the value co-creation during service provision, but its implementation in this field is still scarce in current literature. This raises a research question in this paper:

RQ1: *How to manage logistics-manufacturing interface between the manufacturer and 3PL provider from the perspective of the S-D logic*?

The main purpose of this paper is to investigate the management of the logistics-manufacturing interface between the manufacturer and its 3PL provider from the perspective of the S-D logic. To achieve that, a review of current research on the *inter-functional interface* between logistics and marketing, and manufacturing and purchasing, and the *inter-organizational interface* in the context of supply chain management (SCM) is undertaken. The inter-organizational relationship between the 3PL provider and manufacturer is presented as a co-creation of services and the supply chain as a value co-creation network, which are discussed from the S-D logic perspective. An overview of the research methodology precedes the findings, which include supply chain mapping of the logistics-manufacturing interface at the levels of design, process, and information. After the results summary, the discussion will combine the defined and empirically elaborated framework of managing interface with the S-D logic. Finally, theoretical and managerial implications with future research issues are presented.

Literature review

This research is mainly grounded on the theories of *interface* in the fields of logistics, manufacturing and supply chain, and the *S-D logic* in marketing. The conceptual research framework is based on these two bodies of knowledge.

(1) Interface

The concept of interface has been widely applied in the fields of computer science, product design, chemistry, and sociology, etc. In product design, interface is used to decouple the development and the inner working principles of a product's components (Baldwin and Clark, 2000; Sosa *et al*., 2004; Cabigiosu *et al*., 2013). Whilst in supply chain management, the interface is defined as "area where information or physical goods are exchanged between one trading partner and another – where trading partners "interface" with one another to achieve the successful transfer of goods or information" (Stefansson and Russell, 2008, p. 347). With regard to its application in logistics management, incorporates the interfaces with other internal functions, and the interfaces with different external organizations. Hence, for the purposes of this paper, the current literature on the subject is encapsulated and divided into two types of interface, inter-functional and inter-organizational.

a) Inter-functional interface

Inter-functional interface refers the common boundary between logistics and other functions such as marketing, manufacturing, and purchasing within the company. Early studies and commentaries of one research branch are focused on this aspect of logistics interface in particular.

Interface between logistics and marketing. A coordinated logistics-marketing interface is emphasized as a key contributing factor to differentiate product and/or service offerings that fulfill unique customer requirements (Mentzer *et al.*, 2001), and could lead to cross-functional excellence (Lynch and Whicker, 2008). But not all situations require intensive logistics interaction and collaboration, and high-level, frequent interaction between marketing and logistics personnel does not always lead to positive results, and may in fact lead to higher internal uncertainty (Nilsson, 2006). Moreover, Gimenez and Ventura (2005) found that a high level of internal integration via a logistics-marketing interface does not result in reductions in cost, stock-out and lead time if there is no external integration within the supply chain.

Interface between logistics and manufacturing. Logistics should not be merely be a support for the manufacturing process, it should be coordinated with manufacturing to enhance competitive performance, in particular by offering cost and investment reduction while maintaining service levels (Mentzer *et al.*, 2004). Global manufacturing could increase operational complexity and logistics costs that will in turn weaken the advantages found from lower labor costs; but if the interface of logistics and manufacturing activities are well coordinated, the long-term advantages of global manufacturing are achievable (Scully and Fawcett, 1993).

Interface between logistics and purchasing. The integration of logistics and purchasing is a complex phenomenon driven by organization structure and culture, a reward system, and communication between the functions (Pagell, 2004). Global manufacturing strategies supported by integrated logistics and purchasing activities could bring about higher performance levels for the manufacturer. Thus, global SCM calls for a well-integrated interface between purchasing and logistics functions for performance improvements (Ashenbaum and Terpend, 2010).

b) Inter-organizational interface

As logistics gradually extend beyond the company boundaries to include external organizations, inter-organizational integration is proposed to share resources between the companies in order to deliver greater value to the supply chain (Fawcett and Magnan, 2002), for example by achieving reductions in cost, stock-out and lead time (Gimenez and Ventura, 2005), and also creating opportunities for the use of the 3PL. However, outsourcing internal activities has a significant impact on inbound logistics flow, with the 3PL provider causing disruptions to the manufacturer (Svensson, 2001). Hence, a strategic inter-organization interface between manufacturer and 3PL provider is needed, producing mutual benefits and enhancing their competitive positioning.

Stefansson and Russell (2008) summarized two types of supply chain interface: *physical interface* describing the integration of goods and resource flow with process and activity, and *information interface* presenting the integration of information flow, and data and information content together with information technology. These two interfaces exist among shipper, receiver, transportation carriers, logistics service providers and logistics service intermediaries. Distinct from their research, this paper will only focus on the inter-organizational logistics-manufacturing interfaces between the 3PL provider and the manufacturer.

The physical interface defined in Stefansson and Russell (2008) is focused on the process and activity of logistics service. When logistics is outsourced to 3PL providers, its processes become part of the supply chain processes of the manufacturer. Inter-organizational cooperation is found primarily in the processes of order fulfillment, service management and returns management. In order to efficiently manage the movement of goods from 3PL providers to the manufacturers, they need to integrate their processes and activities to ensure on-time shipment and synchronized documentation exchange (Mortensen and Lemoine, 2008).

Sharing information (especially operational and planning information (Hartmann and de Grahl, 2012)) always plays an essential role in the quality of logistics outsourcing performance. Generally, advances in information systems and technology could enable better interface between customers and service providers, and enhance its service delivery (Ojiako, 2012). For the 3PL providers, the adoption of logistics information systems is regarded as a way to achieve excellence in their field (Barbosa and Musetti, 2010). And for the manufacturer, manufacturing information systems like ERP are widely implemented to manage internal processes and facilitate the data exchange among divisions (Hasan *et al.*, 2011). Because the information systems adopted by them may differ, there is always a need to design an interface that will manage the information sharing between these two parties.

Regarding the logistics service design, empirical evidence has shown that there is a mismatch between the supply and demand of logistics service offerings (Selviaridis and Spring, 2007). Many service offerings are above the expectations of customers. For example, some value-added logistics services have been designed, but the manufacturers may only require basic services like transportation and warehousing. To bridge the gap between supply and demand, close partnership and joint learning between them are invaluable. This engenders better understanding of service requirements and builds competitive competency for both companies (Halldórsson and Skjøtt-Larsen, 2004). Moreover, sharing customer knowledge about product/service, technology, and problems are positively related to the customer's satisfaction with the 3PL provider. It could also facilitate the development of innovative logistics services (Rollins *et al*., 2011).

(2) The S-D logic

a) The overview of the S-D logic

Since many changes developed in the understandings on economics and marketing in the past several decades, the S-D logic is proposed as a new dominant logic for marketing (Vargo and Lusch, 2004). And the S-D logic is a service-centered marketing model, as an alternative to the traditional, foundational product-centered G-D logic (Vargo, 2011), for understanding economic exchange and value creation. The S-D logic highlights the interaction of the producer and customer, and other partners who co-create value through collaborative process. This is different from the conventional G-D logic focusing on production control, efficiency and profit maximization, which means it actually separates customers from the producer (Lusch and Vargo, 2008).

Comparing with the G-D logic, the S-D logic represents eight main shifts in mindset (see Table 1): from focusing on goods creation to the process of serving; from the primacy of tangibles to intangibles; from static operand resources to dynamic operant resources; from highlighting the strategic advantages of asymmetric information to the advantages of symmetric information; from propaganda to conversation and dialog which encourages communications among customers, employees, and other relevant stakeholders; from value adding and creating to making value proposition in terms of firm's role; from transactional exchange to relational exchange; from the goal of profit maximization to emphasizing financial performance.

Table 1. Contrasting the G-D logic and S-D logic

	G-D logic	S-D logic
1	Goods	Service(s)
2	Tangible	Intangible
3	Operand Resources	Operant Resources
4	Asymmetric Information	Symmetric Information
5	Propaganda	Conversation
6	Value Added	Value Proposition
7	Transactional	Relational
8	Profit Maximization	Financial Feedback

(Source: Lusch and Vargo (2008), p. 90)

b) The key foundational premises of the S-D logic

The S-D logic is rooted on ten FPs (see Table 2). Eight FPs were originally introduced in Vargo and Lusch (2004), followed by various modifications and additions. For example, FP_6 was modified in Vargo and Lusch (2006) in order to reflect the interactive and networked nature of value creation and highlight its collaborative nature; FP_9 was added in Vargo and Lusch (2006) as a new FP to emphasize the important role of firm in resource integration, and it was further revised in Vargo and Lusch (2008b) to include individuals as integrator of resources; then FP_{10} was added in Vargo and Lusch (2008b) to explicit the experiential nature of value.

Table 2. FPs of the S-D logic

	Original FPs (Vargo and Lusch, 2004)	Modified/new FPs (Vargo and Lusch, 2006)	Modified/new FPs (Vargo and Lusch, 2008b)
FP_1	The application of specialized skills and knowledge is the fundamental unit of exchange	The application of specialized skills and knowledge is the fundamental unit of exchange	**Service** is the fundamental **basis** of exchange
FP_2	Indirect exchange masks the fundamental unit of exchange	Indirect exchange masks the fundamental unit of exchange	Indirect exchange masks the fundamental **basis** of exchange
FP_3	Goods are distribution mechanisms for service provision	Goods are distribution mechanisms for service provision	Goods are distribution mechanisms for service provision
FP_4	Knowledge is the fundamental source of competitive advantage	Knowledge is the fundamental source of competitive advantage	**Operant resources are** the fundamental source of competitive advantage
FP_5	All economies are service economies	All economies are service economies	All economies are **service** economies
FP_6	The customer is always a co-producer	The customer is always a **co-creator of value**	The customer is always a **co-creator of value**
FP_7	The enterprise can only make value propositions	The enterprise can only make value propositions	The enterprise **cannot deliver value, but** only make value propositions
FP_8	A service-centred view is customer oriented and relational	A service-centred view is customer oriented and relational	A service-centred view is **inherently** customer oriented and relational
FP_9		**Organizations exist to integrate and transfer micro-specialized competences into complex services that are demanded in the marketplace**	**All social and economic actors are resource integrators**
FP_{10}			**Value is always uniquely and phenomenological determined by the beneficiary**

According to the S-D logic, service is regarded as the fundamental basis of exchange (FP_1), while goods are defined as a distribution mechanism for service provision (FP3), not the basic unit and focus of exchange as found in the G-D logic. However, the service-exchange-service is not always apparent due to the service is always provided through complex combinations of money, goods, organizations, and vertical marketing systems (Vargo and Lusch, 2004), such complex indirect exchange actually will mask the fundamental basis of the economic exchange (FP2)

This emergent logic reflects the shift from tangible operand resources in exchange to intangible and dynamic operant resources for competitive advantage (FP4) (Purvis and Purvis, 2012). Operand resources are those that need to be acted upon (e.g. natural resources), and operant resources are those that are able to act (e.g. knowledge and skills) (Vargo and Lusch, 2011). Moreover, S-D logic emphasizes the value co-creation process (Gummesson and Grönroos, 2012) and highlights the customer as the co-creator of value (FP_6). S-D logic also argues that enterprise can only propose value, but not create and deliver it (FP_7).

c) The applications of S-D logic in logistics/manufacturing

Not just a paradigm shift of marketing (Grönroos, 2006; Lusch and Vargo, 2011), S-D logic is increasingly applied in manufacturing and logistics management. With the same evolving focus on partnership, value networks, service provision, and value creation, S-D logic could be used as a means to reframe SCM (Lusch, 2011). However, this philosophical shift has not yet been fully embraced by practitioners and academia, and the research on S-D logic in the context of logistics management is still a work in progress (Keating and Coltman, 2007), just like the development of the S-D logic itself.

Regarding the application of S-D logic in the field of supply chain/logistics and manufacturing, Tokman and Beitelspacher (2011) identified three research gaps, mainly concerning operant resources utilization among supply chain partners. Beitelspacher *et al.* (2012) further verified that operant resources are key enablers in a supply chains to shape competitive advantage and improve performance outcomes. Moreover, several researches have examined how knowledge and skills could provide supply chain based value propositions (Vargo and Lusch 2004; Lambert and García-Dastugue 2006; Randall et al., 2011).

Furthermore, the supply chain involving the manufacturer and 3PL provider could be regarded as a value co-creation network (Lusch *et al.*, 2010; Yazdanparast *et al.*, 2010), which is consistent with the key FPs of S-D logic. Lusch (2011) also highlights that value co-creation should be one of the five major research areas for SCM when adopting S-D logic. In particular within the inter-organization relationship, one essential issue is how to co-create services and values to customers (Daugherty, 2011). Therefore, this research aims to explore how S-D logic could be applied to manage the logistics-manufacturing interface to co-create service and value between the manufacturer and 3PL provider.

(3) Conceptual research framework

As reviewed above, how to define and manage the logistics-manufacturing interface and co-create value becomes a critical issue to the success of both the manufacturer and the 3PL provider. The S-D logic with the key FPs of service and value co-creation appears to benefit this inter-organizational relationship. Therefore, this paper aims to apply S-D logic to identify and define the interface between the manufacturers and 3PL provider, and to identify the enablers to coordinate and manage the interface. As discussed above, most of the current literature on interfaces is focused primarily on process, information and design; hence this paper will concentrate on the same three levels. The conceptual framework of this research is outlined in Figure 1.

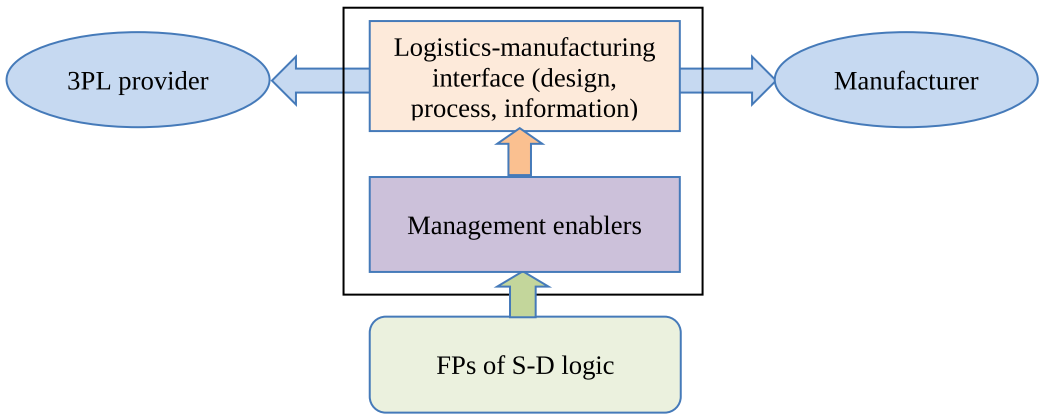

Figure 1. Conceptual research framework

Methodology

Applying S-D logic in manufacturing/logistics management is an emerging issue in both research fields that calls for an abductive approach in theory building. The abductive research process bases its premises and results on combined theoretical knowledge, matching that knowledge with real-life observation that in turn lead to suggestions of a theory with applied final conclusions (Kovács and Spens, 2005). The case research is recommended when "[t]he phenomenon can be studied in its natural setting and meaningful, relevant theory generated from the understanding gained through observing actual practice; the case method allows the questions why, what, and how, to be answered with a relatively full understanding of the nature and complexity of the complete phenomenon" (Voss *et al*., 2002, p. 197). Hence, abductive reasoning with case study method is used to address the defined research question (Yin, 2009).

Due to the increasing product variety in the automotive industry, the operational activities between the manufacturer and 3PL have become more complex. This research is therefore focused on the car manufacturer and its 3PL provider. The *case in this research* is defined as a *supply chain* consisting of a 3PL provider (A) and its customer, a truck manufacturer (B). Both A and B are leading companies in their own industries in East China. Company B is acquired by a top 3 car group company (C) in China. The case choice satisfies the significance requirements of case selection.

Data is collected through semi-structured, in-depth and focused interviews from June 2011 to August 2012, aiming to extract personal insights from top and middle managers. The interviews are conducted with a pre-designed guideline (see Appendix 1) to ensure the data reliability and construct validity (Voss *et al*., 2002; Yin, 2009). The interview details are listed in Table 3. All data is coded and cross-verified with other sources (secondary documentation, archival records, and field visits) to ensure its validity. Data is then analysed through pattern matching (Yin, 2009) that compares the empirical results with the proposed theoretical results, the resulted correlation will enhance the internal validity of the case study.

Table 3. Interview list

Company	Interview type	Role of interviewee	Number of interviewees	Average time (hrs/person)	Total (hrs)
3PL provider (Company A)	*Focused interview*	*CEO*	1	3	3
		CFO	1	3	3
	In-depth interview	*Transportation manager*	3	7	21
		Warehouse manager	4	6	24
		IT manager	3	6	18
Manufacturer (Company B)	*Focused interview*	CFO responsible for supply and logistics management	1	4	4
	In-depth interview	Manufacturing manager	1	6	6
		Logistics manager who responsible for inbound logistics	2	7	14
		Planning manager who responsible for information management	2	7	14
Total			18		107 hrs

Findings

The research results identified three levels of interface: design interface between products and logistic services, process interface between manufacturing processes and service offering processes, and information interface between manufacturing information system and logistics information system. These are mapped in Figure 2.

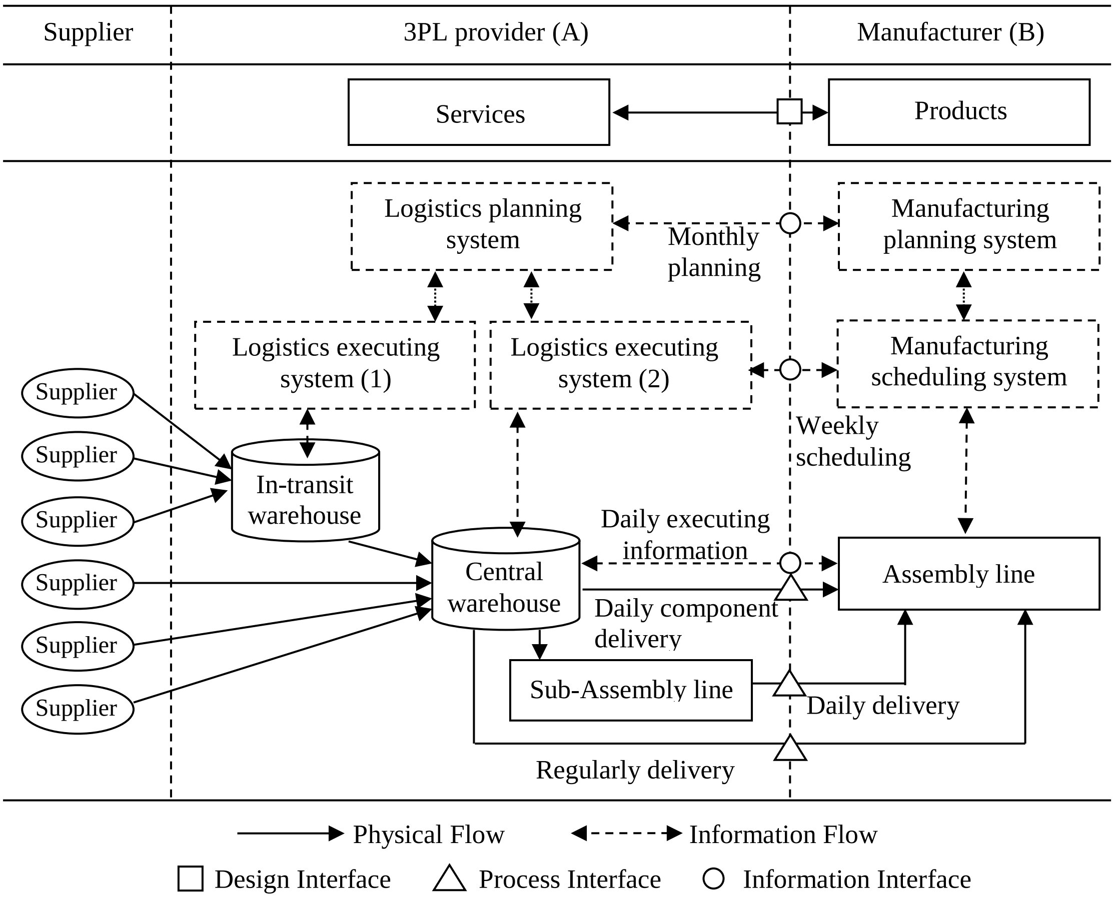

Figure 2. Supply chain mapping of the logistics-manufacturing interfaces

(1) Design interface

First of all, the interface between companies A and B is the design interface between products and services, which implies that the logistics services supplied by the 3PL provider should match with the product characteristics of the manufacturer. For example, company A found that some components needed in company B are customized by the end-customer to a special size, and the van usually used to transport that component was thus rendered unsuitable. Based on its 30-year experience of serving customers in the automotive industry, company A quickly switched to using a flat truck to deliver that particular, special sized component. Company A involved the manufacturer's product design team in the flat truck procurement process and by sharing their knowledge and experience, B helped A choose a suitable flat truck that will help ensure the safe and efficient carriage of most of the special sized components the manufacturer may produce in the future.

In order to better fit the logistics services with the product characteristics, companies A and B signed a long-term agreement to facilitate close collaboration on product/service design. Based on this agreement, the services engineering team in the 3PL provider can better understand the characteristics of both products and production processes in company B, which in turn helps A design customized services to satisfy B. Meanwhile, the product design team in company B can keep updated with service capability information from A, which helps B better adapt with the logistics service at the early stage of product design.

As a result, most service and product designs are conceived as a result of the combined efforts of these two teams. In particular, the manufacturer involves the 3PL provider early on in new product development process, which helps the 3PL provider design logistics services that better serve the new products, and problems are solved or bypassed at an early stage. It is important for the design interface to be managed in a positive atmosphere of close collaboration in order to encourage the sharing of knowledge, experience and skills at every level.

(2) Process interface

Due to their differing operational natures, the process interface between the services offering from 3PL providers and product manufacturing from the manufacturer should be well managed for higher operational performance. As described in Figure 2, there are three key process interfaces, including daily component delivery, daily sub-assemblies delivery, and regular (weekly) delivery.

The process interface should ensure that the paces of the different processes are synchronized. Taking daily component delivery as an example, seat modules are required to be delivered to the assembly line in company B every 15 minutes. However, company A's previous customer's manufacturing pace required a seat module every 25 minutes. This required the redesign of the process to match the faster pace in company B. Company A re-engineered several processes to quicken its pace, including cutting approval processes like quantity audit and check, and authorizing line managers to respond to any urgent situations. The process of re-engineering is also a joint activity between the 3PL provider and the manufacturer. After being re-engineered, company A's logistics processes linked seamlessly with the manufacturing processes in company B.

One special requirement from company B to the 3PL provider is to build a small sub-assembly line to complete some processes that were previously performed in the manufacturer's plant, and then deliver the completed modules daily to the final assembly line in company B. The manufacturer is also involved in building this sub-assembly line as it helps to bring company A not only resources like equipment and tools, but also technical supports. All the efforts contribute to the achievement of a seamless process interaction.

(3) Information interface

Another challenge to both companies is the information interface, involving interfaces between different information systems and management rules.

The first information interface is the link between two different information systems. The 3PL provider has a logistics planning system and a logistics executive system, and the manufacturer has an ERP system (see Figure 2). These two systems were provided by two different software suppliers using different programming languages and database systems, which makes it difficult to directly exchange and share information between the two companies. Fortunately, both companies are extremely willing to work together to solve this problem. They collaborate with the original software providers to develop several functional packages to act as interfaces linking two information systems to achieve seamless information exchange at three levels, including monthly planning, weekly scheduling, and daily executing.

The second information interface is related to the different rules of information management in different companies. For example, company A only checks the inventory level on a weekly basis, but real-time inventory information should be provided as required by the manufacturer. With help from the manufacturer and a third-party software company, the 3PL provider redefines the rules of its inventory information management and upgrades their warehouse management system with new functions to achieve real-time inventory information updating.

(4) Results summary

The findings from empirical research show three separate interfaces: design, process and information interfaces between the 3PL provider (A) and the manufacturer (B). These are summarized in Figure 3.

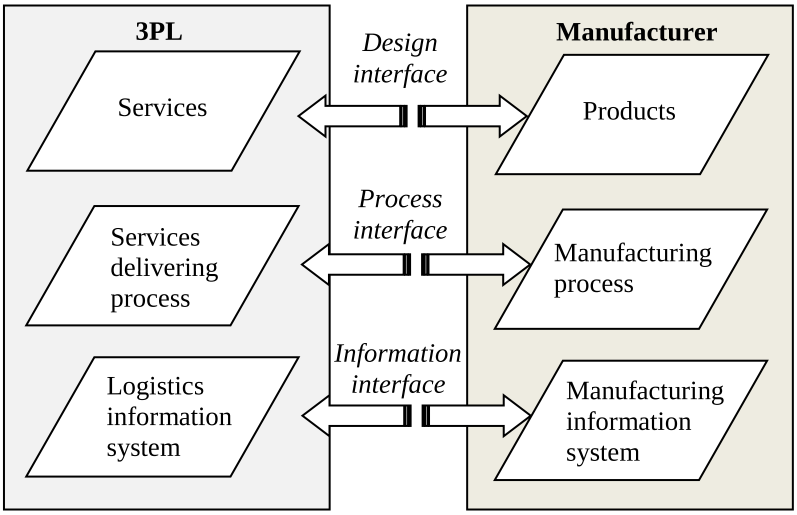

Figure 3: Framework of the logistics-manufacturing interfaces

Due to the fact that operations within the manufacturing and logistics industries differ greatly and product variety in the automotive industry has increased, the interface between product and services design, and its corresponding manufacturing and service offering processes, have become increasingly complex and vague over time. Moreover, the interface between different information systems and rules of information management cause higher complexities in exchanging and sharing real-time information.

Discussion: The framework of managing interface with the S-D logic

Enablers to coordinate and manage the three-level logistics-manufacturing interfaces in the supply chain are summarized in Table 4. In the right-hand column, the implications have been analysed based on the ten FPs of S-D logic in order to understand how (if) S-D logic can help and support the management of these interfaces.

The results show that defining and managing the logistics-manufacturing interface is substantially reliant on the skills, knowledge and experience of the 3PL provider and manufacturer, which reflects the nature of S-D logic that these operant resources are the primary sources of value and drivers of value creation (**FP$_4$**). For the 3PL provider in the case study, the experiences and skills accumulated through serving the automotive industry are the key to its competitive advantage. With the operant resources from both companies, it ensures the logistics-manufacturing interface can be efficiently managed to create value to the beneficiaries.

Table 4. Managing logistics-manufacturing interface with S-D logic

FPs of S-D logic	Logistics-manufacturing Interface														**Implication of applying S-D logic to manage logistics-manufacturing interface** (based on Vargo and Lusch, 2008b) *(Empirical findings for FPs given in parentheses)*
	Design interface					**Process interface**				**Information interface**					
	Years of experiences	Long-term relationship (Agreement)	Customer involvement	Understanding and learning from each other	Using flat truck	Process re-engineering	Collaboration	Customer involvement	Cross-functional integration	High willingness	Collaboration	Customer involvement	Third-party software company	Developing functional package for information exchange	
FP$_1$															Service is defined as the application of operant resources like skills, knowledge, *and experience*, i.e. service is the fundamental basis of exchange.
FP$_2$															Indirect (*goods, equipment, third-party software company*) exchange masks the fundamental basis of exchange.
FP$_3$															Goods and other physical resources are distribution mechanisms for service provision.
FP$_4$															Operant resources (skills, knowledge, *experience*) are the fundamental source of competitive advantage.
FP$_5$															All economies are service economies.
FP$_6$															The customer is always a co-creator of value. *Get customer involved always helps in better understanding manufacturer/customer's product design, manufacturing process, and information system and management rules, and then helps in better designing services to manufacturer and co-creating value to end-consumer.*
FP$_7$															The enterprise cannot deliver value, but only make value propositions. *The value is only realized at the final assembly line when just-in-time delivery services are accomplished. The 3PL proposes the value with designed logistics services*
FP$_8$															A service-centered view is inherently customer oriented and relational. *Customer involvement, collaboration among all the resource integrators.*
FP$_9$															All social and economic actors are resource integrators. *3PL provider, manufacturer, and third-party software company are all involved in the value creation process.*
FP$_{10}$															*Value is realized at the service beneficiary side, and it is perceived and measured by the beneficiary, the customer.*

Furthermore, the results also reflect the fact that the focus of economic exchange is shifting from goods to services. During defining and managing stages of the logistics-manufacturing interface between 3PL provider and the manufacturer, a service is exchanged as a result of understanding and sharing each other's skills, knowledge and experience in their respective fields. This reflects the most basic premise (**FP_1**) of the S-D logic that service is the fundamental basis of exchange, and also follows the premise (**FP_5**) that all economies are service economies.

The results show that goods only act as intermediates necessary for delivering service between the 3PL provider and manufacturer, and do not form the basis of the exchange. For example, the flat truck is used to deliver special sized components and improve the service performance, but it is not the focus of the exchange. This is in accordance with the premise of defining goods as a distribution mechanism for service provision (**FP_3**). Traditionally, goods and other operand resources are regarded as the focus in order to ensure the continuity of production and the supply chain, which obviously masks the service-for-service nature of exchange (**FP_2**). It is essential to the managers, in particular the top managers, to understand and build a service-focused logic to manage the logistics-manufacturing interface.

Another key point highlighted in the results is that the customer plays a critical role as value co-creator (**FP_6**) in defining and managing the logistics-manufacturing interface. The customer (the manufacturer here) is getting involved in many processes, for example, designing a service to match product characteristics, collaborating in the re-engineering process in the 3PL provider's assembly line, and developing a functional package for information sharing and exchanging. Obviously, the customer is collaborating with the 3PL provider to co-create value. Furthermore, not only are the 3PL provider and the customer involved in this process, but also third-party software companies. The value is actually co-created through collaboration between these companies, they use the resources integrator (**FP_9**) to integrate both operant and operand resources to create value in coordinating and managing the interface.

Following the conception of value-in-use, the 3PL provider did not create and deliver value to the manufacturer; they only proposed value to the manufacturer with the designed logistics services (**FP_7**). The value is realized at the final assembly line when the logistics services are accomplished, which means the value is perceived and measured by the customer (the service beneficiary, $\mathbf{FP_{10}}$). Consequently, defining and managing the logistics-manufacturing process with S-D logic should be customer oriented and relational ($\mathbf{FP_8}$).

Conclusions

1) Theoretic and managerial implications

The case study conducted for the purposes of this research set out to explore how to apply S-D logic in identifying and managing the logistics-manufacturing interface between the 3PL provider and the manufacturer. The research findings contribute not only to theories of SCM/logistics management and S-D logic but also to the practices.

This research will contribute to the theory of inter-firm relationships by establishing a framework of logistics-manufacturing interface with three levels (design, process and information). The process and information interfaces are matched with the physical and information interfaces identified by Stefansson and Russell (2008). While the design interface is a coincidence to the findings of Lin and Pekkarinen (2011) that the interface between 3PL provider and its customer is essential to the quality of service design.

Moreover, this research applies S-D logic into the context of logistics-manufacturing interface, and the result analysis is consistent with the ten FPs proposed by Vargo and Lusch (2008b). This expands its application in marketing to the field of SCM/logistics management and will contribute to the development of the S-D logic theory. Moreover, the results indicate that adopting S-D logic in defining and understanding the process interfaces could support in effectively and efficiently managing the interfaces, which agrees with the results that S-D logic could reframe SCM into a unified process and system to enhance performance, customer value and social well-being (Lusch *et al.*, 2010; Lusch, 2011).

To the practitioners, the research results provide them with guidelines of applying S-D logic and a framework of mapped enablers to show directions to coordinate and manage the logistics-manufacturing interface. For both 3PL providers and manufacturers, they could focus on managing those three major interfaces to improve logistics outsourcing performance and enhance competitive advantages, which is complied with the results of Lambert and García-Dastugue (2006) that S-D logic is essential to the successful implementation of cross-function, cross-firm business process in SCM.

In particular for 3PL providers, they should focus on co-creating services and value with their customers (the manufacturers) following the S-D logic, which could improve customer satisfaction and loyalty (Juga *et al*., 2010). This is in accordance with the suggestion of shifting from service management to S-D logic (Gummesson *et al*., 2010). Recent empirical study has proved that a service-dominant service system outperforms a goods-dominant service system in terms of both objective and subjective criteria (Edvardsson *et al*., 2011). And for the manufacturer, being actively involved in service design and openly sharing knowledge and information will lead to higher logistics outsourcing performance. For both of them, joint learning, information sharing, and building a service-focused, customer-oriented, and relational logic are essential to their success, that is in line with the results on logistics service design (Rollins *et al.*, 2011).

2) Limitations and future research

As this research is limited to the context of automotive and logistics industries, future research could be extended to supply chains in other industries as well to understanding how S-D logic might help the managers in practice.

This research is focused on a dyadic interface between the 3PL provider and the manufacturer, which is the basic way of studying inter-firm relationships in the past SCM research (Barratt, 2004). Hence, upstream suppliers are not included in this research. However, there is a growing trend to study the inter-firm relationships with a triad structure of supplier-supplier-buyer (Choi and Wu, 2009; van der Valk and van Iwaarden, 2011). Obviously, a direction of future research could be to consider the whole supply network addressing not only those actors included in this research, but also suppliers and other stakeholders in a triadic view. In that case some FPs of S-D logic might achieve better counterparts in practice (e.g. FP5, and FP9-10).

Service (FP1, service focused), customer involvement (FP8, customer oriented), collaboration and co-creation (relational) values of S-D logic are emphasized in respect to the logistics-manufacturing interface. The premises of S-D logic should be further studied with more case studies to comprehensively understand the implications of applying the S-D logic in the context of SCM/logistics management.

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Appendix 1.

Interview Question Guideline

Description: This guideline specifies the questions we would like to address during the interview. The targeted information of the interview includes:

1. A brief description of the business context and operational process within the interviewee's department.
2. An overview of the operational processes between 3PL provider and the manufacturer, and.
3. Details of the enablers used in managing the interfaces between 3PL provider and the manufacturer.

General Information

Company: ________________ Department: ________________
Name: ________________ Title: ________________
Position in the company: _______________

Questions about the operational process

1. Please describe your department's business function.
2. Please describe the normally operations processes and information flow of your department.
3. Please clarify the interface boundaries between you department and other departments in or out of your company.

Questions about the customer design change

4. What are the strategies, tools, methods to manage the interfaces?
5. Are these used strategies, tools, methods service-oriented, customer-oriented, and relation-oriented? (Note: *S-D logic and G-D logic will be explained at this point if it is not explained at the beginning of the interview.*)
6. How these affects the operations processes in terms of improving efficiency and other performance objectivise defined in your company?
7. Give examples.

Closing questions

8. Would it be possible for us to observe the operational processes and check relevant documents only for academic research purpose?
9. Thank you!