

Research Article

Analysis on Relationship between Supply-demand Coordination and Performance of Logistics Service Supply Chain: An Empirical Study from China

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Abstract: The purpose of this study is to discuss the relationship between supply-demand coordination and performance of Logistics Service Supply Chain (LSSC) and help managers to understand which factors make significant influence on the performance of LSSC. In this paper, a correlation model for supply-demand coordination and performance analysis is presented, and then the survey method is adopted to conduct an empirical study. With software SPSS 15.0, the hypotheses are verified with multiple regression equations. The results show that the working efficiency of Functional Logistics Service Provider (FLSP), the training for FLSP, the order allocation fairness of Logistics Service Integrator (LSI) and the uncertain degree of LSI's order demand are positive to the cooperation performance. The level of information system sharing has no effect on cooperation satisfaction degree of FLSP. For the factors that have effect on cooperation satisfaction, LSI is more concerned about the efficiency of FLSP, while FLSP is more concerned about the cooperation profits. There is a big difference between their focuses. In order to successfully complete the cooperation of LSSC, the managers of LSI and FLSP must understand the each other's concerns, seek common ground while reserving differences, establish the strategic partnership, reduce the information asymmetry and improve satisfaction of cooperation.

Keywords: Correlation analysis, empirical study, logistics service supply chain, performance, supply and demand coordination

INTRODUCTION

Service supply chain management is a new operation strategy to improve the competitiveness of service enterprises. In recent years, with the rising of service supply chain (Lisa *et al.*, 2004), many scholars have made great effort to study the service supply chain management theories and methods. However, how the services supply chain management strategy keeps consistent with operation performance is the problem to be solved eagerly.

Logistics Service Supply Chain (LSSC) is one special type in service supply chain. The main structure of LSSC is from Functional Logistics Service Provider (FLSP) to Logistics Service Integrator (LSI) and to manufacturers or retailers. Among them, FLSP is the traditional functional logistics company, such as transportation companies, warehousing companies, etc. They are integrated as suppliers by LSI in the process of building national or international logistics service network because the service provided by FLSP is simple and usually limited within some regions.

Supply chain is a typical system which needs to be coordinated and LSSC is no exception. As LSSC in nature is the supply chain centered around the logistics service capacity cooperation (Lisa *et al.*, 2004; Liu, 2007), its coordination process and the coordination performance are different from traditional manufacturing supply chains. In order to make the LSSC achieve rapid and timely response to market demand, many scholars have carried out extensive research for LSSC coordination and put forward a variety of supply chain strategies and technologies, but little attention has been paid to the study on LSSC performance, especially on coordination and management performance of China's LSSC. Therefore, this study aims to answer the following important questions:

- LSSC is an effective cooperative system, which is composed of a LSI, a FLSP and a cooperative platform. What are the key factors in the supply-demand cooperation system for LSSC? Are there

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factors which are different from the manufacture supply chain?

- What are the relationships among those key factors in supply-demand cooperation system for LSSC? Which are the key factors? Which are not the key factors?
- How can LSI and FLSP get better cooperation performance with these key factors?

In this study, a correlation model for supply-demand coordination and performance analysis is presented and survey method to do an empirical research is used. With software SPSS 15.0, the hypotheses are verified with multiple regression equations. The correlation relationships among coordinated performance factors are discussed. The results show that there are big differences for the factors between LSI and FLSP focuses. The main conclusions and practical implications of this study are also given in the end.

LITERATURE REVIEW

The literature review in this study is not only to introduce the empirical study of the correlation between supply-demand coordination and performance of LSSC, but also to summarize the empirical study of manufacturing supply chain.

Research on the relationship between supply-demand coordination and performance of LSSC:

Currently, there are few empirical studies on the correlation between supply-demand coordination and performance of LSSC and the studies are mainly analyzed from the perspective of case studies. The correlation between coordination and performance is summarized by demonstrating the operation coordination case of LSSC.

For instance, Liu (2007) studied the case of LSI and FLSP operation coordination in two-level LSSC of China, which included two cases. Choy *et al.* (2007) exemplified the logistics developing conditions in South China and presented the Integrated Logistics Information Management System (ILIMS) to manage the uncertain problems in the LSSC operation coordination.

Research on the relationship between coordination and performance in manufacturing supply chain:

During the past years, the scholars have made many studies on the relationship among different variables of manufacturing supply chain cooperation, such as trust, commitment, adaption, information exchange, cooperation performance, etc. Some scholars have investigated the impact of specific coordination mechanism on the performance of manufacturing supply chain such as information integration, synchronization schedule etc.

The theoretical model built by Kenneth (1999) revealed that the high-quality information exchange between members in the supply chain would improve the product quality and the performance of enterprises. Li (2006) described the supply chain coordination by exploring the relationship between the five coordination behaviors and organizational performance. Wang *et al.* (2007) reviewed the relationship between coordination mechanism selection and performance of supply chain. Zelbst *et al.* (2009) examined the impacts of supply chain relationship on Supply Chain Performance (SCP). Srinivasan *et al.* (2011) examined the relationship between buyer-supplier partnership quality and supply chain performance, in the presence of supply and demand risks and environmental uncertainty.

From the literature review above, many scholars have carried out empirical studies on supply chain coordination especially on the manufacturing supply chain, but the systematic study on the relationship between supply-demand coordination and performance of LSSC is still very rare and the empirical research on China LSSC has not yet appeared. Therefore, carrying out the study in this area will help the managers of Logistics Service Integrator (LSI) and Functional Logistics Service Provider (FLSP) to improve the coordination method of LSSC.

THEORETICAL HYPOTHESES AND MODEL

Supply and demand cooperation system of LSSC:

Seen from Fig. 1, LSSC is an effective cooperative system, which is composed of a LSI, a FLSP and a cooperative platform. For LSI, the trust on FLSP, the training of FLSP, fair allocation of order, cooperation mode choice and uncertain degree of logistics service demand will significantly influence the coordination effect. For FLSP, working efficiency, service quality and uncertain degree of supply capability are the most important aspects in coordination of LSSC. For cooperative platform, it consists of three types of flows including the cash flow, the working flow and the information flow.

The hypotheses and models building:

For the performance of supply chain, there are three important indexes including cooperation profit, mutual trust degree and cooperation satisfaction degree (Wang *et al.*, 2007; Srinivasan *et al.*, 2011), so the three indexes are used to measure the relationship between supply-demand coordination and performance of LSSC. According to supply and demand cooperation system shown in Fig. 1, we propose the hypotheses as follows:

Hypotheses of cooperation profits: As a single LSSC is only a part of complex supply networks, FLSP may serve more than one LSI, so the capacity of FLSP for one LSI may have uncertainty (Choy *et al.*, 2007). The greater the uncertainty is, the more easily affected the service quality is, thus it will affect the cooperation

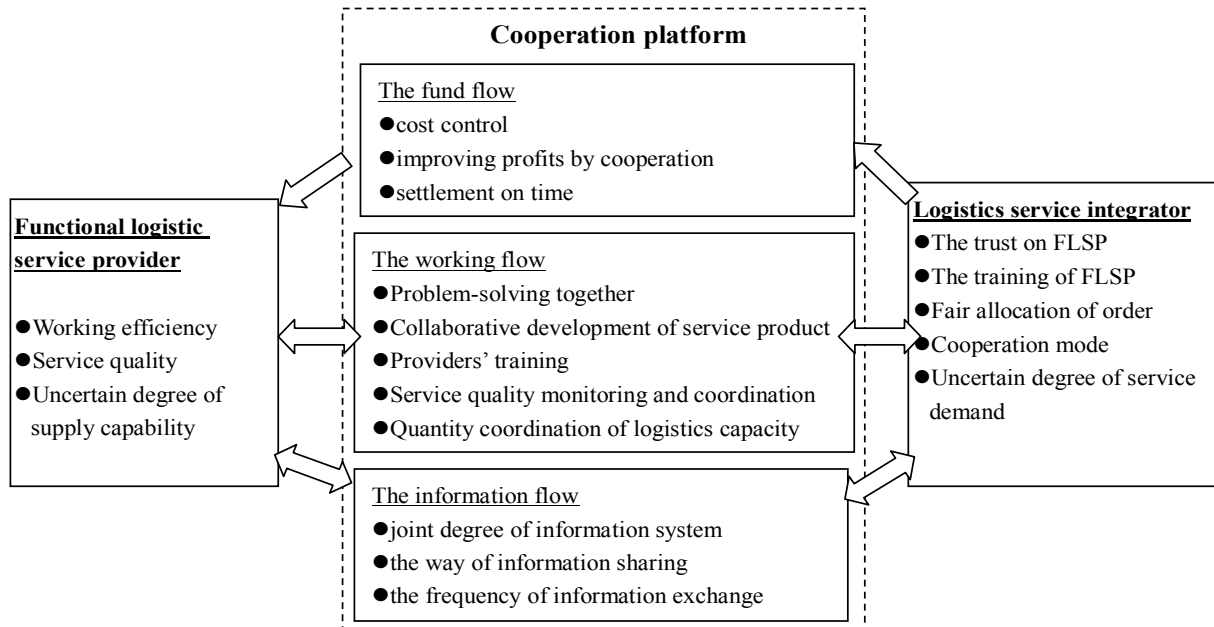


Fig. 1: Supply and demand cooperation system of LSSC

profit of whole LSSC (Liu *et al.*, 2011). So the following hypothesis can be proposed:

H1 (a): The greater the uncertain degree of FLSP's capacity is, the less the cooperation profit is.

LSIs usually have many FLSPs. When faced with FLSPs, a reasonable order allocation decision made by LSI is the key to ensure that LSSC is stable. The fairer the order allocation made by LSI is, the higher the satisfaction of FLSP is, the better the performance of logistics services is and the greater the cooperation profits of LSSC is (Liu, 2007). In addition, changes in customer demand will have an influence on cooperation profits. Liu *et al.* (2011) showed that as the uncertain degree of customer demand increased, the total cost of LSSC would be greater and the FLSPs' overall satisfaction would be lower. Therefore, it can be assumed that:

H1 (b): The fairer the order allocation made by LSI is, the larger the cooperation profit is.

H1 (c): The more uncertain the LSI's order demand is, the less the cooperation profit is.

In the process of services design, the relationship between LSI and FLSP should be strengthened and LSI should give FLSP the necessary training and technical support so that FLSP can understand the customer's logistics service procedures, quality system and requirements (Ryu *et al.*, 2009). These activities not only improve the service quality and efficiency, but

also increase the profits of both sides. Therefore the following hypothesize are made:

H1 (d): The training of FLSP may increase the cooperation profits.

As the actual providers of logistics services, the service efficiency of FLSPs is of importance. The efficiency of FLSP lies in two aspects, one is the quantity delivery of logistics service capacity and the other is the quality delivery of service capacity (Liu, 2007). The higher the efficiency of these two aspects is, the higher the service output is and the larger the service profit is. According to Porter's value chain theory (Chiang and Trappey, 2007), the cost control capability and working efficiency of FLSP are two important elements of value chain and are significant to increase profits of LSSC. Therefore, we propose the following hypothesis:

H1 (e): The higher working efficiency of FLSP is, the better the effect of increasing profits by cooperation of both sides is.

In LSSC, since the downstream LSI is closer to customers, he has initiative in the operation of logistics services, but should consider the profit allocation with the upstream FLSPs. Therefore, LSI need to take into account the effect of the cooperation mode on the future behavior of FLSP. The research of Liu (2007) indicated that the cooperation modes include long-term contracts cooperation, short-term contracts cooperation and loose cooperation. Different cooperation modes have

different influence on the bilateral cooperation profits. Generally speaking, the strategic partnership under long-term contracts would bring more profits (Das, 2011). Therefore, we hypothesize that:

H1 (f): Cooperation mode has influence on cooperation profits.

Hypotheses of LSI's trust degree on FLSP: In LSSC, LSI should provide logistics service to meet customers' requirements. Therefore, the final logistics service quality is under the responsibility of LSI. In order to meet quality requirements of customers, LSI must enhance the monitoring and coordinating of service quality of FLSP. With regular quality communication meetings, the quality requirements can be better understood by FLSP and so the service quality would be improved. This will increase the mutual trust (Zhang *et al.*, 2010). Therefore the hypothesis is generated as follows:

H2 (a): The communication frequency of service quality may increase the degree of LSI's trust on FLSP.

Because LSI has initiative in the operation of logistics services, different cooperation mode represents LSI's trust degree on FLSP. In order to make cooperation for long term, LSI would like to choose the strategic partnership rather than the loose cooperation mode (Krishnamurthy *et al.*, 2009). Therefore, we propose the following hypothesis:

H2 (b): Cooperation mode has influence on LSI's trust degree on FLSP.

In supply chain, the application of collaboration strategies to improve profits is beneficial for both sides (Thomas and Bostrom, 2010), which is also the same in LSSC. On one side, FLSP can communicate with LSI more freely and provide the logistics service better, on the other side, LSI can obtain the dynamic service information from FLSP more freely and make more trust on FLSP. Therefore, the collaboration can increase LSI's trust degree on FLSP. So, the following hypothesis is proposed:

H2 (c): The collaboration of two sides to improve profits can increase LSI's trust degree on FLSP.

Hypotheses of cooperation satisfaction degree of FLSP: Several studies have confirmed that partnerships relied on a high level of relational trust (Morgan and Hunt, 1994). LSSC is an enterprise cooperation union on the basis of mutual trust. For the successful LSSC management, the trust is the necessary prerequisite.

Because LSI is a leader in LSSC, the important cooperation decisions made will influence the following operation of FLSP (Liu *et al.*, 2011). So LSI's trust degree on FLSP will affect the operation of FLSP. Then the following hypothesis is generated:

H3 (a): LSI's trust degree on FLSP may increase the cooperation satisfaction degree of FLSP.

In the process of collaboration with FLSP, LSI no longer unilaterally asks for cutting the price, but emphasizes the way of cooperation so as to help FLSP increase service quality. With the suppliers' training and continuous quality improvement, the whole service procedure is optimized to reduce the cost and increase the profits (Zhang *et al.*, 2011). Meanwhile, with the profit increasing, the cooperation satisfaction degree of FLSP is raised up correspondingly. Thus, we propose the following hypothesis:

H3 (b): The collaboration of both sides to improve profits can increase cooperation satisfaction degree of FLSP.

Communication through information network is the operation basis of services supply chain. LSI and FLSP achieve efficient logistics information management by information system joint. The information system joint may also help to increase the cooperation depth and lay the foundation of higher efficient operation (Rai *et al.*, 2006; Wang *et al.*, 2006), thus the cooperation satisfaction degree of FLSP is increased. Therefore, we put forward the following hypothesis:

H3 (c): The information system joint between LSI and FLSP may increase the cooperation satisfaction of FLSP.

In order to improve the service performance of LSSC and establish strategic partnership, timely settlement is needed (Zhang *et al.*, 2011). There is no doubt that any FLSP will be satisfied with LSI which can make settlement in time. What's more, timely settlement will also be beneficial to enhance FLSP's service quality. Therefore the hypotheses are generated as follows:

H3 (d): Timely settlement may increase FLSP's cooperation satisfaction.

Hypotheses of cooperation satisfaction degree of LSI: The trust mechanism plays an important role in reducing the cooperation cost. In fact, trust of LSI is correlated with his satisfaction (Johnston *et al.*, 2004). The more satisfaction LSI has, the more trust he

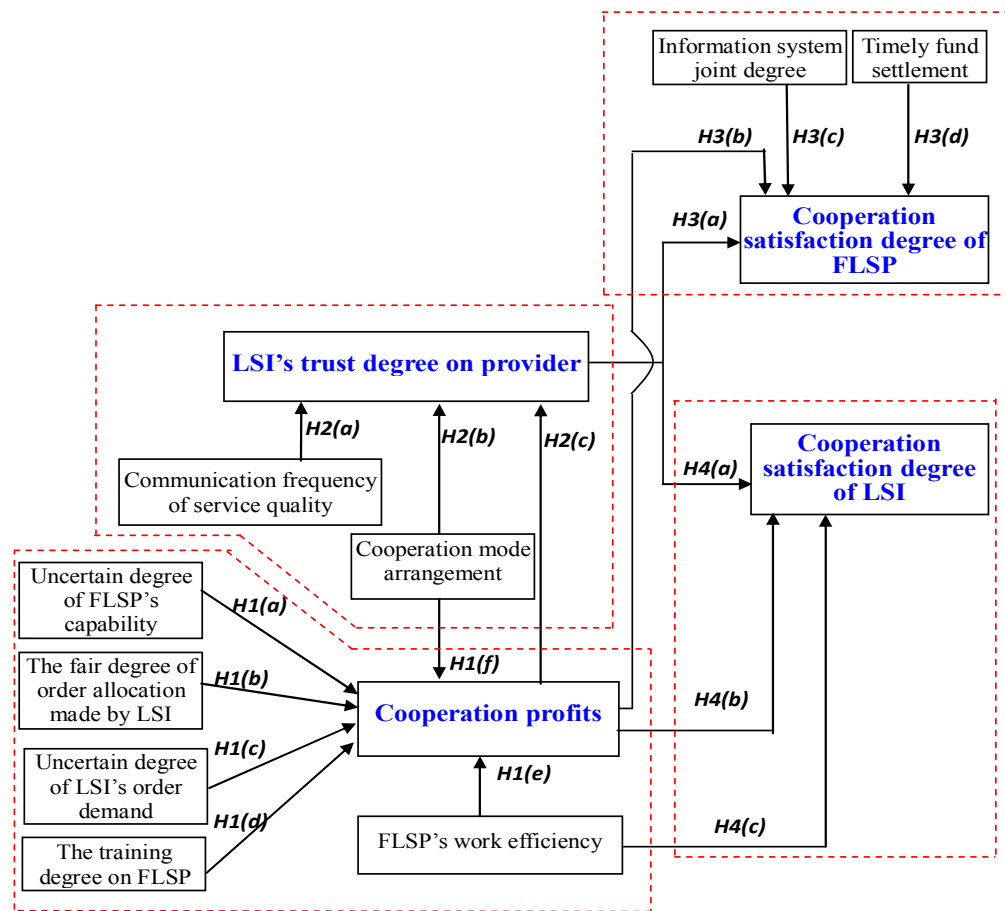


Fig. 2: Correlation analysis model of coordination and performance

will give FLSP. Thus the rising of mutual trust degree may help increase cooperation satisfaction. Then the following hypothesis is generated:

H4 (a): LSI's trust degree on FLSP may increase the cooperation satisfaction degree of LSI.

LSSC in nature is the supply chain which considers the logistics service capacity cooperation as the core (Lisa *et al.*, 2004; Liu, 2007). In order to make sure that LSI could make dynamic services capacity coordination according to customer's requirements, both LSI and FLSP should make the following coordination, such as services product types, quantity of service capability, requirements of service quality, etc., (Srinivasan *et al.*, 2011). Hence, LSI can make more profit if he chooses the collaboration with FLSP, the cooperation satisfaction degree of LSI can also be increased. Therefore, the following hypothesis is proposed:

H4 (b): The collaboration of both sides to improve profits can increase cooperation satisfaction degree of LSI.

FLSPs provide professional services for LSI with their service capacities. Therefore, the logistics service demand of LSI is operated by FLSP. First, the service flexibility of supplier determines the service level of supply chain (Merschmann and Thonemann, 2011). Second, the service innovation ability of FLSP determines the competitiveness of LSSC. Thus the service capacity and efficiency of FLSP has a direct impact on the long-term development of LSSC (Liu, 2007). Clearly, it will also affect the cooperation satisfaction of LSI. Therefore, the following hypothesis is proposed:

H4 (c): The higher the efficiency of FLSP, the more the cooperation satisfaction of LSI is.

Based on the hypotheses above, the following correlation model among the hypotheses is shown in Fig. 2.

In order to discuss conveniently, the codes for every variable are set and shown in Table 1.

In Fig. 2, there are some relations between various variables. They are complicated and can be explored by correlation analysis. In this study, path analysis is

Table 1: Research variables

Research variables	Code
Uncertain degree of FLSP's capacity	V_1
The fair degree of orders allocation made by LSI	V_2
Uncertain degree of LSI's order demand	V_3
The training level for FLSP	V_4
FLSP's working efficiency	V_5
Cooperation profits	V_6
The information system joint degree	V_7
Communication frequency of service quality	V_8
Cooperation mode arrangement	V_9
LSI's trust degree on FLSP	V_{10}
Timely fund settlement	V_{11}
Cooperation satisfaction degree of FLSP	V_{12}
Cooperation satisfaction degree of LSI	V_{13}

used to build regression equations to discuss the relationship between supply-demand coordination and performance of LSSC. There are four regression equations:

Model 1 (the relational model of cooperation profits):

$$V_6 = p_{1,6} \times V_1 + p_{2,6} \times V_2 + p_{3,6} \times V_3 + p_{4,6} \times V_4 + p_{5,6} \times V_5 + p_{9,6} \times V_9 \quad (1)$$

Model 2: (the relational model of LSI's trust degree on FLSP):

$$V_{10} = p_{6,10} \times V_6 + p_{9,10} \times V_9 + p_{8,10} \times V_8 \quad (2)$$

Model 3 (the relational model of cooperation satisfaction degree of FLSP):

$$V_{12} = p_{10,12} \times V_{10} + p_{6,12} \times V_6 + p_{7,12} \times V_7 + p_{11,12} \times V_{11} \quad (3)$$

Model 4 (the relational model of cooperation satisfaction degree of LSI):

$$V_{13} = p_{10,13} \times V_{10} + p_{5,13} \times V_5 + p_{6,13} \times V_6 \quad (4)$$

where,

$p_{i,j}$: Path coefficient, namely the standard regression coefficient

V_i : The independent variable

V_j : The dependent variable

RESEARCH METHODOLOGY

To examine the relationship between supply-demand coordination and performance of LSSC, a questionnaire with 7-point Likert scale is developed to collect data and four regression equations are given with collected data, then the associated path coefficient diagram of LSSC will be built. The research process for this study is shown in Fig. 3.

Measure tools: The measure tool of the study is the questionnaire. Based on the relevant literature review,

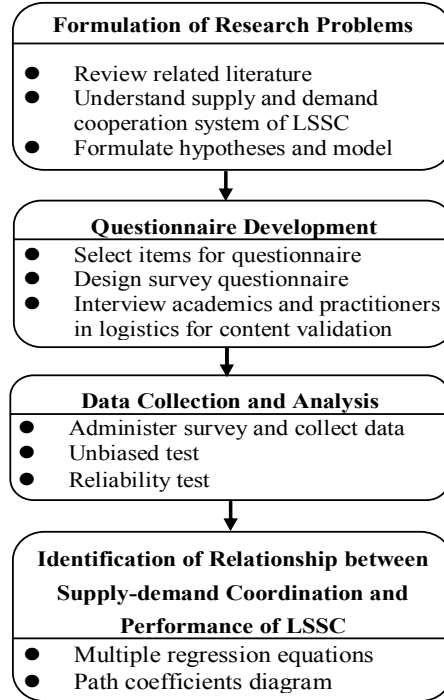


Fig. 3: Research process

this questionnaire is designed by considering the current status and characteristics of China's LSSC. The questionnaire includes three aspects, basic situation of enterprises, the level of supply and demand cooperation and the supply and demand coordination strategy. The questionnaire uses 7-point Likert scale (Lai, 2004) and is filled in by interviewees directly. After all the questionnaires were collected, the statistical analysis was conducted.

Data sample:

Determination of survey area: In order to fully understand the coordination performance situation of China's LSSC, with the support of National Natural Science Foundation of China (NSFC), we issued questionnaires by three modes from December 2010 to May 2011:

- According to the traditional distribution of geographic regions in Mainland China, the survey areas were divided into 7 regions (Wang *et al.*, 2007), namely the Northeast China, Northwest China, North China, Central China, East China, South China, Southwest China, the questionnaires were issued through E-mail and post office. Fifty eight questionnaires were returned from a total of 660 questionnaires.
- From 2011 China Logistics Development Report Conference, 2011 China Logistics Product-Study-Research Combination Forum and 2011 Beijing Global Purchasing and Supply Chain Forum, 54 out of total 300 questionnaires were returned.

- From the postgraduate courses of logistics engineering in Tianjin University, the postgraduate courses of international shipping and logistics in Nankai University and some other courses, 124 questionnaires were returned from a total of 200 questionnaires.

Profile of the respondents: In this survey, 1160 questionnaires were distributed and 236 questionnaires were returned and the response rate is 20.34%; 220 questionnaires are valid and the effective rate is 93.22%. From the effects of the questionnaires returned (Table 2), it can be seen that East China, South China and North China present more positive reaction and response rate is relatively high, while the response rate in other regions is low. This situation is related to the imbalance in development of regional economy. East China, South China and North China are the most developed regions and LSSC is also more mature, so the enthusiasm to return the questionnaire is higher.

For the business revenue of logistics enterprise, the biggest proportion is 34.09% for 10-50 million while the second is 31.82% for more than 100 million. For the number of employees, 501-1000 is the biggest portion which indicates that most of logistics enterprises have more than 500 employees. For the working year of respondents, there are no obvious portion differences among different working years. The percentage of every portion is more than 20%. For the current position of the interviewees, most of them are managers or senior managers.

Unbiased test of the sample: In order to test whether the survey is representative, the unbiased sample test is

Table 2: Profile of the respondents (n = 220)

Category	Number	(%)
Survey region		
Northeast China	15	9.09
North China	38	21.82
Central China	10	12.73
South China	40	18.18
East China	46	20.91
Southwest China	20	11.36
Northwest China	12	5.91
Business revenue of logistics enterprises (RMB)		
Less than 10 million	42	19.09
10-50 million	75	34.09
51-100 million	19	8.64
More than 100 million	70	31.82
Others	14	6.36
Number of employees		
Less than 100	52	23.64
101-500	41	18.64
501-1000	72	32.73
1001-5000	33	15.00
5001-10000	12	5.45
More than 10000	10	4.55
Working years in logistics company		
Less than 3 years	55	25.00
3-5 years	51	23.18
6-7 years	47	21.36
More than 8 years	67	30.45
Current position of the interviewees		
Staff	55	25.00
Supervisor	43	19.55
Manager	63	28.64
Senior manager	59	26.82

required. Unbiased test is to examine whether there is statistical deviation among the responders and non-responders of survey targets.

One approach of unbiased test is to sample twice. For example, the first sampling is performed and then the second sampling is conducted for the sample population with no response (not participated in the survey). After that *t* test is adopted to examine whether the responses of two samples (participated in the survey and not participated in the survey) are different. The other approach is to divide the samples into two groups (two waves) according to the natural wave division line

Table 3: Unbiased test result

Factors	Group	N	Mean	S.D.	S.E.M.	<i>t</i>	Sig. (2-tailed)
Cooperation satisfaction degree of LSI	2	150	4.5897	0.88013	0.14093	2.208	0.750
	1	70	5.1143	1.15737	0.19563		
Working efficiency of FLSP	2	150	4.3590	1.15820	0.18546	2.257	0.627
	1	70	4.9429	1.05560	0.17843		
Communication frequency of service quality	2	150	4.7179	1.27628	0.20437	2.474	0.816
	1	70	5.4571	1.29121	0.21825		
Uncertain degree of FLSP's capacity	2	150	4.3846	1.09100	0.17470	2.115	0.438
	1	70	4.9714	1.29446	0.21880		
The level of LSI's trust degree on FLSP	2	150	4.7949	1.03057	0.16502	2.863	0.205
	1	70	5.4571	0.95001	0.16058		
The training level for FLSP	2	150	3.7179	1.79104	0.28680	3.843	0.410
	1	70	5.2857	1.70762	0.28864		
The fair degree of order allocation made by LSI	2	150	4.4872	1.21117	0.19394	-4.253	0.360
	1	70	5.5714	0.94824	0.16028		
Uncertain degree of LSI's order demand	2	150	3.8974	1.71364	0.27440	-3.378	0.601
	1	70	5.0857	1.24550	0.21053		
The joint level of information system	2	150	3.8974	1.31379	0.21037	-3.377	0.531
	1	70	5.0000	1.49509	0.25272		
Timely fund settlement	2	150	5.4103	1.33215	0.21332	0.746	0.458
	1	70	5.6286	1.16533	0.19698		
Cooperation satisfaction degree of FLSP	2	150	5.0256	1.13525	0.18179	0.903	0.369
	1	70	5.2857	1.34101	0.22667		
Cooperation profits	2	150	4.6154	1.22722	0.19651	2.926	0.505
	1	70	5.4571	1.24482	0.21041		

S.D.: Standard deviation; S.E.M.: Standard error of mean

Table 4: Reliability analysis of data

Factors	Scale mean if item deleted	Scale variance if item deleted	Corrected item-total correlation	Cornbrash's alpha if item deleted
Uncertain degree of FLSP's capacity	57.3409	106.555	0.462	0.847
The fair degree of order allocation made by LSI	56.8773	107.116	0.401	0.850
Uncertain degree of LSI' order demand	57.7136	101.534	0.428	0.851
The level of training for FLSP	57.6045	94.881	0.564	0.842
FLSP's working efficiency	57.3318	103.836	0.567	0.841
Cooperation profits	56.8773	103.418	0.562	0.841
The level of information system splice	57.4591	98.404	0.572	0.860
Communication frequency of service quality	57.0045	103.920	0.463	0.847
Cooperation model arrangement	56.9818	101.192	0.573	0.840
LSI's trust degree on FLSP	56.7955	104.611	0.623	0.839
Timely funds settlement	56.5864	105.912	0.379	0.852
Cooperation satisfaction degree of FLSP	56.7500	103.866	0.563	0.841
Cooperation satisfaction degree of LSI	57.2045	103.024	0.671	0.836
Total Cornbrash's alpha = 0.854				

of sample response time and perform comparison test (*t* test) to determine whether there exists differences. In this study, the second approach is adopted and the test results are shown in Table 3. Test results show that the sample is not statistically significant different ($p < 0.05$) and is unbiased.

Reliability test of the sample: In this study, the reliability test method adopted is "Cronbach a" coefficient. With software SPSS 15.0, the reliability test is executed for the assumption variables in Table 1. The results are shown in Table 4.

According to the reliability test results above, it can be seen that the reliability degree of all variables in Table 1 is more than 0.8. The overall reliability is 0.854 which is acceptable. The results indicate that the design of assumption variables in questionnaires and results are consistent and reliable.

DATA ANALYSIS

According to the data from questionnaires, four models are verified with regression equations and we will discuss the relationship between supply-demand coordination and performance of LSSC.

Model 1 (the relational model of cooperation profits):

$$V_6 = p_{1,6} \times V_1 + p_{2,6} \times V_2 + p_{3,6} \times V_3 + p_{4,6} \times V_4 + p_{5,6} \times V_5 + p_{9,6} \times V_9$$

According to regression analysis in Table 5, the tolerances of collinearity statistics are 0.85, 0.726, 0.761, 0.6, 0.782 and 0.745. VIF are 1.177, 1.378, 1.314, 1.665, 1.278 and 1.343, which are all less than 10, so the collinearity hypothesis between them can be rejected. This indicates that the multi-collinearity of all variables is not serious and is fit to the path analysis conditions. Thus:

$$V_6 = -0.095 \times V_1 + 0.099 \times V_2 + 0.008 \times V_3 + 0.12 \times V_4 + 0.215 \times V_5 + 0.359 \times V_9 \quad (5)$$

Known from the Eq. (5), the results of path analysis confirm the hypotheses H1 (b), H1 (c), H1 (d), H1 (e) and H1 (f). It shows that the working efficiency of FLSPs, the training level for FLSP, the fair degree of order allocation made by LSI, the uncertain degree of LSI's order demand and the cooperation mode arrangement have positive effect on the cooperation profits of two sides. Meanwhile, as the path coefficient of V_1 is -0.095, means that with the increase of the uncertain degree of FLSP's capacity, the cooperation profits is reducing. Therefore the H1 (a) is also confirmed.

From the coefficients of the Eq. (5), in the process of improving the cooperation profits, the working efficiency of FLSP and the training level for FLSP have greater influencing weight, while the uncertain degree of FLSP's capacity and the variability of LSI's order demand have lower influencing weight.

Model 2 (the relational model of LSI's trust degree on FLSP):

$$V_{10} = p_{6,10} \times V_6 + p_{9,10} \times V_9 + p_{8,10} \times V_8$$

Shown from the regression analysis in Table 6, the tolerances of collinearity statistics are 0.926, 0.775 and 0.736. VIF are 1.080, 1.378, 1.290 and 1.359 and the values are all less than 10, thus the collinearity assumption between them can be rejected. It indicates that the multi-collinearity of all variables is not serious and the data meet the path analysis conditions. Thus:

$$V_{10} = 0.142 \times V_6 + 0.268 \times V_9 + 0.251 \times V_8 \quad (6)$$

According to the Eq. (6), the results of path analysis confirm the hypotheses H2 (a), H2 (b) and H2 (c) and indicate that cooperation profits, communication frequency of service quality, cooperation mode arrangement have positive effect on LSI's trust degree on FLSP.

Known from the coefficients of the Eq. (6), among the influencing factors of LSI's trust degree on FLSP, the cooperation mode arrangement has the maximum

Table 5: Regression analysis of model 1

Model 1	Un-standardized coefficients		Standardized coefficients			Collinearity statistics	
	B	S.E.	β	t	Sig.	Tolerance	VIF
Uncertain degree of FLSP's capacity supply	-0.100	0.094	-0.095	1.065	0.009	0.850	1.177
The fair degree of order allocation made by LSI	0.098	0.095	0.099	1.032	0.005	0.726	1.378
Uncertain degree of LSI's order demand	0.006	0.069	0.008	0.083	0.004	0.761	1.314
The training level for FLSP	0.079	0.070	0.120	1.130	0.001	0.600	1.665
FLSP's working efficiency	0.222	0.096	0.215	2.313	0.003	0.782	1.278
Cooperation mode arrangement	0.322	0.085	0.359	3.783	0.000	0.745	1.343

Dependent variable: Cooperation profits gained; S.E.: Standard error

Table 6: Regression analysis of model 2

Model 2	Un-standardized coefficients		Standardized coefficients			Collinearity statistics	
	B	S.E.	β	t	Sig.	Tolerance	VIF
Communication frequency of service quality	0.188	0.066	0.251	2.847	0.005	0.926	1.080
Cooperation profits	0.121	0.082	0.142	1.479	0.042	0.775	1.290
Cooperation model arrangement	0.204	0.075	0.268	2.712	0.008	0.736	1.359

Dependent variable: LSI's trust degree on FLSP; S.E.: Standard error

Table 7: Regression analysis of model 3

Model 3	Un-standardized coefficients		Standardized coefficients			Collinearity statistics	
	B	S.E.	β	t	Sig.	Tolerance	VIF
Cooperation profits	0.346	0.083	0.357	4.167	0.000	0.702	1.425
The joint level of information system	0.000	0.064	0.000	0.004	0.997	0.710	1.409
LSI's trust degree on FLSP	0.386	0.092	0.338	4.181	0.000	0.787	1.270
Timely fund settlement	0.188	0.066	0.224	2.849	0.005	0.833	1.201

Dependent variable: Cooperation satisfaction degree of FLSP; S.E.: Standard error

influencing weight, while the communication frequency of service quality and the cooperation profits have less influencing weight. It indicates that the strategic partnership before cooperation is the most critical factor which has impact on trust degree and the communication frequency of service quality during cooperation is the second important factor, while the cooperation profits after cooperation have less weight.

Model 3: (the relational model of cooperation satisfaction degree of FLSP):

$$V_{12} = p_{10,12} \times V_{10} + p_{6,12} \times V_6 + p_{7,12} \times V_7 + p_{11,12} \times V_{11}$$

As shown from the regression analysis in Table 7, the tolerances of collinearity statistics are 0.702, 0.710, 0.787 and 0.833. VIF are 1.080, 1.378, 1.290 and 1.359 and the values are all less than 10, thus the collinearity assumption between them can be rejected. It indicates the multi-collinearity of all variables is not serious. The data meet the path analysis conditions. Thus:

$$V_{12} = 0.338 \times V_{10} + 0.357 \times V_6 + 0 \times V_7 + 0.224 \times V_{11} \quad (7)$$

According to the Eq. (7), the results of path analysis confirm the hypotheses H3 (a), H3 (b) and H3 (d) it also indicates that the LSI's trust degree on FLSP, cooperation profits, timely fund settlement have positive effect on the cooperation satisfaction degree of FLSP.

The coefficient of V7 is 0, which indicates that the joint level of information system has no effect on the cooperation satisfaction degree of FLSP, neither positive, nor negative influence. Therefore, the assumption H3 (c) is rejected, which implies that in China nowadays, LSSC is still under a low level. On the other hand, the result shows that enterprises have not yet realized the importance of information sharing and the information transparency is not enough. This is related to the conditions that the internal information systems of most enterprises are defective, data processing technology is backward. Information communication tools in LSSC should be improved.

From the coefficients of the Eq. (7), among the influencing factors of cooperation satisfaction degree of FLSP, the cooperation profits has the largest influencing weight, while the LSI's trust degree on FLSP and the timely fund settlement have less influencing weight. This shows that the cooperation profits obtained is the most important factor which affects the satisfaction of FLSP. Therefore, the satisfaction of FLSP will be raised significantly by increasing cooperation profits.

Model 4: (the relational model of cooperation satisfaction degree of LSI):

$$V_{13} = p_{10,13} \times V_{10} + p_{5,13} \times V_5 + p_{6,13} \times V_6$$

According to Table 8, the tolerances of collinearity statistics are 0.680, 0.847 and 0.711. VIF separately are

Table 8: Regression analysis of model 4

Model 4	Un-standardized coefficients		Standardized coefficients			Collinearity statistics	
	B	S.E.	β	t	Sig.	Tolerance	VIF
FLSP's working efficiency	0.511	0.072	0.560	7.103	0.000	0.680	1.471
Cooperation profits	0.185	0.062	0.209	2.962	0.004	0.847	1.180
LSI's trust degree on FLSP	0.135	0.080	0.130	1.688	0.034	0.711	1.407

Dependent variable: Cooperation satisfaction degree of LSI; S.E.: Standard error

1.471, 1.180 and 1.407 and the values are all less than 10, thus the collinearity assumption between them can be rejected. It indicates that the multi-collinearity of all variables is not serious. The data meet the path analysis conditions. Thus:

$$V_{13} = 0.13 \times V_{10} + 0.56 \times V_5 + 0.209 \times V_6 \quad (8)$$

For the Eq. (8), the results of path analysis confirm the hypotheses *H4* (a), *H4* (b) and *H4* (c). It shows that the LSI's trust degree on FLSP, working efficiency of FLSP, cooperation profits have positive effect on the cooperation satisfaction degree of LSI.

According to the coefficients of the Eq. (8), among the influencing factors of cooperation satisfaction degree of LSI, the FLSP's working efficiency has the largest influencing weight, while the cooperation profits and the LSI's trust degree on FLSP have less influencing weight. This implies that the FLSP's working efficiency is the most important factor which affects the trust degree. Compared with model 3, LSI pays more attention on FSLP's working efficiency in cooperation, while FLSP focuses on the cooperation profits. This is really a big difference.

RESULTS AND DISCUSSION

Main findings: Figure 4 is the path coefficients diagram based on the analysis above.

In summary, the following important conclusions are reached from the empirical study:

- The factors, like working efficiency of FLSP, training for FLSP, fairness of order allocation made by LSI, variability of logistics service LSI's order demand have positive influence on bilateral cooperation profits. The increasing of uncertain degree of FLSP's capacity has negative influence on bilateral cooperation profits. In the process of improving bilateral cooperation profits, the endeavors of FLSP and LSI, such as the working efficiency of FLSP and training for FLSP, have great influence on bilateral cooperation profits.
- The bilateral cooperation profits, communication frequency of service quality and cooperation mode arrangement have positive influence on LSI's trust degree on FLSP. Among them, cooperation mode

arrangement has the largest influencing weight, while communication frequency of service quality and the cooperation profits have the smaller influencing weight. Therefore, the establishment of strategic partnership is important to improve their mutual trust.

- LSI's trust degree on FLSP, cooperation profits and timely fund settlement has positive influence on cooperation satisfaction degree of FLSP. Among them, cooperation profit is the most important factor which has influence on satisfaction degree of FLSP. Therefore, increasing the bilateral cooperation profits as much as possible can raise the satisfaction of FLSP significantly. In addition, the results of empirical study indicate that the joint level of information system has no influence on the cooperation satisfaction degree of FLSP, neither positive, nor negative impact. In China nowadays, LSSC cooperation is under a low level and logistics enterprises have not yet realized the importance of information sharing.
- LSIs' trust degree on FLSP, working efficiency of FLSP and cooperation profits has positive influence on cooperation satisfaction degree of LSI. Among them, FLSP's working efficiency has the largest influencing weight, while communication frequency of service quality and the cooperation profits have smaller influencing weight. Among the satisfaction degree's factors, LSI is more concerned about FLSP's working efficiency in cooperation, but FLSP pays more attention on the cooperation profits, which is really a big difference.

Implications for researchers: From a research perspective, understanding the relationship between supply-demand coordination and performance and how this may affect the behaviors of LSI and FLSP opens up new approach to develop theories about LSSC. For instance, how can LSI and FLSP avoid the negative cooperation factors? How can they play the positive factors in the cooperation? How to choose the best cooperation mode to achieve the maximum profit? Because the sharing of information system has no influence on the cooperation satisfaction degree of FLSP, how does LSI promote the sharing of

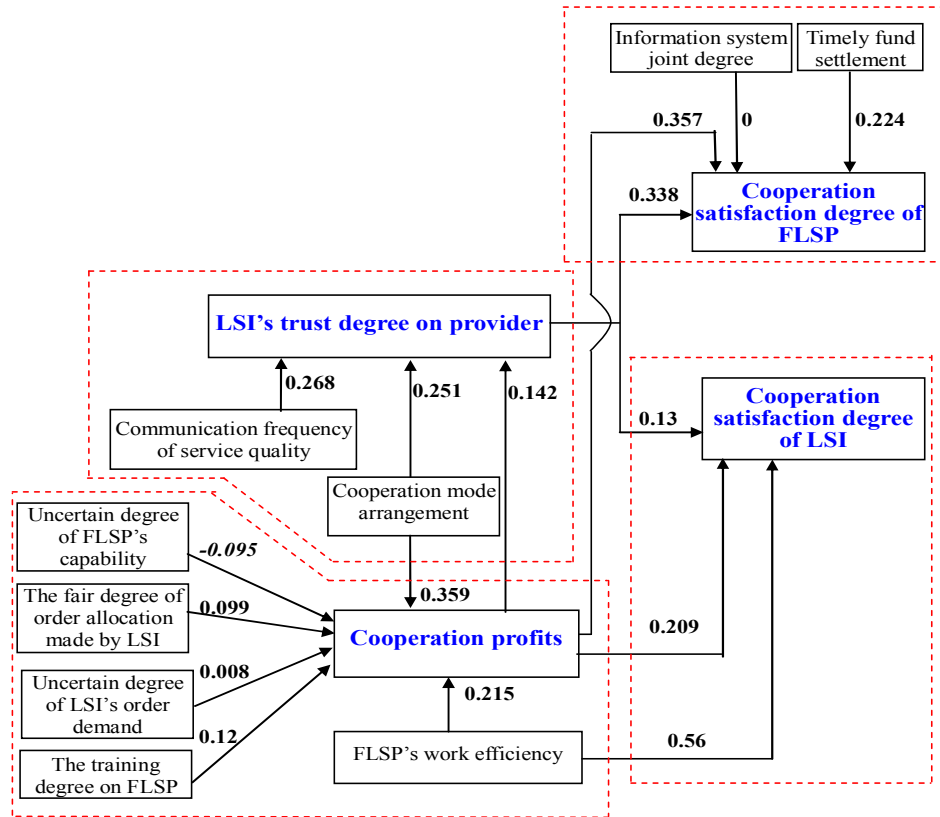


Fig. 4: Path coefficients diagram for the relationship of supply-demand coordination and performance in LSSC

information system? This study provides benefit thinking for further research on the supply-demand coordination in LSSC, particularly that the focus differences between LSI and FLSP provide a necessary theoretical basis for future empirical study and model building.

Implications for managers: From the managerial standpoint, the results of the study show that there are many focus differences between LSI and FLSP. To successfully complete the cooperation of LSSC, both managers of LSI and FLSP should understand each other's concerns, seek common ground while reserving differences, establishing the strategic partnership, reducing the information asymmetry and improving satisfaction of cooperation. In addition, For the managers of LSI, they should strengthen the training for FLSP, increase the fairness of order allocation, reduce the uncertain degree of order demand, improve the trust degree on FLSP and settle the funds timely with FLSP; For the managers of FLSP, they should improve the working efficiency, reduce the uncertain degree of capability supply and raise the communication frequency with LSI. What's more, both managers of FLSP and LSI should solve the information system sharing problem properly together. LSI should take more effective measures to promote information system sharing.

RECOMMENDATIONS

As Chinese market is increasingly competitive and market uncertainty is increasing, the two parties of supply and demand in LSSC are urgently required to strengthen coordination to create competitive advantages through the rapid response. Through theoretical analysis and empirical study, this study has verified some assumed propositions. This study provides valuable decision-making references for improving future agility strategy of LSSC in Mainland China.

There are some limitations of research work in this study. For instance, the distribution of the sample is not uniform enough; the sample is over-concentrated in coastal and developed regions and the samples from the western region is not enough. In addition, based on the conclusions from this study, different types of logistics enterprise case analysis may be carried out. What's more, the effect of cooperation strategies on the cooperation performance and the ways to optimize supply-demand coordination strategy in LSSC are worthy of further study.

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