

Research on the Coordination Mechanisms of Port Service Supply Chain Based on Element Analysis

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Abstract — The port is an important part of the global logistic chain and the port service supply chain evolved from the development of port systems is the general trend of the world shipping industry. However, several reasons exist which result in disorders of port service logistics, giving overall low performance of port supply chain as well as a decline in competitiveness of our port. First, the paper defines the connotation of the supply chain of port services. Then the paper takes a factor analysis of the coordination elements through a questionnaire and expert interviews. On the basis of core elements, we build a framework for coordination mechanism of the port service supply chain, which can facilitate the coordination of the port service supply chain by the effective coordination of the dynamic mechanism, conduction mechanism and security mechanism.

Keywords - Service supply chain; Coordination mechanisms; Element analysis

I. INTRODUCTION

Port is a significant segment of the global logistic chain and its service supply chain evolved from its development is a general trend of the world port system. For the reason that the port service supply chain interweaves numerous businesses, different types of service enterprises are distinct from each other in business objectives, thus the coordination of the port service supply chain is symbolized by low efficiency.

A great continuous endeavor at home or abroad has been injected into the coordination of the port service supply chain. Peggy. D^[1] utilized the social network theory to study the coordination of the port service supply chain. In China, Gao Jie, Zheng Hong^[2] conducted a research of the information coordination of the port service supply chain, while Song, D.W.,^[3] set up a multi-objective and multi-factor model of interests distribution mechanism to realize the coordination of the port service supply chain, and Zhao Na^[4] took advantage of the agent theory to construct the port service supply chain coordination systems. Lu Yao's^[5] introduction of the concept "Freight option" established the coordination mechanism of port service supply chain. By conducting the reorganization of logistics operation procedure, Sun Fengshan^[6] promoted the coordination of port service supply chain. Throughout the existing literature, we can discover that all studies on this field were from single perspective such as the logistics service process reengineering, profits distribution, information sharing and so forth. Nevertheless, plenty of influential factors play roles in the coordination of port service supply chain and this paper takes a step to establish a coordination model of the port service supply chain on the foundation of element analysis.

II. DEFINITION OF THE PORT SERVICE SUPPLY CHAIN

The port service supply chain revolves around port enterprises and integrates the port, service providers and customers into a service supply chain by means of information technology. The structure flowchart is shown in figure 1.

The service supply chain of the port has the following characteristics:

(1)The port-centered supply chain, which primarily contains the owner of cargo, overland transportation businesses, port enterprises, shipping companies, functional logistics providers etc.

(2)The service supply chain: Port produce no new products; instead, its revenue is mainly obtained by offering logistics services (such as loading and unloading as well as storage), for which it is a service-oriented supply chain.

(3)Bi-directionality. Set the port enterprises as the nodes in the chain. Both owners of cargo in the supply chain upstream or the shipping companies and users in the downstream of the supply chain are customers.

(4)Complexity. The port service supply chain is composed by a great number of various types of enterprises, even in many states, so the composition of this relationship is very complex.

(5)Great difficulty in Integration. In the port service supply chain, the goal of each part is not consistent, which may trigger conflict inside. Shipping companies are in the pursuit of the shortest stay in port, while port enterprises seek for the rational allocation of port resources. Meanwhile, the discrepancy between the nodes of enterprises is relatively large, thus the integration of the port service supply chain seems very difficult.

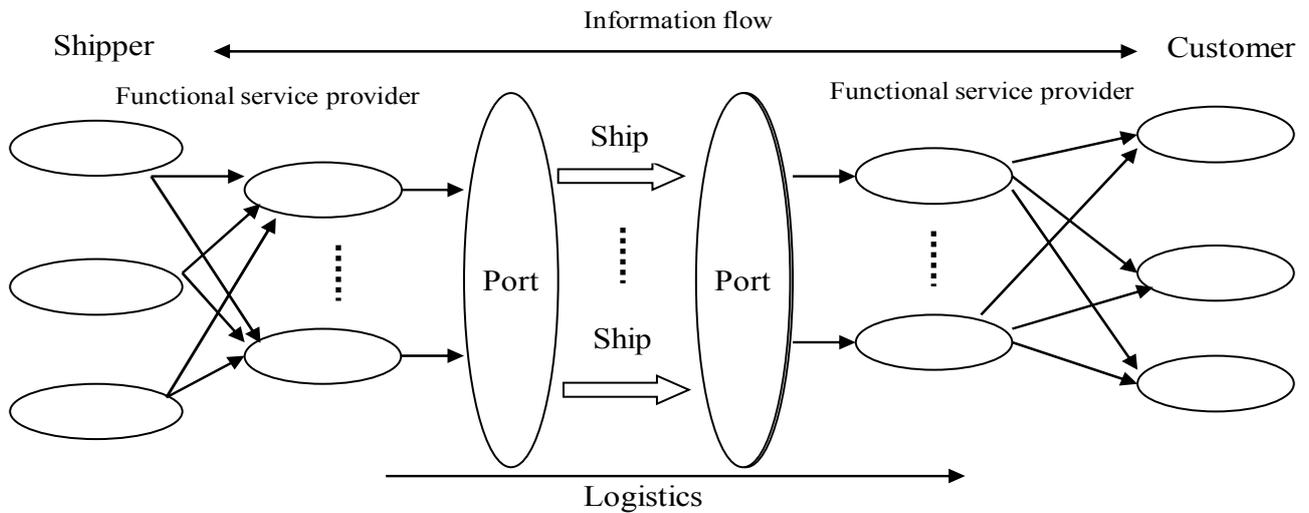


Fig. 1 Structure Model of port service supply chain

III. ELEMENT ANALYSIS OF THE COORDINATION OF PORT SERVICE SUPPLY CHAIN

According to the researches of domestic and foreign academicians on the service supply chain coordination, elements involved were summarized into ten points, such as logistics networks^[1], information sharing^[2,4,11], partnership^[3], price^[5], service capability^[7,8], interests distribution^[9], service efficiency^[10], service quality supervision^[12,13], flexible service^[14] and risks sharing^[15], etc.

The coordination of port service supply chain possesses not only general attributes of the service supply chain, but also its unique properties. And this article extracts the core elements in the coordination of port service supply chain through the questionnaire and the principal component analysis in order to provide evidence for the construction of the port service supply chain coordination mechanism. Being filled by the experts and scholars in the field of port logistics as well as enterprise managers, 215 out of 280 questionnaires were collected, and 207 of them maintained their validity. Principal component analysis to extract the

factor, Bartlett's Test of Sphericity as well as Kaiser-Meyer-Olkin, KMO were used to identify whether the items of variables are appropriate for factor analysis or not. First reliability test of questionnaire on the elements involved in port service supply chain coordination was brought into effect via software SPSS18 with the result that the Cronbach's Alpha coefficient was 0.768, which manifested the credibility of the questionnaire. Then the author carries forward the factor analysis, with the following results demonstrated in Table 1, table 2 and table 3.

In table 1, the KMO test's result is 0.798, bigger than 0.7, which is testified to be suitable for factor analysis. Bartlett's spherical degree test Sig. value is 0.000, indicating hypothesis rejection.

TABLE 1 KMO AND BARTLETT TEST RESULTS

Sufficient degree of Kaiser-Meyer-Olkin		.798
Bartlett Ball test	Approximate chi square	437.331
	df	66
	Sig.	.000

TABLE 2 LIST OF PRINCIPAL COMPONENTS

Components	Initial eigenvalue			Extraction square and loading			Rotating square and loading		
	total	variance %	accumulate %	total	variance %	accumulate %	total	variance %	accumulate %
1	4.839	41.566	41.566	4.84	41.566	41.566	4.58	38.173	38.173
2	3.254	25.240	66.806	3.25	25.240	66.806	2.89	24.047	62.220
3	2.452	17.615	84.421	2.45	17.615	84.421	2.66	22.201	84.421
4	1.018	7.940	92.361						
5	.337	2.405	94.766						
6	.262	1.871	96.637						
7	.154	1.192	97.829						
8	.098	.936	98.765						
9	.082	.756	99.521						
10	.065	.479	100.000						

In Table 2, we can find that the first principal component eigenvalues is 483.9; variance contribution rate is 41.566%; and the accumulative contribution of the first three principal components rate is 84.421%. According to the conditions of factor extraction, eigenvalue > 1, and this paper have selected three factors.

Table 3 displays the factor load matrix after rotation. Options less than 0.7 were discarded from the statistics

TABLE 3 THE FACTOR LOADING MATRIX AFTER ROTATION

	Elements		
	1	2	3
Service ability	0.874		
Logistics networks	0.838		
Price			
Information sharing	0.806		
Service efficiency			
Flexible service		0.769	
Interest distribution			0.731
Risk sharing			
Partnership			
Service quantity supervision		0.807	

As a consequence, through the factor analysis of coordination elements, the core elements of the port service supply chain are divided into service capacity, service quality and profit distribution.

IV. THE COORDINATION MECHANISM MODEL OF PORT SERVICE SUPPLY CHAIN

Mechanism indicates the coupling relationship for mutual connection and restriction among the internal organizations in the system. Besides, favorable mechanism is able to make the system be close to a self-adaptive state. In port service supply chain, the coordination mechanism refers to the process of generation and change of its coordination state.

According to the coordination of elements, the paper erects the coordination mechanism of port service supply chain, which is capable of coordinating port service supply

because here set point of threshold is 0.7. Finally six elements and three factors were sorted out. The former includes service capability, logistics network, information sharing, service supervision and control, flexible service and interest distribution. The port infrastructure, logistics network, information sharing can be summarized as service capacity, while flexible service, service supervision and control are concluded as service quality.

chain through operation of port service supply chain’s dynamic, transmission and guarantee mechanism, so as to attain the objectives of the reduction in the operating costs, the enhancement of service quality, the risk sharing, and the increase of the overall supply chain efficiency. The coordination mechanism model is presented in Fig. 2.

It can be read from figure 2 that there is a main line involved in the formation of coordination mechanism of port service supply chain, namely, ”dynamic mechanism → transmission mechanism → the formation of port service supply chain coordination → the generation of the coordination effect.” To be specific: the coordination mechanism of port service supply chain takes its shape on account of the promotion of port competitiveness. As intermediaries in port supply chain, service capability, service quality and the price generate the transmission mechanism. After the coordination of service capability and service quality supervision as well as profits distribution after gaming, members in port supply chain makes their rational determinations creating the intention of coordination of the port supply chain. Guarded by the guarantee mechanism, coordination of supply chain gradually approaches stable in the long run, which boost the members in the port service supply chain to enhance service quality, to reduce cost, to handle the risk and to increase income.

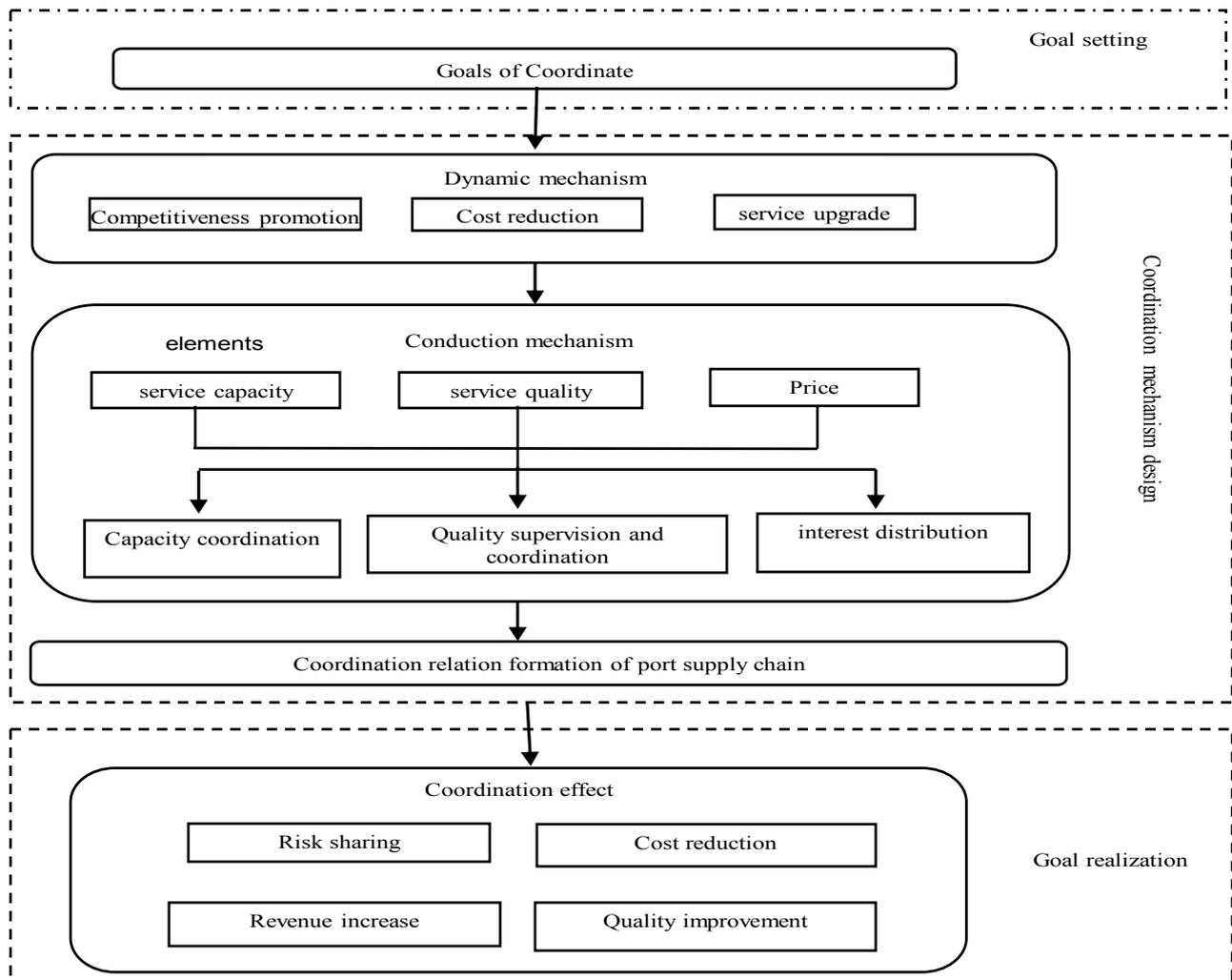


Fig. 2 The factors of port service supply chain coordination mechanism model

4.1 The dynamic mechanism of port service supply chain coordination

The formative impetus from port service supply chain coordination stems from the procedure that members in port supply chain seek for the coordination of port service supply chain. During this period, they gradually lay more trust on each other via transaction game and rational choices, so that the transaction cost will decrease with less uncertainty but closer partnership. As the two sides co-share the

coordination effect of port service supply chain, the desires of coordination between the two sides will be further enhanced. Constantly raising the degree of service quality, risk sharing, benefits sharing as well as port competitiveness, will eventually promote the establishment of port service supply chain coordination and the dynamic mechanism of coordination of port supply chain is demonstrated in Fig.3.

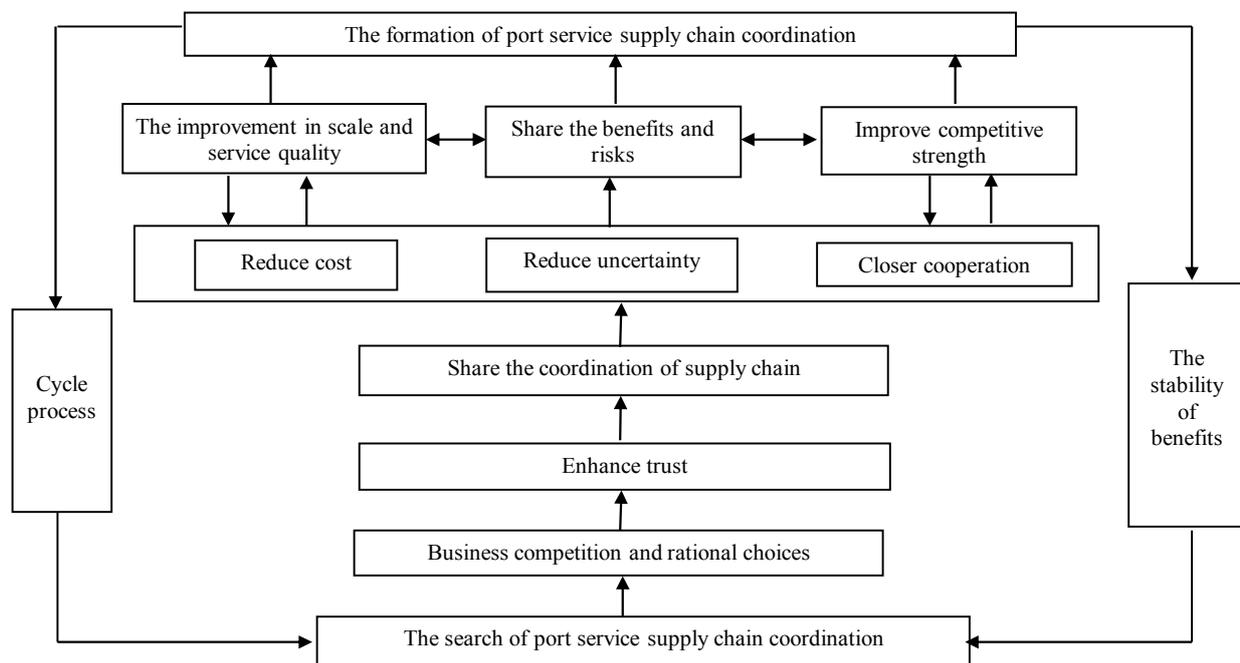


Fig. 3 Dynamic mechanism model of port service supply chain coordination

4.2 Transmission mechanism of port service supply chain coordination

The transmission mechanism of port service supply chain means driven by the pursuit of benefits, risk aversion and improvement of service quality, port service supply chain will develop supply chain coordination under the interactive influence of some coordination elements, comprising of service quality, service capacity and price, etc.

4.2.1 Transmission of the service capability collaboration

The base of port service supply chain coordination lies in service capability, affecting the effective operation of the former. Issues like the order quantity of service capability and matching of investment volumes in port supply chain will find their corresponding solutions by the coordination of service capability. When service capability reaches its coordination, its order quantity by port is in accordance with its investment volumes by logistic providers, thereby refraining from idle resources caused by over-investment on it or loss of opportunity due to the reverse situation.

4.2.2 Transmission of the service quality improvement

Service quality shows the subjective feeling that customers harbor toward the service process, reflecting what level the service arrives at and directly influencing customers' satisfaction. Port service quality is characterized by safety, punctuality, economy and efficiency. The methods and measurements adopted by port enterprises enable logistic service providers to increase the investment on logistic resources and to make ceaseless efforts to perfect service quality, so that the behaviors of the logistic service

providers are in consistent with the goal of the whole supply chain, promoting the coordination of port service supply chain. The former contains the supervision and control on service quality provided by logistic service providers, while the latter includes punishment, reward and monitoring.

4.2.3 Transmission of profits distribution

Prices exert an effect on specific decisions and movement of port as well as logistics service providers and finish their conduction by means of profits distribution. In the profits allocation of port service supply chain, rational distribution will be carried out between port enterprises and logistic service providers from the perspectives of fixed income, elements input and risk exposure. Hence prices can balance the benefit or loss of the members recruited in the supply chain, while prices stimulation mechanism should be employed to reward honest partners or to punish opportunists for the sake of realizing the coordinative behaviors of port service supply chain.

4.3 Guarantee mechanism of port service supply chain coordination

Under the drive of dynamic mechanism, port enterprises and logistics service providers coordinate their service capability and the quality of service, but still fail to guarantee the stable development of port service supply chain coordination in the long run, therefore, the need of guarantee mechanism emerges. Port enterprises take a series of incentives and constraints against logistics service providers to insure the achievement of the coordination of port service supply chain.

4.3.1 Incentives

Port enterprises put fair, feasible and stable incentives on logistics service providers into effect to ensure the establishment of port service supply chain coordination. When high quality service supplied by logistics service providers in accordance with the contract, both material and spiritual rewards will be garnered by logistic service providers from port enterprises, The former principally indicates technical support, financial backing and the maintenance of long-term partnership; while the latter refers to appreciation and publicity in port supply chain which is designed to trigger a "demonstration effect" to other logistic providers.

4.3.2 Constraints

Constraint refers to the standards and restrictions that port enterprises impose on logistics service providers aiming at the prevention of violating rules by logistics service providers. Both incentives and constraints adopted by port enterprises should be implemented on logistic service providers. When logistics service providers breach the contracts, their excess earnings are expected to be less than their default loss, so as to fulfill the goal of port service supply chain coordination.

To sum up, the formation and development of port service supply chain coordination is a process of deduction, resulted by synthetic function of dynamic, transmission and guarantee mechanism. Thanks to mutual promotion and mutual coordination, these three mechanisms co-accomplish the coordinating effect of port service supply chain.

V. CONCLUSION

This paper is probed into the problem in the coordination of port service supply chain, drawing a conclusion that the kernels of the coordination of port service supply chain are service capacities, service quality and price via an analysis of the coordination elements of port service supply chain. In light of the result, the author builds a model of the coordination mechanism of port service supply chain and takes advantage of efficacious coordination among dynamic, transmission and guarantee mechanism to accelerate the coordination of port service supply chain.

In this paper, we study the qualitative model of the coordination of port service supply chain instead of quantitative analysis and thus, there are some limitations. How to coordinate port service supply chain through service capability, service quality and profits distribution is in need

of a modeled and simulated analysis, which will be further discussed in the future.

ACKNOWLEDGMENT

This work is supported by the Natural Science Foundation of Zhejiang Province (Grant: Y17G010025).

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