

An Empirical study on improvement of operation for feeder vessel route between Busan and west coast of Japan

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Abstract : In this paper, practical problems for current feeder service between Busan port and west coast of Japan were extracted through in depth interviews with Japanese feeder vessel companies, shippers, and port authority based upon which major criteria (elements) for improvement of the feeder network are structured in hierarchic order and weighed relative importance through AHP method. From the questionnaire answered by Korean and Japanese port users and experts the weights of criteria were calculated and the shipping service was ranked the first by both parties with 0.235 and 0.217, respectively. The port service and support system ranked the second and the third, whereas the port marketing was shown to be the lowest of all.

Considering the overall weights, the increase in a port loading and unloading speed of port service was followed by provision of dedicated deck for feeder vessel of port facilities for Korean respondents. Therefore, speed up of the port operations and providing docks for feeder vessel are to be firstly provided for more efficient feeder operations, which would be the basis for the construction of optimal transportation network.

Key words : Feeder vessel operation, AHP, cargo transshipment, feeder network, Busan Port

1. Introduction

As of 2010, the overall feeder service on Busan - Japan sea routes are being operated by 13 shipping companies with a total of 62 vessels in about 60 ports in Japan and 6 ports in Korea including Busan and In-Cheon. The cargo volume has been increased by 3.8% on average from the year 2000 to 2010 during which the import and export were up by 6.5% and 1.9%, respectively on average. However, in the year 2008 alone, the cargo volume was 602,883 TEU down by 2.6% compared to the previous year. Types of container cargo between Busan and West Coast of Japan feeder vessel routes consist of dry(91.1%), reefer(3.6%), less than container load(3.7%), flat rack(0.9%), open top(0.8).

For the research, we conducted in-depth interviews with port authority, shippers, shipping companies, and port experts in Japan to extract existing problems on feeder operations between Busan port and west coast of Japan, and based upon the results the AHP (Analytic Hierarchy Process) method was implemented to calculate the

importance of each factor for the improvement of feeder service.

Chou(2010) used AHP method to choose an optimal port based on the influential factors with their relative weights. Brian(1985) applied 11 factors to select the optimal port including inland freight rates and inter model links as well as the port related factors such as port size, security, equipment, and congestion. James and Gail(1988) said that the frequency of shipping service was a main factor for the selection of ports in cargo transportation. Thomson (1998) provided 7 critical factors for transshipment port, which are length of berthing time, loading/unloading rate, number of berths, quantity of cargo, port facility, links to major customer markets, and port working hours. Sternberg (2000) pointed out that geographical location, flexibility of process, continuous investment, and related business are the key factors for the transshipment port. Baek(2008) selected the transshipment port among 5 international ports in Korea, Japan, and China using the relative importance of factors through AHP method. Cho et al (2003) described a

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comprehensive research works for decision making problem modeled in AHP formulations.

In this paper, we extract the existing problems through interviews with Japanese port related experts and operators. Secondly, based upon the results from the interviews essential factors are organized in hierarchic order for the improvement of feeder networks and use the AHP method to determine relative importance among the factors. The analysis of the AHP results and possible implementations are discussed. Finally, conclusion of the research is summarized.

2. Priority of major factors through AHP method

The AHP proposed by Satty (1980) has been widely used for multi criteria decision making problems, which breaks down the whole problem into factors (elements) in a simplified hierarchical manner and usually the bottom level represents the list of alternatives to be selected.

The general steps for the AHP are as follows:

- (1) Define the objective and set up the decision hierarchy starting from the top level through the intermediate levels to the lowest level in a hierarchic order
- (2) Perform pair-wise comparison of elements usually on a 1-9 point scale to represent the dominance of one element over the other for each of the levels
- (3) Calculate the relative importance(weight) of each element using eigenvectors
- (4) Finally, aggregate the relative weights to rate the overall alternatives for decision making

For the selection of the impeding factors which prevent Busan port from attractive consideration, interviews with Japanese feeder vessel companies, shippers, forwarders and port authority were conducted over the period from April to June, 2009. The results of the interview are summarized as follows:

- For shipping companies: the major problems are imbalance between export and import of the cargo volume and connecting schedule conflicts with mother vessel.
- For forwarders : wage dumping among forwarders to secure supply and reduction in profit due to the competition with the ocean shipping companies are two critical problems.
- For port authority: there are difficulties of quantifying the competitiveness of Busan port over other ports in Japan such as Tokyo, Nagoya, and Osaka to which the

cargo is delivered from the west coast of Japan.

- For shippers : the uncertainty in lead time, greater possibility of cargo breakage, tardiness, inaccuracy of information for transshipment cargo, and paying additional costs for using ODCY(Off Dock Container Yard) are unfavorable factors

Considering the results drawn from interviews and the opinions of experts the following hierarchy of 6 major criteria (support system, port marketing, port service, port facilities, information service for shipping and port system, and shipping service) and corresponding sub criteria for each criterion are constructed as shown in <Fig. 1>.

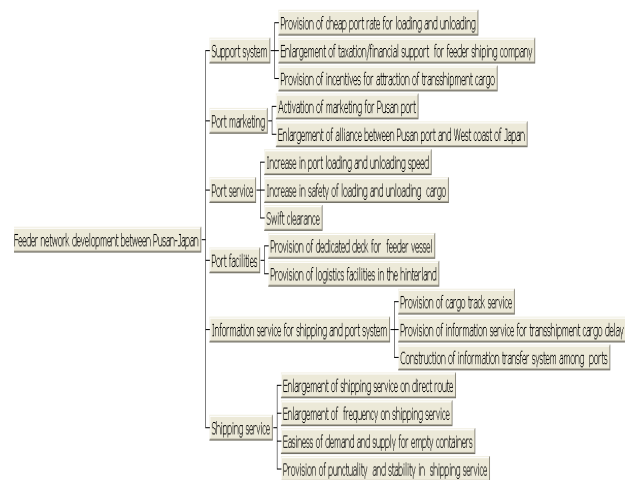


Fig. 1 The hierarchy of criteria with 2 levels

For the calculation of the relative importance of each factor, a survey questionnaire was distributed to the major shipping companies, shippers, logistics companies in the port related industry, and researchers in organizations. Among the 45 domestic (Busan) respondents 32 was used for analysis (see<Table1>).

Table 1 Characteristic of domestic respondents

Type of expert group	Distributed	Responded	Response rates
Academic and research institutions	7	7	100 %
Government agencies	7	5	71.4 %
Maritime-related business	17	12	70.6 %
Port and logistics-related businesses	13	8	61.5 %
Total	45	32	71.1 %

The same number of questionnaire was sent out to the Japanese counterpart and 35 was used for analysis (see <table 2>).

Table 2 Characteristic of Japanese respondents

Type of expert group	Distributed	Responded	Response rates
Maritime, ports and logistics related companies	25	21	84 %
Government agencies	5	3	60 %
Other related companies	15	11	73.3 %
Total	45	35	77.8 %

3. Calculation of weights through AHP

3.1. For domestic (Busan)case

(1) Weights of 6 major criteria in level 1

The weights of 6 major criteria in level 1 is obtained using the Expert choice software for AHP, where shipping service was ranked the first for the improvement of feeder service with the weight of 0.235 followed by port service(0.214), support system(0.166), port facilities(0.162), information service for shipping and port system(0.112), and port marketing(0.110). The result of each weighting is given in the following <Fig. 2>

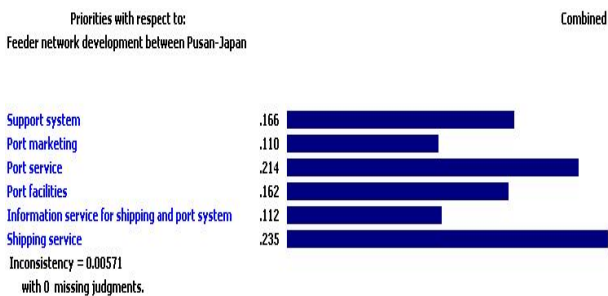


Fig. 2 Weights of 6 major criteria

(2) Weights of sub criteria (for each criterion) in level 2

1) For shipping service

Among the 4 sub criteria under the shipping service, the provision of punctuality and stability is ranked the highest with 0.355, whereas the easiness of demand and supply of

empty container marked the lowest weight with 0.135.

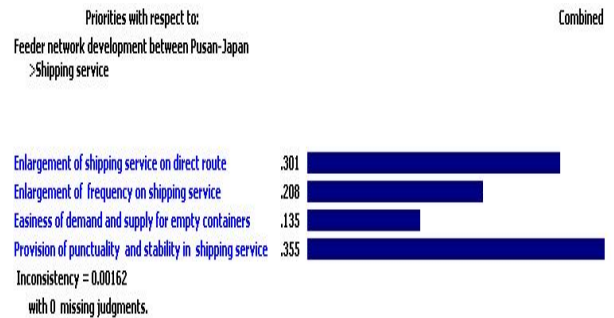


Fig. 3 Weights of sub criteria under shipping service

2) For port facilities

Provision of dedicated deck for feeder vessel and provision of logistics facilities in the hinterland were weighed 0.551 and 0.449, respectively.

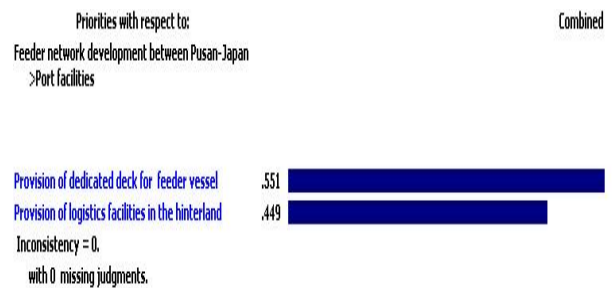


Fig. 4 Weights of sub criteria under port facilities

3) For port service

Among the 3 sub criteria, the loading/unloading speed and clearance are shown to be the first two important elements with 0.472 and 0.328 of weights, respectively.

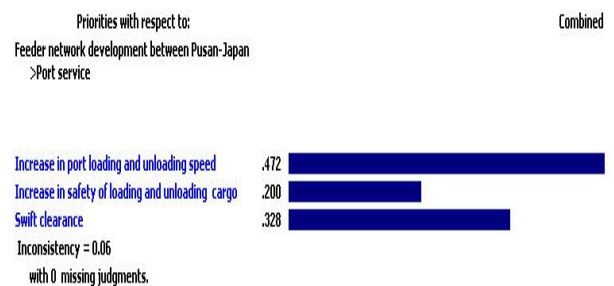


Fig. 5 Weights of sub criteria under port service

4) For port marketing

Port marketing activation and alliance are weighed 0.539 and 0.461, respectively.

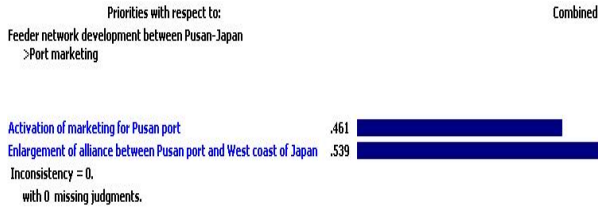


Fig. 6 Weights of sub criteria under port marketing

5) For information service for shipping and port system
 The cargo track service was given the top priority of 0.420 over the other two elements, i.e. the information service for transshipment delay (0.238) and information transfer system among ports(0.342),

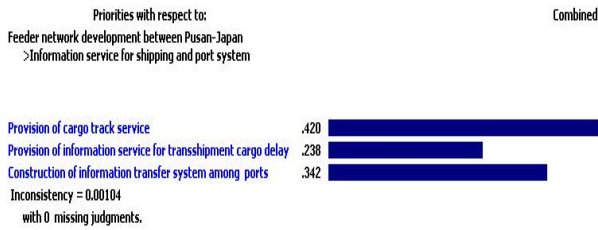


Fig. 7 Weights of sub criteria under information service for shipping and port system

6) For support system
 The 3 elements are almost of equal importance with the taxation/financial support for feeder shipping company having the highest weight of 0.340 followed by cheap port rate(0.334) and incentives for attraction of transshipment cargo(0.326).

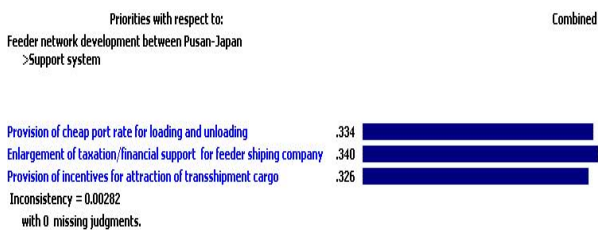


Fig. 8 Weights of sub criteria under support system

3.2. For Japanese counterpart

For the criteria in level 1, the shipping service(0.217) ranked first followed by port service(0.202), support system(0.190), information service for shipping and port system(0.160), port facilities(0.125), and port marketing (0.106). For each criterion the corresponding weights of sub criteria in level 2 is summarized in Appendix.

3.3. Comparison of weights for both parties

The differences of priorities for the major criteria are represented in <Table 3> below.

Table 3 Comparison of priorities for major criteria

Criteria	priority	
	Busan	Japan
Shipping service	0.235	0.217
Port facilities	0.162	0.125
Port service	0.214	0.202
Port marketing	0.110	0.106
information service for shipping and port system	0.112	0.160
Support system	0.166	0.190

Combining both the criteria in level 1 and sub criteria in level 2, the overall weights and ranks for sub criteria are summarized and compared in the following <Table 4>.

Table 4 The overall weights and ranks for sub criteria

Criteria	Sub criteria	Overall weight		Rank	
		Busan	Japan	Busan	Japan
Shipping service	Enlargement of shipping service on direct route	0.071	0.047	5	14
	Enlargement of frequency on shipping service	0.049	0.050	12	13
	Easiness of demand and supply for empty containers	0.032	0.030	16	17
	Provision of punctuality and stability in shipping service	0.083	0.089	3	1
Port facilities	Provision of dedicated deck for feeder vessel	0.089	0.053	2	10
	Provision of logistics facilities in the hinterland	0.073	0.072	4	4
Port service	Increase in port loading and unloading speed	0.101	0.059	1	8
	Increase in safety of loading and unloading cargo	0.043	0.063	14	7
	Swift clearance	0.070	0.080	6	2
Port marketing	Activation of marketing for Busan port	0.051	0.037	11	16
	Enlargement of alliance between Busan port and West coast of Japan	0.059	0.069	7	6

Information service for shipping and port system	Provision of cargo track service	0.047	0.070	13	5
	Provision of information service for transshipment cargo delay	0.027	0.053	17	11
	Construction of information transfer system among ports	0.038	0.038	15	15
Support system	Enlargement of taxation/financial support for feeder shipping company	0.056	0.057	8	9
	Provision of incentives for attraction of transshipment cargo	0.054	0.053	10	12
	Provision of cheap port rate for loading and unloading	0.055	0.079	9	3

4. Results of analysis

Based upon the AHP analysis, the followings are obtained. Among the major factors, shipping service was the most important criterion and port marketing was the least important factor for both parties. For the sub criteria, increase in loading and unloading speed was ranked first for Korean respondents, whereas the provision of punctuality and stability was the first factor for Japanese correspondents. The provision of information service for transshipment cargo delay and easiness of demand supply for empty containers were the lowest for both parties, respectively.

Korean respondents consider container handling speed, dedicated terminal for feeder vessels, and punctuality of shipping service to be the most important factors to improve feeder operations between Busan and west coast of Japan. On the other hand, Japanese respondents, point out punctuality of shipping service, swift clearance, and lowered port handling charge as important factors to enhance the present feeder services.

Therefore, to improve feeder vessel operations between Busan and west coast of Japan, port of Busan needs to provide dedicated terminal for feeder vessels, whereas the port operators provide reduced cargo handling time. Shipping company should provide on time shipping service. West coast of Japan ports should provide swift clearance by improving their customs procedures and to reduce

shippers' logistics costs, port handling charge has to be reduced by institutionalization.

5. Conclusion

The overall feeder service on Busan - Japan sea routes are being operated by 13 shipping companies with a total of 62 vessels in about 60 ports in Japan and 6 ports in Korea including Busan and In-Cheon, and the importance of feeder network has been increased to become a successful port. In the study, practical problems for current feeder service between Busan port and west coast of Japan were extracted through in depth interviews with Japanese and Korean feeder vessel companies, shippers, and port authority based upon which major criteria (elements), for improvement of the feeder network are structured in hierarchic order and weighed relative importance through AHP method. From the questionnaire answered by Korean and Japanese port users and experts the weights of criteria were calculated and the shipping service was ranked the first by both parties with 0.235 and 0.217, respectively. The port service and support system ranked the second and the third, whereas the port marketing was shown to be the lowest of all.

Especially, the increase in a port loading and unloading speed and the provision of dedicated deck for feeder vessel were found to be the most important sub criteria for Korean respondents. Therefore, efficient operations in port activities and providing dedicated feeder vessel docks need to be firstly provided for more efficient feeder operations, which would be the basis for the construction of optimal transportation network. Considering the dramatic changes in maritime operations among ports and vessels the criteria drawn from the interviews and opinions of both parties would be greatly meaningful for the decision makers in more efficient feeder operations. Future research will be focused more on the strategic implementation of the current results.

Acknowledgement

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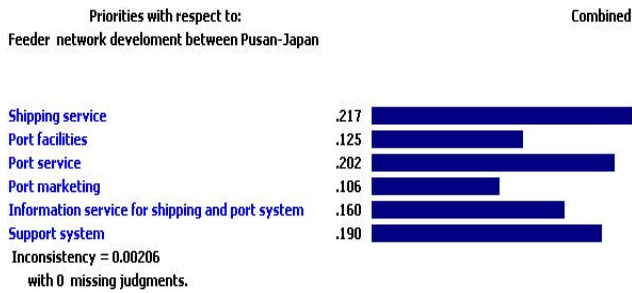
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Appendix

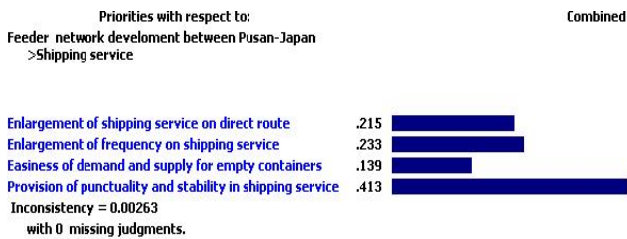
The followings are the weights for Japanese counterpart.

1. Weights for 6 major criteria

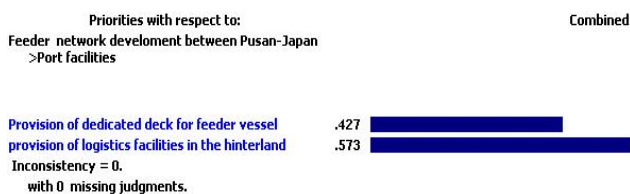


2. Weights for sub criteria under each major criterion

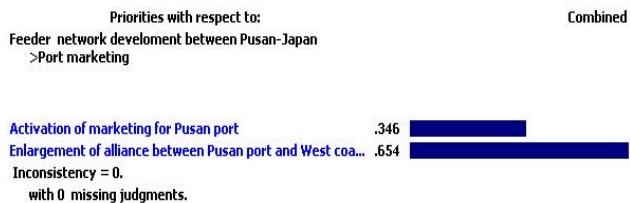
(1) For shipping service



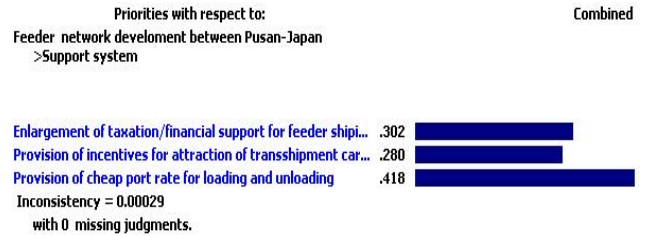
(2) For port facilities



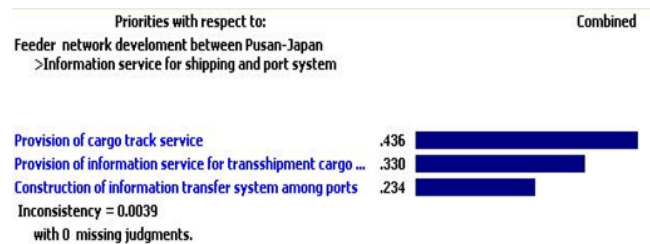
(3) For port marketing



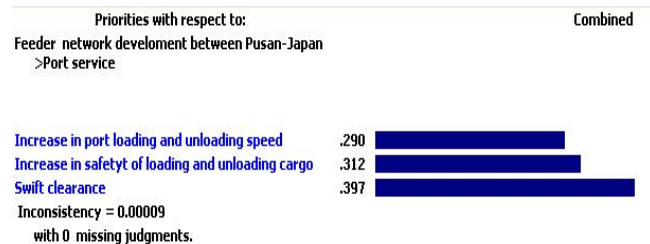
(4) For support system



(5) For Information service for shipping and port system



(6) For Port service



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