An analysis of shippers' port choice behavior in Chubu region, Japan- social network analysis technique

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Understanding the behaviors of shippers for seaport selection is crucial for economic development of any country. This paper attempts to identify the factors influencing to shippers' choices considering companies' characteristics and reasons for them for choosing a seaport for foreign trade. The analysis is performed using Social Network Analysis technique (SNA) to analyze a case study of port selection behavior of shippers in Chubu region, Japan. The analysis results demonstrate that service quality of the port is another important factor besides the distance for companies while selecting seaports.

Key Words : Social Network Analysis, Logistics.

1. INTRODUCTION

International freight businesses are occupying the large parts of Japanese economy. Especially Chubu region is home the most important industries in Japan. Nagoya port located in the Chubu region is one of the most important ports in Japan in which it ranks for the second of the country by the total volume of cargos import and export. Recently, the Japanese government has launched a plan to increase the country's potential for international trade, the government has appointed Nagoya and Yokkaichi ports to serve as the major international ports for the Chubu region[1]. However, comparing between the two ports, the capacity of Yokkaichi port is far behind one of the Nagoya port. In addition, Nagoya port has recently reached to its capacity. There have been several discussions on what kind of measures and policies for coping with the situation; however, at present there still yet reach to the conclusion. This study therefore attempts to find the possibility to increase the share of Yokkaichi port in which the port still remain spaces for the improvement.

In this study, we analyze the shippers' behavior on their decisions on selecting seaports considering several factors and shippers' attributes. The analysis was performed using social network analysis (SNA) technique in order to understand the characteristics and their relationships of the shippers' decision on the port selection between the two ports.

The next section provides present situation of both seaports. Section 3 presents methodology and analysis results. Section 4 discusses policies and measures suggested based on the findings. The last section

provides conclusion and recommendation on the study.

2. PRESENT SITUATION OF NAGOYA AND YOKKAICHI PORTS

From the nationwide flow survey of import-export cargos collected by the regional MLIT in 2003, cargos generated and attracted to Mie Prefecture through its nearest port (Yokkaichi port) share only less than 30 percent of the total volumes. This figure demonstrates that the closest distance is not necessarily the only key factor for shippers to choose the port for their international cargos. Kakita and Hideshima [2] conducted a survey about port selection for companies in Chubu region. Seaports located in Chubu region include, for example, Nagoya, Yokkaichi, Mikawa, and Shimizu Ports. Again, the result from the survey in 2006 confirmed that only 17 companies from the total 228 shippers who answered the questionnaires chose Yokkaichi Port for their choices. Recently, the MLIT-Chubu regional bureau, once again conducted another survey to collect the present situation of the international cargos in the region. This study utilizes the present data set for an analysis. Among 2,616 companies, there are 866 companies answered the questionnaires. There are totally 437 shippers related with the foreign trade among all the companies surveyed. Among this number, there are 319, 46, 49, and the remaining 23 shippers who are using Nagoya, Yokkaichi, Osaka, and other ports respectively.

The reasons for choosing port is listed as follows:
1. Access distance is short so that transport cost is cheap
2. Access is convenience so that access time is short
3. Port is close to stock point
4. The currently using route is provided by the port
5. Many numbers of service routes
6. Route and carrier are fixed
7. Port service fee is cheap
8. Port service is convinient
9. Good carriers in the port
10. Logistics facilities are provided
11. Fix by customer
12. Fix by head office
13. Possible for mix cargos
14. Already use for many years
15. Port commercial
16. Others

Figures 1 and 2 presented the reasons for companies to choose Nagoya and Yokkaichi ports for their international trades categorized by location of the shippers in each prefecture in Chubu region. Figure 1 demonstrates that 62.7 percent of shippers select Nagoya port because of the shortest distance so that the transportation cost is the cheapest. However, when comparing the different locations of the shippers, the shortest distance is not always the most important factor. The other reasons such as "There are shipping line services that the companies want to use", "There is more numbers of operated routes", "Access to the port is convenience so that the access time to the port is the shortest", "The port is decided by the customer", and so on.
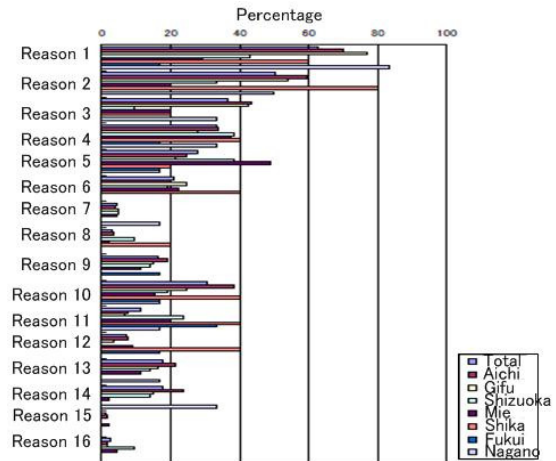

Fig. 1 Reasons for choosing Nagoya Port by location of shippers

Figures 2 for Yokkaichi port, companies mostly select the port because of the shortest distance to the port. The number is corresponding to 87 percent; especially for the companies located in Aichi and Mie prefectures. At this point, we can conclude that companies located in the same prefecture to the port will choose the port that is the closest, while the companies in the other prefectures will choose the ports by their services (such as number of operation routes, facilities, and so on).
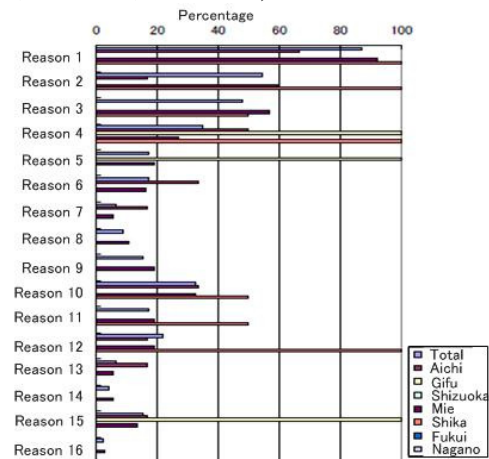

Fig. 2 Reasons for choosing Yokkaichi Port by location of shippers

However, if we look at the reasons other than distance, some reasons related to the volume of the shipments. For example, when the shipments are needed to be consolidated, the reasons for choosing became complicated such as who is the decision maker (eg. head office, branch office, or customer), how is the service scope of the carrier and etc. From this point of view, to ship some of the users from Nagoya port to Yokkaichi port; it is suggested to improve the service quality of the port instead of putting large investment for the access roads to the port.

3. METHODOLOGY

Social Network Analysis (SNA) is a method to analyse the relationships (called links) among a set of actors (called nodes). The analysis of links and nodes assists ones understanding of the structure of the entire network[3].

SNA is selected for analysis of the relationship among the reasons and among shippers themselves to choose the ports for their operation. We analyze three characteristics:
(1) Similarity among shippers.
(2) Relationship between reasons for port selection, decision makers, and type of businesses.
(3) Relationship between the reasons for port selection.

(1) Similarity among shippers.

Shippers using Nagoya or Yokkaichi ports are listed in row with their answers for the reasons for choosing the ports, given 16 reasons in the questionnaire listed in column as shown in Table 1.

Table 1 Constructing matrix for shippers and the reasons for port selection

		Reasons															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Shippers	1	1	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0
	2	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	3	0	0	1	1	1	0	1	1	1	0	0	0	0	0	0	0

In case that a shipper selects the reason, we value one to the cell and zero for otherwise. A shipper can choose many reasons. This table is rewritten into a matrix (Matrix A) presented in Figure 3. Different matrices are constructed for each of the ports. To analyze the similarity, we transpose Matrix A (A^T) and multiply the transpose matrix back to Matrix A ($A \cdot A^T$). Next, the cell values are sorted in descending order as shown as Matrix B in Figure 3.
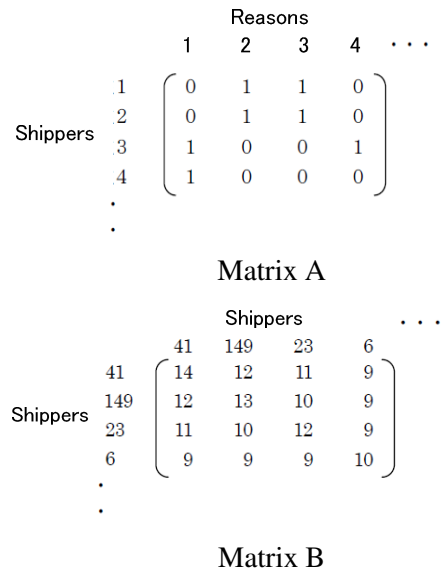
Figure 3. Matrices A and B for analysis of the similarity among shippers

From the analysis results, we understand that shippers using Nagoya port headquarter their manufactures in Aichi prefecture (the prefecture where the port is located). While, shippers using Yokkaichi port have their branch manufactures in Mie prefecture (the prefecture where the port is located). The results confirm that shippers are mainly choosing the port having the closest distance to their places. When considering the logistics characteristics, the deliveries are performed mainly by carriers in which it accounts as much as 91 percent of Nagoya port users and 96 percent of Yokkaichi port users.

At this time, there are 319 shippers using Nagoya port; this gives the number of combinations to 50,721 cases. In the same way for Yokkaichi port, the number of combinations is 1035 cases. Among the cases, we rank the cases those shippers having the same answers for the reasons for choosing port into three ranks shown in Table 2. Ranks 2 and 3 which mean high similarity among shippers are having very small numbers of cases. This implies that there is less similarity in characteristics related to the selection behavior among the shippers.

Table 2 Ranking of the number of cases that shippers share the same reasons

(a) Nagoya Port

Rank	Number of same answers	Number of cases	Percentage
1	0～5	50,325	99.2%
2	6～10	393	0.8%
3	11～15	3	0.0%
Total		50,721	

(b) Yokka-ichi Port

Rank	Number of same answers	Number of cases	Percentage
1	0～5	1,023	98.8%
2	6～10	12	1.2%
3	11～15	0	0.0%
Total		1,035	

(2) Relationship between reasons for port selection, the decision makers, and type of businesses.

Next, we analyze the relationship for the reason for port selection with the type of business, type of office, and type of decision maker. The relationship matrix is constructed based on the information in Table 3, given 1 for each type of the offices, business types, and decision makers and 0 for otherwise. Matrix C is constructed from information in Table 3.

Table 3. Constructing matrix for analysis of shippers' attributes and the factors

Shippers	Office type		Business type			Decision Maker						Reasons															
	Head Office	Branch Office	Manufacturers	Wholesalers	Others	1. Head office	2. Branch office	3. Customer	4. Carrier	5. Receiver or forwarder	6. Other	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	1	0	0	0	1	0	0	1	0	0	0	1	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0
2	0	1	1	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0
3	0	1	0	1	0	0	0	0	1	0	0	0	0	1	1	1	0	1	1	1	0	0	0	0	0	0	0

After multiplying the matrix with its transposed value (C*C^T) and ranking the cell values in descending order. The results demonstrate that 146 companies from the total 319 companies (46 percent) for Nagoya port and 12 companies from the total 46 companies (26 percent) are deciding the port by themselves. These relatively high percentages imply the high possibility for companies to change the port. From this point of view, the government is suggested to implement some measures directly to shippers to attract more numbers of users to the port.

In addition, shippers using Nagoya port are choosing port by themselves and are paying attention mostly on the distance and travel time from their places to the port. This is the same for shippers using Yokkaichi port. Therefore, in order to shift some share from Nagoya port users to Yokkaichi port, it is important to implement measures to increase accessibility to Yokkaichi port and at the same time better not to increase transport cost.

(3) Relationship between the reasons for port selection.

This analysis is performed in order to grasp the relationship between the reasons since many companies selected many reasons to support their choices. The relationship is presented in Tables 4 and 5.

Table 4 The relationship between the reasons for choosing port for Nagoya port

Reasons	1	2	3	4	10	5
1	1.00	0.87	0.59	0.55	0.47	0.43
2	0.87	0.77	0.52	0.49	0.41	0.38
3	0.59	0.52	0.41	0.35	0.28	0.28
4	0.55	0.49	0.35	0.38	0.28	0.30
10	0.47	0.41	0.28	0.28	0.28	0.23
5	0.43	0.38	0.28	0.30	0.23	0.26
6	0.31	0.27	0.19	0.20	0.17	0.16
13	0.28	0.24	0.17	0.18	0.15	0.14
9	0.27	0.24	0.17	0.17	0.15	0.14
14	0.25	0.23	0.16	0.15	0.14	0.12
11	0.10	0.09	0.06	0.07	0.06	0.05
12	0.09	0.08	0.06	0.06	0.05	0.05
7	0.08	0.07	0.05	0.05	0.04	0.04
8	0.06	0.06	0.04	0.04	0.03	0.04
15	0.03	0.02	0.02	0.02	0.01	0.01
16	0.01	0.01	0.01	0.01	0.00	0.01

Table 5 The relationship between the reasons for choosing port for Osaka and Kobe ports

Reasons	5	4	10	1	2	13
5	1.00	0.89	0.57	0.38	0.40	0.37
4	0.89	0.90	0.52	0.33	0.33	0.34
10	0.57	0.52	0.42	0.25	0.24	0.25
1	0.38	0.33	0.25	0.31	0.25	0.19
2	0.40	0.33	0.24	0.25	0.28	0.17
13	0.37	0.34	0.25	0.19	0.17	0.19
6	0.38	0.36	0.24	0.15	0.13	0.15
14	0.32	0.30	0.22	0.15	0.16	0.15
9	0.32	0.30	0.21	0.15	0.15	0.14
11	0.21	0.20	0.17	0.13	0.11	0.12
12	0.18	0.20	0.13	0.07	0.06	0.08
3	0.14	0.12	0.09	0.07	0.07	0.05
8	0.12	0.11	0.09	0.07	0.07	0.06
7	0.04	0.04	0.02	0.03	0.02	0.02
16	0.01	0.02	0.01	0.00	0.00	0.01
15	0.01	0.00	0.00	0.01	0.01	0.00

From the results, Nagoya port is selected because of its close distance to companies in the region causing cheap cost for delivery. In addition, it has good accessibility so that the access time is short. The reasons are different for Osaka and Kobe ports; in this case this port is selected due to its many numbers of

service routes. Therefore, in the case that port providing many number of shipping line services, it is possible to win over other ports those are located in the close distance.

4. DISCUSSION

In order to attract more users to Yokkaichi port, it is important to not only simply consider measures to build more roads but also to improve services for shipping route and logistics facilities. We suggest also preparing expressway to increase accessibility to the port that will reduce access time. At the same time, since transport cost is also important, the government should prepare a policy to support to reduce the transportation cost as well. MLIT recently has planned to develop this region to serve as a logistics hub. For Yokkaichi port, there is a plan to prepare the port for an intermediate stock point. Service level of the port is one of the most important factors. Therefore, it is necessary to prepare port workers to be ready for such improvement by, for example, providing training for terminal operators.

5. CONCLUSION

This paper has presented the analysis of the factors for shippers to select port for their foreign trade. The analysis is performed using social network analysis method by constructing a network of the shippers with their characteristics and factors for them to choose the port. The analysis results suggest that only implementation of costly measures by building more access roads is not enough to attract more users to the port. It is important as well to implement other incentives to improve service quality of the port by for example increase number of shipping line services, improve access time, etc. In addition, as the government has planned to upgrade the ports to serve as a logistics hub, it is very important to prepare good human resource to be ready for such operations.

REFERENCES

1) Website of central japan international port (http://www.pa.cbr.mlit.go.jp/centralport/)
2) Kakita and Hideshima. A Study on Policies for Seaport using Social Network Analysis. *Studies in Regional Science* Vol. 40, No.2, Japan Section of the Regional Science Association, pp. 437-448, 2001. (Japanese)
3) Yasuda Y. Network Analysis-Thoery and Methods. Shin-You-Sha Co., 2003. (Japanese).