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SNA Approach for Analyzing the Research Trend of International Port Competition*

Jun Woo JEON^a, Ying WANG^b, Gi Tae YEO^c

^a Ph.D. Candidate, Incheon National University, Korea, E-mail: jwjeon@inu.ac.kr (First Author)

^b Assistant Professor, Yantai University, China, E-mail: yingmickey@163.com

^c Professor, Incheon National University, Korea, E-mail: ktyeo@inu.ac.kr (Corresponding Author)

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ABSTRACT

Although port competition is changing continually in various environments, no research trend analyses of port competition have been carried out. Instead, prior studies have focused on ports gaining a competitive advantage or the development strategies of ports, this study analyses the research trends in port competition using a Social Network Analysis (SNA). We build the network using keywords from existing academic papers on port competition. By visualizing divisions by generation, studies in the first period (1980–1999) focused mainly on keywords such as “port competition” and “competitiveness.” Then, in the second period (2000–2007), the trends shifted to include “port competition” “China” “container port” and “Hong Kong” which became central in the network. The most drastic change occurred in the third period (2008–2015), where, in addition to “port competition,” the central point of the network also included “cooperation” and “supply chain”. The results of the analysis using the high central value of SNA method indicate that the focus of research on port competition ranges from one dedicated region to globalization. This can help researchers understand the research trend of port competition from an academic viewpoint.

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1. Introduction

Port competition has become fiercer in recent years for the rising of international trade, the concentration of the shipping industry, and the liberalization of transport markets (Meersman and Van de Voorde, 2002). Larger-sized vessel tendency, the improvement of port infrastructure, and the increasing scale of shipping companies may heighten competition

among ports in a region, even in one country. Therefore, cooperation among adjacent container ports might be a strategic option to decrease competition strength for port and shipping liners in order to carry on in the ever-increasing competitive environment (Avery, 2000). Furthermore, the property of port competition has changed from provide high quality port

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services solitary to draw integration and fit into door-to-door supply chains (De Langen, 2007). These changes in the environment have meant that national port authorities have begun to aggressively seek the new management strategy of co-opetition in order to achieve competitive advantage in the increasingly competitive environment (Gatrell et al., 2006).

Despite the level of port competition in the rapidly changing environment, there are no research trend analyses of this competition. Thus, to fill this gap, this study analyses the research trends in port competition using a social network analysis (SNA). We build a network using keywords presented in academic papers on port competition. By visualizing the divisions by generation, it is possible to observe the research trends in the competition among the world's ports. It is important to understand the network data and to convey the result of the analysis.

This paper is divided into five parts. Following the introduction, the second section provides a literature review on the keywords for port competition. The third section reviews the proposed methodology SNA. Analysis and findings are suggested in the fourth section and the final section of the paper provides suggestions, conclusions, and future research opportunities with respect to this study.

2. Port Competition Studies and Research Flow

2.1. Previous studies about port competition

One of the first studies on port competition was that of Slack (1985), who explored the key criteria in the port selection process and port competition among shippers. The findings suggested that price and service were key criteria, but that port infrastructure was not. Additionally, He addressed the importance of containerization in promoting the development of international trade and increasing port volumes.

Since the study of Slack (1985) and with the increase in ocean traffic, increasing numbers of studies have focused on port competition (Fleming, 1989; Hoyle and Charlier, 1995; Kreukels and Wever, 1996; Heaver, et al., 2000; Cao et al., 2004; Hao, 2007; Chang et al., 2008; Lam and Yap, 2011; Silva and Rocha, 2012; Bae et al., 2013; Do, et al., 2015). Table 1 summarizes some recent representative studies on port competition. Note that the keywords are also included in the table in order to illustrate the key study content.

Hayuth (1991) studied the advantages of port development from the perspective of transportation. He proposed the importance of intermodality to increase the connectivity of shipping and inland transportation. Heaver (1995) found that the port policy of the government and the management skill of port operators were key criteria in terms of being competitive. Song (2002) studied the competitive relationship between Hong Kong and ports in South China, and indicated that cooperation is an efficient strategy to avoid vicious competition among ports. According to this strategy, ports handle different kinds of goods, considering the supply of goods over short distances, and cooperate/share shipping lines in order to achieve common development. De Langen (2007) indicated that only ports with strong and broad hinterland supply lines could remain competitive. In other words, ports should strengthen their connection to the hinterland in order to develop. Czerny (2014) suggested that the competitiveness of ports is related to the transport policies among hub ports and that a strategy of privatization can improve management efficiency and enhances the competitiveness of ports. In the study conducted by Alvarez-San et al. (2015), port competition analysis

focused on the integration of port and inland freight transport. That study suggested that the port that can provide one-stop service in the supply chain is a competitive port for attracting cargo.

Previous studies on port competition focus mainly on gaining a competitive advantage or the development strategies of ports. Few studies have analyzed port competition from a macroscopic perspective, i.e., to analyze the research trends of port competition. This research attempts to fill this gap by analyzing the keywords of previous studies related to port competition to identify the research trends for port competition.

Table 1
Previous studies about port competition

Year	Authors	Keywords
1985	Slack	containerization, port competition, port selection
1991	Hayuth	load centre, intermodality, inland transportation, port competition
1995	Heaver	port competition, port policy, port policy, management
1997	Notteboom et al	port competition, Containerization, competitive, urban ports in Europe
1998	Xin	port competition, market structure, competition behaviour
1999	Fleming and Baird	port competition, united States, western Europe, competitiveness
2002	Song	competition, co-operation, container port, Hong Kong, South China
2003	Veldman and Bückmann	container port competition, demand choice models, logit models
2005	Cullinane et al	port competition, Shanghai, Ningbo, container ports
2006	Yap and Lam	port competition, container throughput, integration test, error correction model, East Asia, China
2007	De Langen	port choice, port competition, hinterland, Austria, case study
2009	Fan et al	container shipping, optimization models, inter-port competition
2010	Hoshino	competition, hub port, port development
2003	Song	competition, co-operation, container port, Hong Kong, South China
2013	Ishii et al.	port competition, non-cooperative game theory, port charge, port capacity
2014	Czerny et al	hub port, transport policy competition, privatization
2015	Alvarez-San et al.	port competition, inland freight transport, integration

2.2. Research flow

Details about the research flow of this study are shown in Figure 1 below. The first step provides an overview of the current port competition situation. Fierce competition among ports forces port operators and managers to seek more efficient development strategies for port survival, such as cooperating with an adjacent port or providing value-added services to port users, and so on. Second, we searched for related studies about port competition in several of the main journals, which were published from 1980 to 2015 by Science Direct, Springer e-journal, and Taylor & Francis. We then summarized the keywords from these journal articles. In the third step, the keywords summarized from the journals in the database were coded in order to analyze the trends using the SNA method. The degree centrality and betweenness centrality of the keywords were also analyzed. Lastly, based on the results of the analysis in the third step, we obtained a visual representation of the research trends in port competition.

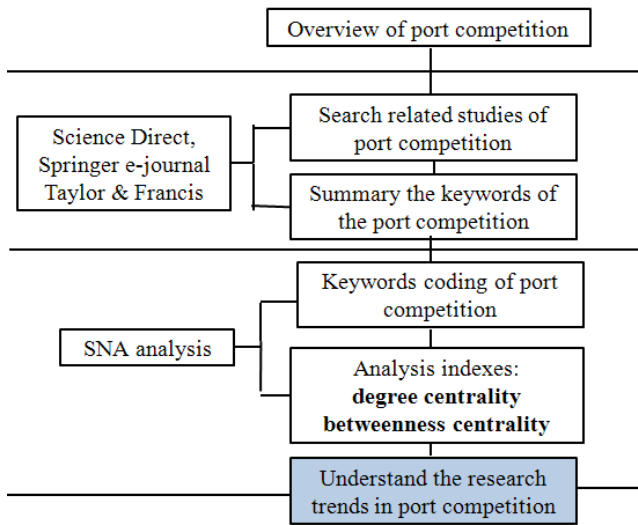


Fig. 1. Research flow chart

3. Methodology

3.1. Social Network Analysis

The analysis of research trends in port competition employs the SNA method. The SNA method was created in 1954 by Barnes. It is an approach and set of techniques used to study the exchange of resources among groups, and it builds a network of nodes and analyzes the connections between them. The main idea is to analyze patterns of connections. This technique is an important research method that has been used in social sciences to study such topics as the structure of communities of friendship (Wallman, 1984), commercial patterns (Zack and McKenney, 1995), diffusion of innovation (Valente, 1996), and the spread of diseases (Klov Dahl, 1985). This study uses academic networks, which are social networks limited to researchers and scholars, thus, making it appropriate for an academic network analysis (Wang et al., 2011). In our research, we used two analysis indexes to obtain the research trends of port competition, i.e., degree centrality and betweenness centrality.

3.2. Degree centrality

Degree centrality is calculated as the number of direct ties to a node. A high degree centrality value means that the node has more ties directed to it. In our research, this means that a word with a high degree centrality value is an important keyword in port competition research studies, and that word is located in the center of the visible network. The degree centrality, $CD(n_i)$, for node $j(n_i)$ is defined as follows (Freeman, 1979; Glanzer and Glaser, 1959):

$$C_D(n_i) = \sum_j x_{ij} \quad (1)$$

3.3. Betweenness centrality

Betweenness centrality indicates a node's centrality based on the number of shortest paths from all vertices to all other nodes that pass

through that node. A high betweenness centrality value means that the node can connect the key node to other nodes. In our research, this means that a word with a high betweenness centrality value is an important research issue in port competition research studies, and that word is located near the center of the visible network. Betweenness centrality is expressed as follows (Freeman, 1977):

$$C_B(n_i) = \sum_{j < k} g_{jk}(n_i) / g_{jk} \quad (2)$$

4. Analysis and Findings

4.1 Data collection

To analyze the research trends for port competition, the first step in data collection requires identifying academic papers related to port competition. Here, we relied on sources such as Science Direct, Springer e-journal, and Taylor & Francis. The second step is to search for papers that output the term “port competition” and to identify the keywords in each paper.

As a result of the data coding related to “port competition,” 118 published academic papers were identified from the period 1980 to 2015. Then, each paper's keywords are summarized as the database, such as hub port, shipping liners/lines, which we use for further analysis. In order to analyze the research trends in port competition step-by-step and compare the differences in the trends by each period, the research trends were analyzed for the following three periods: 1980–1999, 2000–2007, and 2008–2015.

4.2 First period (1980-1999)

Figure 2 is a visual representation of the keyword network of published research papers for the period 1980–1999. Table 2 shows the degree centrality and betweenness centrality values of the keywords in detail.

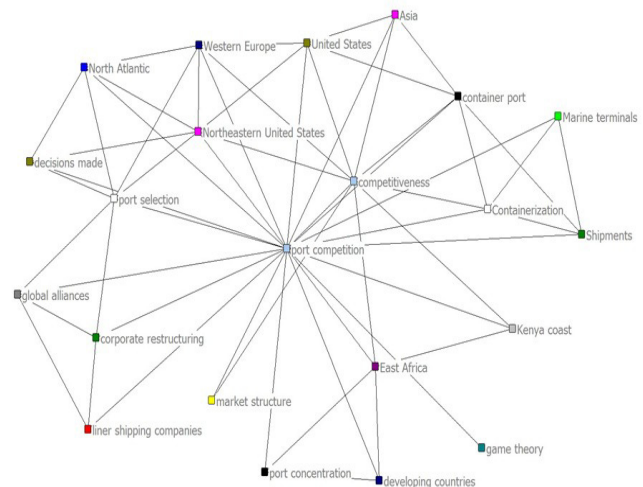


Fig. 2. Result of visualizing in 1980-1999

“Competitiveness” and “port competition” are located in the center of the network. This indicates that, in the 1980–1999 period, most of the research studies about port competition were conducted from the perspective of competitiveness, i.e., they either establish the evaluation structure of port competitiveness or provide some suggestions about how to enhance the competitiveness of the ports. “Port selection,” and “north

Southeast Asia	0.033	0
Spanish Ports	0.05	0
Supply Chain	0.15	0.005
Suzhou Port	0.067	0.001
Terminal Operating Companies	0.067	0
Transport Costs	0.1	0.002

5. Conclusion

This study analyzed research trends in port competition using a social network analysis, and, in particular, to identify the changes and evolution in trends related to port competition, the research timeframe is divided into three periods between 1980 and 2015. Studies in the first period (1980–1999) focused mainly on keywords such as “port competition” and “competitiveness.” Then, in the second period (2000–2007), the trends shifted to include “port competition,” “China,” “container port,” and “Hong Kong,” which became central in the network. The most drastic change occurred in the third period (2008–2015), where, in addition to “port competition,” the central point of the network also included “cooperation” and “supply chain.”

These dynamics in keyword changes show that the perception of port competition has changed, from pure competitiveness to a mix of competition and cooperation, giving rise to the term co-opetition. Furthermore, “supply chain” has become a popular keyword, which shows us that the global supply chain has become increasingly sophisticated, robust, and complex as the concept of port competition has broadened. A comparison of these three periods shows that the focus of port competition analysis has changed from sole region ports to a view of globalization.

In addition to providing concise and clear data on the history of port competition research, our findings enable us to forecast how port competition research will progress in the future. However, our research study has two limitations: (1) only 118 studies from 1980 to 2015 were collected and analyzed from the research database and (2) the keywords analysis using SNA has no directivity; therefore, the meaning of the betweenness centrality value is not obvious.

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