A Possible Risk Reduction of the Negative Impact of Port Blockage by Disasters on the Global Trade and Economy - Case study of U.S. West Coast Port Disruption -

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ABSTRACT: The progress of international container trade has advanced the globalization of modern trade and economy through reducing transportation lead time all over the world. This means that the stagnation of international container shipping directly suffer maintaining global supply-chain, leading to the serious negative impact on the world trade and economy. While, port is affected not only by natural disasters like earthquake, tsunami and hurricane, but also by man-made disasters, such as strike, explosion, IT system trouble and so on. In this context, this study discusses the impact of consequences of port blockages on international container trades by focusing on the automotive parts supply chain during the 2014/15 U.S. West Coast port disruption. The disruption caused a dramatically increasing transportation lead time and cost. Emergency transportation management for container cargos including efficient port shift operations for container ships may be considered under mutual alternate port system.

Keywords: Port Disruption, Supply-Chain, Lead Time, Container, Alternative Route

1. INTRODUCTION

The international container shipping may be one of essential elements for the modern world trade and economy, therefore, to be secured during and in the aftermath of both natural and human-made disaster. In particular, container cargo shipping to/from China, Southeast and South Asia is currently a main pipeline of linking so called “factory of the world” with the global market including Europe and North America. This well-developed global supply-chain, however, was identified as having the aspect of fragility against various disasters. After the Great East Japan Earthquake, the suspension of automotive parts manufacturing in Japan stopped the production lines of car factories all over the world (Ono et al., 2015). This fact demonstrated that the negative impact of disasters easily spread to rest of the world through the global supply-chain. In this point of view, maintaining international container shipping trades is one of basic requirements for global industrial network in the context of sound supply-chain function. In this study, the authors analyze, evaluate and discuss the negative impact of port blockages on international container shipping by referring the 2014/15 U.S. West Coast port disruption case and the resulting automotive parts supply chain disruptions. Possible policy developments are also being suggested for improving disruption risk management in the port and shipping subsector.

2. PORT DISRUPTION BY VARIOUS DISASTERS

Port is affected not only by natural disasters but also by man-made disasters. In 1995 and 2011, Kobe port and Tohoku Pacific Coast ports were severely damaged by the Great Hanshin-Awaji Earthquake and East Japan Earthquake, respectively. Busan port was stricken by the Typhoon Maemi in 2003 severely, New York/New Jersey port was affected by Hurricane Sandy in 2012. Port blockades by strikes were occurred in many countries such as, U.S., France, China, India, Bangladesh and so on. Tianjin port operation was fully suspended by the explosion of chemical material in 2015. Same kinds of explosion accidents had occurred at Mumbai and Dalian ports in 2010 consecutively. New York/New Jersey port was affected by IT system trouble in 2013, and the stagnation of container handling kept two months. These are the only one part of port disruptions by disasters, in other words, global supply-chain formed by container trade has been and is exposed by various disaster risk.

Among the previous studies, Southworth *et al.* (2014) investigated U.S. port disruption by disasters and Lam and Su (2015) reviewed Asian port blockades. As to the negative economic impact of port blockades, Martin Associates (2001) claimed that the 2002 West Coast port lockout would cost the U.S. economy $ 1.9 billion per day. For the impact of 2014/15 West Coast port disruption, Werling (2014) and Martin Associates (2014) estimated the cost of 20 days port closure. Funase *et al.* (2011) and IRGC (2011) estimated the impact of Nagoya port and Malacca Strait closure, respectively.

3. DISRUPTION IN U.S. WEST COAST PORT

3.1 Labour Management Negotiation of U.S. West Coast Port

At U.S. West Coast port, in recent years, the employees' representing body ILWU (International Longshore and Warehouse Union) and employer group PMA (Pacific Maritime Association) have negotiated labor contract every six years. The 2002 negotiation entered in the port lockout, which was ended in 11-days by implementation of the 1947 Taft-Hartley Act emergency provisions by U.S. president Bush. In 2014, the negotiation between ILWU and PMA started middle of May, but the labor contract expired at the end of June without agreement. Although the negotiation continued, ILWA started work slowdown late October, PMA stopped night work by labor shortage at the end of the year. In February 2015, PMA proposed and announced the compromise and stopped holiday work. Finally, U.S. labor Secretary Perez, who was send by president Obama, mediated the two organizations.

3.2 Stagnation of Port Function

The stagnation of cargo handling caused long offshore waiting and terminal berthing time of container ships. Fig.1 shows the change of berthing time from Lloyd's List Intelligence data, and the time at all four ports increased drastically in January and February 2015. In this time, over thirty container ships waited offshore of Los Angeles and Long Beach port. This long berthing time also caused the decrease in number of calling ships and volume of container handling.

At these ports, work slowdown and suspension of night work reduced the efficiency of container handling. Fig. 2 shows the change of average berthing time per container box loading/unloading, and this resulted in approximately 60% lower efficient in January and February 2015 comparing with same month of 2013. In this figure, NSA means Northwest Seaport Alliance comprising ports of Seattle and Tacoma.

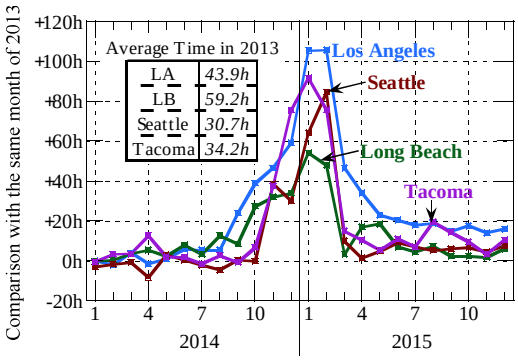

Fig. 1: Change of Terminal Berthing Time per Ship

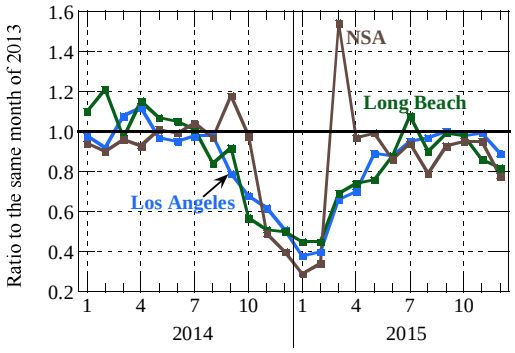

Fig. 2: Efficiency of Container Handling (Time per box)

4. IMPACT ON CONTAINER TRADE AND ECONOMY

4.1 West Coast Port Utilization Rate by East Asian Cargos

In the container transport between East Asia and U.S., it is possible to choose one route from the two options: i.e. i) West Coast port route: loading/unloading at West Coast ports for connecting to rails, so called "intermodal", and ii) East Coast port route: loading/unloading at East Coast port, so called "all waters".

The disruption of U.S. West Coast port led the route change of East Asian container cargos from West Coast port to the East. Figure 3 expresses the rate of West Coast port route of East Asian boxes from PIERS data,, and the rates of all four countries began to decrease at 2nd half of 2014. The rates declined to the lowest level in January and February, 2015 and did not yet return to the level of 2013 first half in 2015 latter half. The West Coast port rate of the countries whose ordinary rate were low, were inclined to decrease larger in the lowest level, especially in Korea. This fact indicates that the shippers/shipping companies/forwarders that had been using East Coast port ordinary could easily shift the route.

4.2 Lengthening of Transportation Lead Time to/from Japan

The direct influence of West Coast port disruption was the lengthening of transportation lead time. Table 1 shows the time between West Coast port and Japan by using LLI and PIERS data. In the table, "All" indicates total time, "Sea" and "Term." is navigation and berthing time, respectively. Compared with February 2014, total time increased 14 to 15 days in east bound ships, 4 to 7 days in west bound ships in 2015. The gap between east and west bound is the time of offshore waiting, which was 8 to 9 days, at West Coast port. This long waiting time caused large negative impact on the U.S. and trade partner economy.

4.3 A Case Study - Autoparts -

Japanese and Korean auto makers, such as Toyota, Honda, Nissan, Hyundai and Kia, operate and sponsor a lot of car factories in North America, and a certain percentage of needed autoparts are shipped from their home countries. As described before, the freeze of manufacturing autoparts in Japan stopped the production of car factories in North America after the Great East Japan Earthquake. At the time of West Coast port disruption in 2014/15, it was widely broadcasted in Japan that the autoparts shipping to North America largely delayed and the production of factories in U.S. were cut. Therefore, authors analyzed autoparts shipping as a case study.

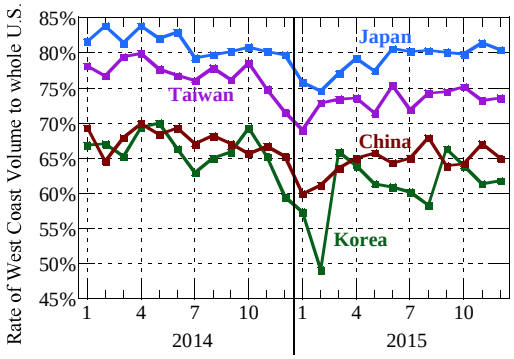

Table 1: Lead Time between West Coast and Japan

		Feb. 2014		Feb. 2015		2014 to 2015	
		East Bound	West Bound	East Bound	West Bound	East Bound	West Bound
PNW	All	*10.9*	*14.4*	*25.0*	*20.9*	*+14.0*	*+6.5*
	Sea	*9.7*	*13.2*	*19.7*	*15.1*	*+10.0*	*+1.8*
	Term.	*1.3*	*1.2*	*5.3*	*5.8*	*+4.0*	*+4.7*
PSW	All	*11.9*	*16.5*	*26.9*	*20.9*	*+14.9*	*+4.4*
	Sea	*10.3*	*15.3*	*22.0*	*17.4*	*+11.7*	*+2.1*
	Term.	*1.6*	*1.2*	*4.8*	*3.5*	*+3.3*	*+2.3*

*Unit:Days **PNW: Seattle and Tacoma, PSW: LA/LB
***Japanese ports: Tokyo and Yokohama.

Fig. 3: West Coast Port Rate of East Asian Container Cargos

The geographical location of Japanese and Korean related car factories in U.S. are similar. From PIERS 2013 data, approximately 20% of U.S. destinations of autoparts from both countries are California State, and the rest are the areas that are near East Coast than West Coast. At ordinary times, however, most of Japanese autoparts are transported via West Coast port route, while Korean are shipped via both West and East in 60/40. Fig. 4 and 5 express the shipping route of autoparts from both countries in 2014/15 by U.S. trade statistics and PIERS data. The difference in ordinary route is reflected to the alternative route at the port disruption. When the cargo handling function at West Coast port stagnated, Japanese car maker selected air transport for substitution, which constituted 30% of shipping weight in February 2015, on the other hand, Korean maker increased the rate of East Coast port. It is estimated that the total additional cost of the Japanese auto makers amounted to approximately $220 million based on the press report, which described the additional transport cost of Fuji Heavy Industries by chartering airplanes for shipping autoparts during the period.

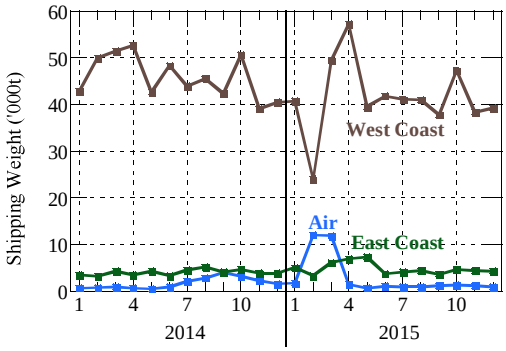

Fig. 4: Shipping Route and Weight of Autoparts (Japan)

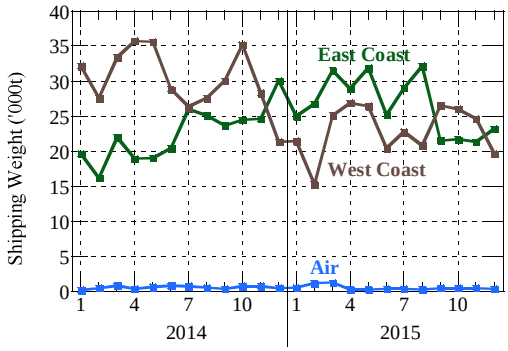

Fig. 5: Shipping Route and Weight of Autoparts (Korea)

5. DISCUSSION

It is impossible to fully eliminate risks of port disruptions by natural and man-made disasters. However, in the aftermath of a disaster, maintaining the acceptable level of port functions, and accelerating port restoration by proactive measures and preparatory works are possible. In Japan, under the Basic Act for National Resilience Contributing to Preventing and Mitigating Disasters for Developing Resilience in the Lives of the Citizenry legislated in 2013, and based on the action plan of this act, each port has been preparing port-BCP (Business Continuity Plan). The authors have undertaken research works in this field to improve effectiveness of port-BCP implementation. In U.S., Safe Port Act was legislated in 2006, and various security strengthening policies have been implemented under Department of Homeland Security. In this context, Massachusetts Institute of Technology (MIT) has been running the Port Resilience Project for securing port functions in the aftermath of a disaster. APEC (Asia-Pacific Economic Cooperation) has developed a Trade Recovery Program for repairing and sustaining the international trade system in the event of a disaster to the global supply chain, such as a disruption caused by a major terrorist attack since 2006. APEC is working in collaboration with World Customs Organization for quick identification of outbreak of a disaster and for quick and steady transmission of information of a disaster. These policies, projects

and research projects are expected to improve resilience of port and container shipping and to reduce the negative impact of disasters.

Container cargo shippers may also be able to take effective measures for securing its supply chain network. It is indicated through the above analysis and discussions that the Korean car manufacturer could successfully mitigate port disruption risks, however, it was not the case for Japanese manufactures. As a result, some production lines were disrupted with substantial cost increase during the period, which influenced on the global car production and sales. On the other hand, it is difficult to sacrifice the ordinary time efficiency just for preparing the disaster situations. In this regard, authors noted it necessary to improving port disruption risk management of container shipping for facilitating the more efficient shift of container ship to the possible alternative ports at the time of port disruption. The mutual cooperation of ports may be one of effective measures for coping with a large-scale disasters. The authors (2015) proposed the estimation method of alternative container port cargo handling volumes, which contributes the progress of developing a wide area port-BCP alliance. Rice *et al.* (2012) also constructed "Port Mapper", which visualize the various port capacity to analyze the vulnerability. However, it's a future problem of how to develop the mutual total support agreements among container ports, and also how to coordinate port cooperation with container shipping company that is constrained by contract with shipper.

Above mentioned approaches will mitigate negative economic impact not only due to port disruptions caused by disasters, but also due to large-scale disasters that do not affect port itself. This is because, in the aftermath of large-scale disasters, port cargo demands may increase greatly by humanitarian logistics. Since port cargo handling capacity cannot be developed in a moment, mutual support of ports is of great importance.

6. CONCLUSION

In this study the authors analyze, evaluate and discuss the negative impact of port blockages on international container shipping based on the 2014/15 U.S. West Coast port disruption case and resulting automotive parts supply chain disruptions. Japanese auto maker engaged in the air transportation for alternative measures, which constituted by 30% shipping weight at the peak time, but led to a high additional transport cost. Korean car manufacturer could successfully mitigate the port disruption risk by shifting the cargos to U.S. East Coast ports. Possible policy developments are also being suggested for improving disruption risk management in ports and container shipping by disasters. This policy may be effective for the large-scale disaster which doesn't affect port directly. The authors are going to evaluate the economic loss due to the port disruptions for further considering mitigation policy to avoid these economic losses.

7. ACKNOWLEDGEMENT

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