AN ENGINEERING AND SOCIAL ANALYSIS FOR THE OPTIMAL LOGISTICS HUB LOCATION PREPARING TO KOREAN UNIFICATION AND EURASIA

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ABSTRACT. *The practical approaches solving for the reunification problems should have been explored with an object of being North and South Korean. The logistic system has been one of the important factors for solving the current issues in Korea. In this paper, the logistic hubs are being examined and proposed by engineering method for Korean and Eurasia especially railroad concerns, and its social effects are also explored.*
Keywords: Logistics hub, Railroad transportation system

1. **Introduction.** Korean government has recently proposed a practical re-unification strategy, which includes politics, economy, culture, athletics, education, especially the things of getting over the life quality. The main proposal can be summarized as the infra strategy for stabilizing of the livelihoods of the public differences between North and South Korea.

Furthermore, the President has mentioned the Eurasia Initiative in Dresden Declaration in German. It is the North Korean railroad transportation system achieving for these matters, such as Silk Road Express, in which China, Russia, and the Central Asia are to be coordinated in various concerns [1]. Therefore, the optimal logistics hub locations are to be searched in this paper based on engineering and social analysis with the logistics value factors such as cost, distance, time, and flow quantity. It can be also proposed of a promising marketing strategy expanding to East-North Asia, China, Mongolia, Siberia, and Europe.

It also gives a synergy for socio-economic effects such as acceleration of GDP growth and goods turnover in the participating countries, Eurasia transport routes diversification, counter measure to global crisis in the economy, increase in the investment attractiveness of the territories, and increase in population mobility and deepening of cultural integration.

With a view point of political effects, there can be strengthening of relations of trust through economic interdependence of the participating countries, formation of a common Eurasia macro-region, integration of the North Korea into the international community and normalization of international relations on the Korean peninsula.

However, the construction expansion and standardization of the current railroad, harbors, airports, and loads in the North Korea based on logistics must be defined and analyzed first in order to perform those current national issues, which can be simply

stated as global logistics in the Earth. The optimal logistics strategies can make either logistics cost or economic and social effects, leading the better life quality including cultural concerns for Korea.

Therefore, the global logistics system in Korea can be helpful in not only logistic itself but also social, economic profit, so the discussion of these concerns should be explored in various areas of applications preparing to Korea unification and Eurasian transportation routes in the near future [2].

2. **Methodology.** The multiple facility location in the plane method has been applied to this research, which can be stated that the procedures getting to find the one point with one finger under the big dish on the fruits with various weights and sizes dispersed [3].

One heuristics approach is to alternate between a location problem and allocation problem, with a set of demand points with volume of demand such as distance, time, flow quantity, population, industrial bases, marketing, social factors, education service level, and a set of locations and an allocation of the demand points to these locations in order to the sum of the transportation cost [4].

The following four phases are the procedures for solving the main logistics hub location problem. The first phase is to set the X-Y coordinates in the map including Korea, and to select the cities with larger population in comparison to other cities, and in this case, twenty five cities in each cases of South and North Korea, Eurasia, have been selected.

The second phase is to assume that the distance between each location has been Euclidean distance in practically, so the weights are to be the volume of demand described before. The next phase is to calculate the distance with the given weights, also the transportation costs are to be calculated by the shipping, loads, railroad, etc., considering the weights with flow quantity, transportation network, etc. One of the most important factors for solving the logistic hub location problem is to set the weight in a reasonable manner.

The final phase is to solve the transportation cost function with a necessary condition for optimality of new coordinate which cannot be solved explicitly for optimal points, and it also requires the initial approximation. Therefore, the successive substitution method satisfying the condition with an object of terminating when two successive locations are sufficiently close. It means that the transportation cost and/or distance moved between two successive points is negligible.

3. **Analysis.** The logistics hub location analysis is divided into two categories, such as Korea and East-North Europe. Three routes in North Korea heading for the Europe, Russia, and Korea are analyzed. The transportation cost to the Europe is going to be half of the current cost, for example, if the railroad is used through the Eurasia from the East-South Asia and Japan. It also gives a practical effect for touring logistics which can be affected to language and cultural communications using the modernization and enhancement of power supply, information, and communication facilities, implementing of bi-directional automation [5].

Reconstruction of stations, extension of industrial background, and expansion of the container terminal network to enable reworking large capacity containers are also explored.

3.1. **Logistics hub simulation.** The analytical results show that, generally speaking, it costs down 80% if railway is used instead of trucking. Especially, the transportation cost and distance considering flow quantity, population, living standards, etc., which are input data for this research the one of the most important factors for solving these problems.

It has been considered of the speed of delivery and transit time stability, service regularity, keeping on fixed transit schedule, competitive rates by the price delivery time criterion, stability of the rate policy, and upfront notification of rate changes.
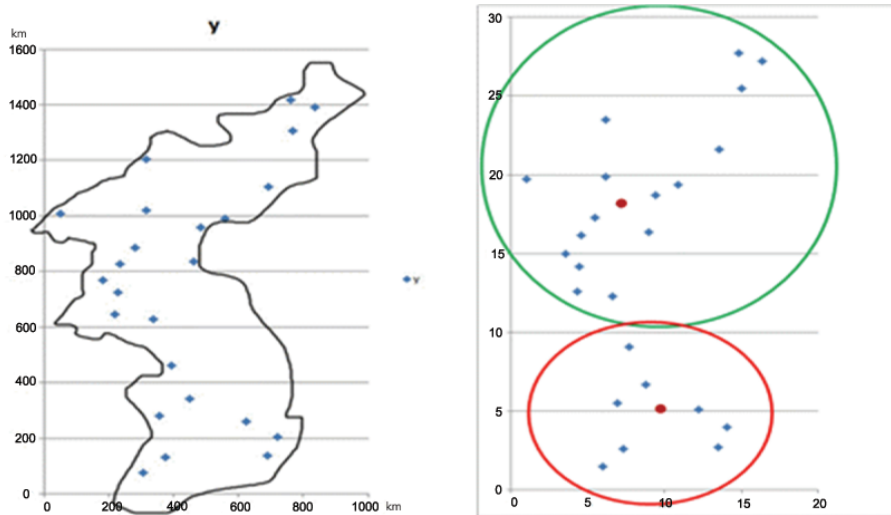
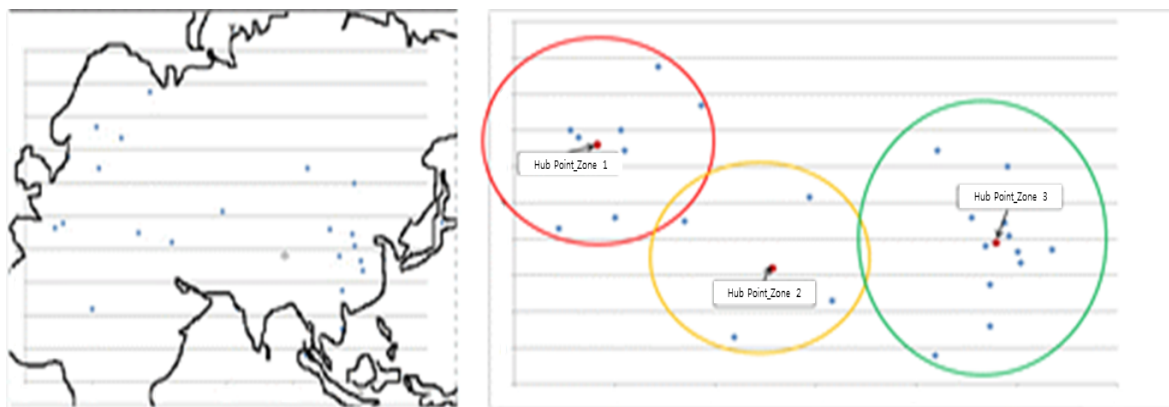FIGURE 1. Logistics hub simulation in Korea

FIGURE 2. Logistics hub simulation in Eurasia

Figure 1 shows that there is one location in South and North Korea areas, which indicates global logistics hub in each area. However, there is an interesting point of one hub in the South Korea for the North Korea logistics, which can be described that all the industries and the population, etc., are dense in capital city in North Korean transportation network.

Figure 2 results in that it can be categorized into three areas based on the different railway track width. Although the analytical results are based on the theoretical approach, the research indicates the detailed hub locations in Korea and Eurasia as possible.

However, the constructional investment and standardization of the railway in the North Korea should be done in order to perform the Eurasia Initiative through by China and Russia [6]. Even though there are so much cost and time needed for doing these concerns, gauge changeable trains can be used in order to operate on the railways with different rail gauges instead of changing all railways in standard width [7].

3.2. **Railway transportation routes.** In this section, the possible railway transportation routes in Eurasia have been analyzed considering the current railway situations in the North Korea, where more than 90% of logistics flow quantity has been transported by railway [8].

However, the widths of railway are not standardized for all Eurasia, and Figure 3 shows the four different routes heading to Eurasia, such as TMR, TMGR, TCR, TSR. For example, the trans-Siberian railway, which may be the longest railway line in the world, is fully

FIGURE 3. Railway routes in Korea and silk road express

electrified and fitted out with state-of-the-art means of automation, communications, and information technology. Russian railway is implementing a new transport product called "The Transsib in Seven Nights". By this year, it will be taking seven full days to transport containers from the west to the east of Russia. Today's speed is about 1,200km/full day [9].

The technical method of running gear should be so designed that gauge changeable trains run safely in all operating conditions safely. This technique can not only reduce the time of changing bogie and of trans-passing the customers in a different railway, but also give reliability function, since the variable gauge bogie system is designed to develop cargo system between Korea, Russia and European countries. For this concern, the pre-investment for the railway construction in Korea, especially 500km in North Korea which causes bottleneck situation to Eurasia routes, should be performed first for preparing to unification.

At the summit in Pyongyang in June 2000, the North Korea decided to restore the rail connection between two parts of the Korean Peninsula which was interrupted in 1953. Russian railway is working on the project in liaison with railway administrations and transport agencies of Austria, Slovakia, and Ukraine on the strength of memoranda signed and a number of bi-lateral agreements.

It is as well as arrangements set down in protocols of intergovernmental commissions for trade and economic, scientific and technical cooperation. Currently, work is being done on forming tender documentation, preparing and announcing a tender on the development of an extended feasibility study for the project.

4. **Simulation.** The logistics hub location points for transporting goods from Jeju Island in South Korea, and Fukuoka, in Japan to all areas in North Korea has been simulated, and the distance, time, cost, population, industry level, social effects, living quality, marketing factors, etc. are also calculated by engineering and social weights. Hence, the weighted input data has been one of the most important factors in this research, also the harbors and related railway routes are investigated [10].

The methodology of multiple location problem, transportation problem, and assignment problem have been applied to simulation, and the current logistics situations in North Korea have been considered such as the difference between east and west geographical areas, transportation network and harbor systems, population, and related industries.

West two lines from Jeju

East two lines from Fukuoka

Upper four lines in North Korea

FIGURE 4. Simulation results

The results show that, first of all, the optimal selection of route among the alternatives is the main issue for solving the global logistics system, which can be stated as a linear function of transportation cost. Secondly, it also indicates that the more logistics hubs are, the less transportation cost is given, hence the complementary railway and load construction considering harbor condition should be done.

Third, it had better use the railway for transporting goods to North Korea. There is at least 60% difference in transporting cost depending on the route selection, for example, one ton of daily necessities from Jeju Island to North Korea. Figure 4 shows the optimal logistics routes from Jeju in South Korea and Fukuoka in Japan to North Korea, where the west two lines indicates from Jeju, east two lines as form Fukuoka, and upper four lines as from two points to North Korea areas.

5. **Conclusions.** In this paper, the optimal logistics hub locations have been explored preparing to Korea unification based upon the engineering and social analysis, and simulation was also performed. The proposed simulation suggests that there is a possible chance to develop unified logistics system in Korea, if the North Korea agrees with the Eurasia Initiative. However, there are many things to be done first implementing for this ideal project, such as standardization and re-construction for load, harbor, airport, and railway, etc.

The pre-investment to the railway construction from South Korea should be considered preparing to unification which can prevent the logistics chaos when the unification comes true. Reconstruction of trans-Korean railway may be implemented in the framework of an international consortium with participation of investors from Korea, Russia, China, and other countries. The educational effort to the professional personnel for logistics should be also planned, and the following four categorized studies preparing to unification are suggested regarding to logistics system.

1. Optimal logistics hub location for daily necessities: optimal modeling based on the flow quantity and route, and transportation cost, transported methods, selection of transporting mechanism, warehouse system, reconstruction railway route to Eurasia.

2. Education and culture based logistics hub locations: selection of educational institutes considering geographical condition and its characteristics, and cultural differences.

3. Infra industrial logistics for the necessities of life: mainly focusing on the medical support, clothes, architectures considering their needs such as hospital, and children support system.

4. Risk analyzed logistics system: optimal modeling with order picking sequence problem, container packing optimization, shipping sequences, pallet standardization and general packing problem, electricity, related industries development, etc.

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