1. Introduction

The logistics cost of bulk cargo such as coal accounts for the largest part of the total product cost. Therefore for this type of cargo, efficient logistics process is essential to achieve business competitiveness. Main transport mode of bulk cargo is railway and road in Korea. The major advantage of road transport is that it can enable door-to-door delivery of cargo. Rail freight transport is eco-friendly transport mode and can handle large amount of cargo at once. But railway usually needs shuttle transport between railway station and final destination. The transhipment between truck and freight train usually cause increase in operation time and fugitive dust. This paper suggests how to improve railroad logistics process of bulk cargo to deal with the previous problems.

2. Logistics Process of Bulk Cargo (As-Is)

The first step of road transport is loading bulk cargo onto a truck by using a pay loader or an excavator. After install a cover to prevent dust scattering during transport, a truck delivers cargo to the final destination where the truck dump it.

In the case of railway, bulk cargo is transported to the dispatch station after loaded onto a truck. After the cargo is delivered from the dispatch station to the arrival station by railway, it is transferred to a truck and transported to the final destination. The transhipment between train and truck by using excavator causes increase in operation time and fugitive dust.

Figure 1: Current railway logistics process of bulk cargo
3. The Improvement of Railway Logistics Process of Bulk Cargo

To solve the previous problems due to the transhipment we developed attachable freight container which can be loaded on a flat car (and a container car) or a container chassis and has a dumping door. (figure 2)

![Attachable container for bulk cargo](image)

**Figure 2: Attachable container for bulk cargo**

![Suggested railway logistics process of bulk cargo](image)

**Figure 3: Suggested railway logistics process of bulk cargo**

**Table 1: Operational Efficiency**

<table>
<thead>
<tr>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Loading time into truck: 30 Min.</td>
<td>• Container loading time to trailer: 4 Min.</td>
</tr>
<tr>
<td>• Time cycle between final station and</td>
<td>• Time cycle between final station and</td>
</tr>
<tr>
<td>destination: 99 Min./1 car</td>
<td>destination: 54 Min./1 car</td>
</tr>
<tr>
<td>• Coal loss on shuttle transporting</td>
<td>• No coal loss on transportation of shuttle</td>
</tr>
<tr>
<td>• Civil complaint with dust scattering</td>
<td>trailer</td>
</tr>
<tr>
<td>• Inconvenient to store bulk cargo</td>
<td>• No dust scattering</td>
</tr>
<tr>
<td>• Operation efficiency is low because</td>
<td>• Able to do multi-stack loading like</td>
</tr>
<tr>
<td>waiting time is longer</td>
<td>container</td>
</tr>
<tr>
<td></td>
<td>• Able to use flat car immediately after</td>
</tr>
<tr>
<td></td>
<td>unloading</td>
</tr>
</tbody>
</table>
4. Results and conclusions

This paper suggests the introduction of an attachable container for the improvement of railroad logistics process of bulk cargo. Comparison between logistics processes of “as is” and “to be” models shows that attachable container is useful for the railway logistics of bulk cargo.

References

Study on Port Work Accident Preventing/Diminishing with IoT and Big Data

Hyongmo Jeon

1 Research Planning & Cooperation Team, Korea Maritime Institute, Busan, South Korea
*Corresponding author: hmjeon@kmi.re.kr

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1. Introduction

Generally, port work was known as a dirty, hard and dangerous job, but, nowadays, use of various machines like container crane (CC), bridge type crane (BTC), continuous ship unloader (CSU), are increasing in many parts of port work, especially, loading and unloading processes, and the accidents in port work are decreasing. Also, fully automated loading and unloading systems are realizing in several advanced container terminals.

However, in some parts of port work, manual works are still necessary and port works are asked to work along with heavy equipments and it caused accidents. Actually, in South Korea, over 100 accidents are still occurs in port work and about 4-5 people are killed by the accidents in every year. Another problem is long-term and accumulative damages on human body like musculoskeletal diseases and disorders. It caused by long-term and repetitive inappropriate postures during the work.

Traditionally, worker education and working regulation are most popular method to reduce those accidents and damages. However, human makes mistakes and some of inappropriate postures are unavoidable in current working circumstances. So, more fundamental and direct methods are needed to decrease the accidents and damages. The aim of this research is to propose new way to decrease the accidents and damages using new technologies, like Internet of Things (IoT) and Big Data analysis.

In this research, first, current accident rates and trends of the port of South Korea are analysed. And the research shows that which type of cargo is most dangerous and emergent to diminish the hazards in working circumstance. Next, loading and unloading processes of the dangerous cargo work are analysed and some ergonomics tools are to be apply to the processes to figure out what is the most fundamental problems which cause accidents and damages in work. After that, based on previous analysis, concepts of safety system are proposed using IoT and Big Data Analysis.

2. Port accident analysis of South Korea

Result of past five years accident analysis shows that accidents in steel cargo ports are most frequently occurs. Container ports are the next, and mixed cargo ports are the third. It is a little surprising that container ports are the second dangerous ports because the most container ports of South Korea are well equipped with advanced operation technologies. It is due to the massive amount of cargo volumes of containers in South Korea.
Figure 1: Accident rates of major types of cargos in South Korea from 2011 to 2015

Most dangerous process in cargo handling is hold (inside of ship). Over 50% of accidents is occurs in hold work.

Figure 2: Ratio of accident of each port work process

3. Ergonomics Analysis of Steel Cargo Port Worker

Most of steel products in ports are coil product or plate product in Korea. To assessment the risk of jobs, multiple of severity and probability are used. Jobs with over 9 risk points are not acceptable and needed to resolve the risk problem.
The Most high risk job is figured as Plate Hold Dropping(16), and Coil Hold Dropping(12) and Plate Quayside Lifting(12) are next.

4. Concept of IoT/Big Data Safety System

To decrease the risk of those jobs, a concept of IoT/Big Data Safety System is proposed.
Using IoT, worker can recognize some kind of unusual movements of cargos or equipments and can avoid the accident with higher probability.

References

ILO, 「Recording and notification of occupational accidents and diseases」, 1996
OSHA, “Hazard identification and Risk assessment” 2017
The Design framework for Cargo Hub Facilities

Kap Ilwan Kim, Chulung Lee, Hun-Koo Ha*

1Department of Industrial Engineering, Pusan National University, Busan, Korea
2Division of Industrial Management Engineering, Korea University, Seoul, Korea
3Asia Pacific School of Logistics/Graduate School of Logistics, Inha University, Incheon, Korea
*Corresponding author: hkha@inha.ac.kr

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1. Introduction

Over the past decade, courier service industry has seen a dramatic growth. Over the same period, new telecommunication technologies enabled internet access from virtually anywhere on this planet, which resulted surge of e-commerce across global economies. The success of e-commerce altered the characteristics of the courier service forever as percentage of individual customers grew and percentage of corporate customers diminished. Courier service, once a B2B industry, has now become a B2C industry.

As individual customers increased, however, problems started to surface as well. The total number of volume skyrocketed, flooding terminals with parcels. The shape of parcels diversified, requiring courier service providers to handle irregular shaped parcels on top of many different sizes of boxes. These changes put burden on terminals. More workforce, increased capacity, and higher efficiency are needed to solve these problems.

Then mega hubs emerged. UPS made an expansion of its air hub in Louisville, and now the hub can handle up to 416,000 parcels per hour. FedEx built SuperHub in Memphis, and the facility handles about 1.4 million parcels every night. Their super-sized facilities were able to meet the ever-increasing demands, and time did not take long before other courier service providers benchmarked success of the two companies.

Nonetheless, building hubs is not a simple task. First, ideal location to build a hub must be selected. Then the schedule of all in-bound and out-bound cargoes and their volumes must be derived for the hub to reach optimal performance. Right equipment must be purchased and installed to handle parcels efficiently, and facility must be managed economically. Most importantly, there is no room for an error since a hub and its equipment are irreversible once built.

In this research, to build an optimal hub, we benchmarked leading courier service providers globally and thoroughly analyzed equipment used in hubs. We gathered actual data from a Korean courier service provider, and processed the data to get useful insights. Based on the data, we created simulation to find feasible solutions, and we carried out economic analysis to provide the optimal solution.

2. Benchmarking and assumptions

Parcel handling processes and equipment used in a terminal suggested in this paper are benchmarked from various global courier service providers.

In most terminals, parcels are classified by their sizes (small, medium, and large) and shapes (regular box, irregular shape), and each classified parcel is processed in a designated process line. This is due to the fact that sorters, which are widely used in terminals these days, have different specifications,
meaning that each sorter differs in efficiency and the type of parcel it handles. Thus, to shorten processing time of parcels and to increase efficiency, terminals are constructed with many process lines with adequate equipment.

Chronogate, a terminal run by Japanese courier service provider Yamato, classifies parcels into small-medium and large. Small-medium parcels are sent to cross-belt sorter, and large parcels are sent to slide shoe sorter. Canada Post classifies parcels into small, medium, and large, and parcels are sent to cross belt sorter according to their sizes. A terminal run by CJ Korea Express, a Korean courier service provider, classifies parcels into small, medium, and irregular. Small and medium parcels are sent to cross belt sorter, and irregular parcels are processed manually. By benchmarking many courier service providers including Yamato, Sagawa, UPS, Canada Post, and DHL, the ideal equipment types for each line are presented.

Through benchmarking, it is possible to know the following information. Automated sorting system can be divided into two shapes, which are linear sorter and curved sorter. In general, small parcels are processed in curved sorters, larger parcels can be processed in both types of sorters, and irregular parcels are either processed manually or in linear sorters.

Curved sorter can further be divided into cross belt sorter and tilt sorter. Although the two sorters do not differ too much in their processing capacity, tilt sorter has less friction. Since parcels in courier service industry are usually small and light, less friction results in more damaged parcels. Thus, in this paper, only cross belt sorter is considered when using curved sorter.

Linear sorter can further be divided into shoe sorter and wheel sorter. Again, these two sorters have nearly the same output, but wheel sorter is more economical. Thus, only wheel sorter is considered when using linear sorter.

Table 1: Belt types and parcel sizes

<table>
<thead>
<tr>
<th>Type</th>
<th>Small</th>
<th>Medium</th>
<th>Large</th>
<th>Irregular</th>
</tr>
</thead>
<tbody>
<tr>
<td>Curved</td>
<td>Cross belt sorter</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Linear</td>
<td>Wheel sorter</td>
<td>X</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Manual</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Figure 1: Cross belt sorter
3. Methodology

Methodology of this research is shown in Figure 3. For Step 1, we first categorized yearly average throughput by 300,000 boxes, 500,000 boxes, 800,000 boxes, and 1 million boxes. Using previously obtained data set, for each average throughput value, we organized daily throughput in increasing order, which is then divided into 5 sections according to rate of increase. Then distribution for lots with higher percentage of small parcels and lots with higher percentage of large parcels are obtained. We applied further categorization according to nine classifications of parcels. In the end, we obtained total of 540 scenarios.

For Step 2, we calculated the number of truck docks for each of the four yearly average throughput values. In our algorithm, in-bound trucks that are coming from closer terminals arrive first, and out-bound trucks that have longer travel distance depart first. To sign each dock a destination and to obtain destination groups that can be managed within the terminal’s operation hours, we modeled arrival time of trucks in destination groups uniformly. Lastly, we calculated the optimal number of out-bound truck docks for each number of in-bound truck docks, and then we selected the one with the lowest total number of truck docks as the optimal number of truck docks.
For Step 3, we used a simulation analysis program AutoMod for one of the previously mentioned 5 sections, which is the section consisting of the most daily throughput. We considered two equipment (linear sorter and curved sorter) for large parcels, two equipment (linear sorter and curved sorter) for medium parcels, a curved sorter for small parcels, and a linear sorter and manual labor for irregular parcels. Thus, seven combinations of equipment are used in simulation. All processes except irregular parcels follow automated process, and parcels follow manual process only if a certain level of bottleneck is reached.

For Step 4, economic analysis for each scenario’s result is carried out, and the measures such as equipment purchase cost, labor cost, and maintenance cost are included. For example, in calculating equipment purchase cost, value depreciation and economic life are considered to obtain yearly operation cost of sorter, induction, scanner, singulator, and conveyor. These costs and throughput obtained from simulation are used to compute cost per box, and we selected the optimal equipment by comparing each scenario’s cost per box.

4. Results and conclusions

With the recent increase in ratio of minimum wage and inflation rate, and as workers avoid courier service industry due to the industry’s extensive labor, courier service providers need to find ways to increase efficiency of terminals. This preparation, along with the competition and structure of the industry, will provide the optimal strategy and policy to companies. This research provides optimal methods and equipment to build a hub terminal, and the result of this research will become useful in obtaining management strategy and increasing competitiveness of companies.

References

A new approach to urban rail networks for freight

Hag-Seoung Kim*, Dae-seop Moon

1 Logistics Research Division, Korea Railroad Research Institute, Korea
2 Green Transport & Logistics Institute, Korea Railroad Research Institute, Korea
*Corresponding author: hskim@krri.re.kr

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The logistics industry in Korea is growing year after year, and freight volume is also steadily increasing. But the industry has a high cost structure that is concentrated on road transportation. Road transport accounts for about 80% of the transport share of Korea’s logistics industry, and the proportion of rail transport is declining. Significantly, as the proportion of road transport increases steadily, CO2 emissions are increasing every year.

On the other hand, as the Seoul Metropolitan Area expands, population and companies are becoming concentrated in the metropolitan area. In addition, the logistics environment is shifting toward light weight, small quantity, and high frequency delivery as customers prefer to buy in the online market. Therefore, the logistics service in the metropolitan area as well as the usage of vehicles are expected to grow.

These changes are causing traffic congestion, which has a negative impact on the economy. The traffic congestion cost in Korea in 2012 was about 30.3 trillion won. In Seoul, the traffic congestion cost amounted to about 8.41 trillion won, accounting for about 27.7% of total traffic congestion cost in Korea. In addition, road traffic congestion is causing air pollution, greenhouse gases, noise, etc., and also has high social costs.

![Figure 1 Trend of the traffic congestion cost](source: KOTI, Traffic Congestion Costs: Estimation and Trend Analysis, 2014)

To solve these logistics problems in the Seoul Metropolitan Area, it is necessary to transform the current urban logistics system into a new eco-friendly urban logistics system that mitigates traffic congestion. The new urban logistics system utilizes environment-friendly railway facilities rather than road-based transportation.
In the current urban logistics system in the Seoul Metropolitan Area, goods are delivered to customers and stores by small trucks from a Distribution Center (DC) located near the border of the city. But due to the high construction cost in the Seoul Metropolitan Area, the logistics facilities are either quite old or too small. As such, these facilities are insufficient to meet the demand.

On the other hand, there are 9 subway lines and 293 stations in Seoul. Rail train depots are located in the suburbs of the city. So after carefully considering the influence of the existing subway network and the possibility of using the underground space, it was determined that these facilities should be used for the urban logistics system. In this way, the new urban rail logistics system should minimize its influence on the existing rail network.

The concept of the Urban Rail Freight System (URFS) is to develop an urban logistics system based on the existing subway infrastructure without constructing a new freight metro line. So, in this concept, URFS will use the train depot as DC, and delivers goods to subway stations by train.

In the train depots utilized as DC, logistic activities such as incoming, distribution/transhipment, and delivery of goods will be carried out. Also, trains need to be modified to accommodate freight for transportation by adding some functions such as loading/unloading and storage for goods to the existing rolling stock.

To the subway stations, freight service areas and facilities where freights can be moved and sorted for each customer should be added. It is also essential to have the facility to provide last mile delivery service from the station to the stores and customers by using electric vehicles. As well, additional logistics services such as urgent delivery and storage of remaining items for up to 1-2 days should also be provided at the subway station.
The URFS will be commercialized on a step-by-step basis. Phase 1 is to provide service to a single line without transhipment, and phase 2 is to expand full networking services through transhipment based on the outcome of Phase 1. Success factors of the URFS are to minimize the initial investment for infrastructure and train remodelling and to increase journey reliability and delivery punctuality with high quality of service. Finally, the expected effects of the URFS are as follows. First, the URFS will be able to reduce logistics cost by lowering the number of individual small delivering trucks. Second, the URFS will reduce the use of fossil fuels, resulting in environmental improvements such as CO2 reduction. Third, traffic congestion will be mitigated by reducing truck operations in the cities. Fourth, the stability and punctuality of urban logistics delivery services will be improved. Finally, a new underground freight transport market will be developed.

References

KOTI, Traffic Congestion Costs: Estimation and Trend Analysis, 2014