1. The status of KORAIL

The transportation volume of KORAIL (Korea Railroad) for the recent five years is on the rise with the opening of KTX (Korea Train Express) in 2004. However, the rail freight volume in 2009 was decreased to 38 million-tons due to the long-term economic recession, and then the sharing ratio of overall freight transportation remained at 6.4%.

Table 1-1. The national freight sharing ratio (per : 1,000ton)

<table>
<thead>
<tr>
<th>Year</th>
<th>Total volume</th>
<th>Rail volume</th>
<th>Road volume</th>
<th>Shipping volume</th>
<th>AIR volume</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ratio</td>
<td>ratio</td>
<td>ratio</td>
<td>ratio</td>
<td>ratio</td>
</tr>
<tr>
<td>2008</td>
<td>729,824</td>
<td>46,806</td>
<td>555,801</td>
<td>126,964</td>
<td>254</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>6.4</td>
<td>76.2</td>
<td>17.4</td>
<td>0.03</td>
</tr>
<tr>
<td>2007</td>
<td>715,190</td>
<td>44,531</td>
<td>550,264</td>
<td>120,079</td>
<td>316</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>6.2</td>
<td>76.9</td>
<td>16.8</td>
<td>0.04</td>
</tr>
<tr>
<td>2006</td>
<td>690,779</td>
<td>43,341</td>
<td>529,278</td>
<td>117,805</td>
<td>355</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>6.3</td>
<td>76.6</td>
<td>17.1</td>
<td>0.1</td>
</tr>
<tr>
<td>2005</td>
<td>687,451</td>
<td>41,669</td>
<td>526,000</td>
<td>119,410</td>
<td>372</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>6.1</td>
<td>76.5</td>
<td>17.4</td>
<td>0.1</td>
</tr>
</tbody>
</table>


The Korean government has established “the Low Carbon Green Growth Act” and “the Sustainable Transportation Development Act” to lay a legal basis for the conversion system. It has introduced the system to increase the rail ratio of transportation share from 2010. In which, if cargo owners use railroads instead of car-roads for transportation, 1,750 million-won conversion subsidy is supported in 2010 and about 3,000 million-won will be supported in 2011.

In addition to this government support, it is necessary for KORAIL to find the efficiency ways for increasing the volume of cargo against cost-up. The one is that it has conducted a variety of marketing policies, for example flexible rail freight charge, Block-Train, KoreaJapan Rail-Sea-Rail Service etc. And the other is studying the methods for improving station facilities. This paper is relating to the latter. It comes up with a plan for improving the transport efficiency through introducing a dis-shuffling model (omits shuffling works). This model intends to improve the container infrastructure that have achieved a gradually growth.

The transportation of containerized cargo was begun from 1972. The cargo of railroad containers is expected to rise steadily in the long-term. The rail container transportation has the following strengths. It is comparatively safe and stable regardless of a weather change. And it reduces the cost in the case of long-distant transportation and the greenhouse gases 8 times more than the road transportation can. Finally, it can transport containerized cargo speedily through a linked transportation between railroads and roads.
2. The needs of the dis-shuffling model

KORAIL began to operate fixed trains for improving the efficiency of railroad container transportation from October 2008. At the early stage, it tried to operate two 120km/h trains with 33 carriages that were run by non-stop between an initial station and a final station.

The effects obtained from the fixed trains operation can be divided into two. The first is the efficiency of inspection times through simplified checking ways. The second is to become understood how important dis-shuffling works are for cost-down practically. As a result, the fixed container trains have expanded: 12 trains in March 2009 and 20 trains in July 2009. It is a bit success in terms of inspection and shuffling.

However, it is problematic to expand the fixed trains additionally. It is difficult for the fixed trains to be shuffled “on-the-way stations”. And another problem is that most on-the-way stations do not have the capacity for the 33-car train (the basic model of fixed trains) because the railway lines are too short to conduct the work of loading cargos. They also do not have an appropriate shuffling signal system. So if those problems are not solved, it is difficult to expand fixed trains and thus it is necessary to prepare a plan for improving facilities through linking between the systems of the work lines of on-the-way stations and the main lines.

3. A similar model abroad

We look for JR freight E&S(Effective & Speedy Container Handling System) model. Containers are loaded or unloaded directly to/from a train on the rail. The E&S model is the system to operate immediately after finishing the unloading works with the unloading equipments with maintaining the composition of the relevant train on the main line which the train operates, that is, the unloading track combined with the destination and departure track in case the freight car of the main line delivers the freight at the way cargo station.

Unlike the existing ways, it can not only reduce the costs for the shuffling of freight cars but also can be used for other purposes by reducing the site needed for shuffling and has a merit to enhance the efficiency of train operation and the application of freight cars.
Challenge C: Increasing Freight capacity and services

Fig 3-1. E&S model shortening of hours

Fig 3-2. The cost-effect analysis of E&S model


4. A new dis-shuffling model of KORAIL

4.1. Method for construction

The basic conditions for a dis-shuffling model are as follows:

To begin with, most cargo containers in KORAIL are 20-feet and 40-feet sizes. They are too large and heavy to use forklifts to load and unload. Thus, it is necessary to use reach stackers or trans-trainers to load and unload the cargos.

As for locomotives to be used, diesel locomotives will be used rather than electric ones, in consideration of the equipments for loading and unloading heavy cargos. And because the electric supply is stopped for the purpose of maintaining the railway lines after 12:00pm, the trains used at night will be diesel locomotives. However, the national R&D(research and
development) of LNG hybrid locomotives, which use clean energy and replace diesel ones, will be conducted.

As for the railway lines at the station, it is necessary to design those who are longer than 600m in consideration of the effective length of track (600m). As for the signal system, the main lines should be interlocked to the lines of work in order for a train to at once arrive and depart. The yard for cargos should be 600 meters long.

And it is recommendable that with a view to reduce equipment-improving expenses, the method for a targeted station should be changed to a side (side-platform) one which makes it possible for both-direction trains to enter at the same time through the cross-over from the main line.

![Diagram of Present and Modified Dis-shuffling Model](image)

**Fig 4-1 Korean dis-shuffling model draft**

For example: explain the present container shuffling works of 2-car train
1. Train arriving
2. 2-car train leading by lead tracks
3. Entering the 2-car train into CY
4. 4-car train leading by the lead tracks(already the other 2-car train prepared to start in to main line on CY)
5. Entering the 4-car train into main line(Given a long enough length of time for shuffling in main line)
6. Entering the 2-car train into CY(2-car train leading by lead tracks, Entering the 2-car train into CY)
7. Only the locomotive into main line(leading by lead tracks and entering into main line)

**4.2. The Plans for Improving Station Facilities**

Some cargos need transshipment at on-the-way stations. Because the dis-shuffling model can execute loading and unloading cargos effectively, it is very effective in a station with the cargos. By contrast, it is less effective in on-the-way stations and the initial and final stations in which cargos are loaded and unloaded to be transported to the initial and final stations than in intermediate stations.

We choose 9 stations for the dis-shuffling model. Hoedeok Station on the Gyeongbu Line is expected as intermediate freight station in future. It will assume a important role in ramification(function of relay) of Gyeongbu Line, Honam Line and Janghang Line. And the model should be applied to other additional stations in order: firstly to Hoedeok Station, followed by Sojeongni Station, Yakmok Station, Sapgyo Station, Cheongju Station, Gunsan
Challenge C: Increasing Freight capacity and services

Station, Dongik Station, Dongsan Station, finally Chungju Station (total 9 stations).
For improving the facilities of on-the-way cargo stations, several ways are applied: minimal purchase of land through considering the track based on the maximal use of existing railroad land; using the existing station track to choose the length of the working line as the 600-meter effective length of track; adopting an interlocked signal system related to cross-over so that trains can directly enter the working line on both sides.

The Hoedeok Station and the Sojeongni Station out of the nine stations were examined as the targeted ones.

Fig 4-2 South Korea Railroad Map

4.3 The improvement of Hoedeok Station

4.3.1. Current Status

Now the station do not have any function of physical distribution. But the station will be a foothold station for physical distribution which can assume a role in ramification of the Gyeongbu Line, the Honamseon Line, the Chungbuk Line and the Janghang Lines in future. Additionally, as the Yongsan train-base is going to be moved to the Daechang train base located in Daejeon, the Shintanjin Station will not treat cargo containers any longer. And then it is necessary for the next Hoedeok Station to replace the Shintanjin Station.
In the long-term, this station is also planned to treat the cargo containers for the Okcheon Station.

Fig 4-3 Hoedeok Station area situation

4.3.2. Facility Improvement

The Hoedeok Station, which now does not treat container cargos, should have container-treating facilities. The track needs to be constructed not only that the existing track may be maintained but also that the effective length of track can be secured. The loading track is placed in the outside of the remaining track; the cargo-train track is placed in the inside of the remaining track.

The Hoedeok Station is an intermediate foothold station; so the 2 working lines are connected to the main track so as for cargo trains to easily come in and go out. The effective length of track of the 2 working tracks and 2 cargo-train tracks will be set as 600 meters so as for long and large car-trains to easily come in and go out. A 600-meter drill track will be built at the starting and end point of the station so as to easily drill without interfering with the main track.
Challenge C: Increasing Freight capacity and services

Fig 4-4 Hoedeok Station wiring map

For the purpose of securing the effective length of loading track, it is necessary to install a ramification machine on the main track in the direction Busan; so the main end track is improved from 10‰ to 2‰, to expanded 757 meters.

Fig 4-5 The main end track improved

Since the improvement in the main track should be made during train operation, it is inevitable to install an interim track. And we will have a yard for physical distribution, 49,500 m² in area, which can treat 230TEU a day as of 2031. The entrance road into the yard will be a 4-lane road connected to Gapcheon Intercity Highway.

Fig 4-6 the entrance road into Hoedeok station

4.4. The improvement of Sojeongri Station

4.4.1 Current Status

The Sojeongri Station, whose course of cargo movement includes CheonAn and ASan areas to Busan area, has a comparatively small amount of cargos to be treated. However the station is chosen as a foothold station because the next Dujeong Station will not treat container cargos any longer for its difficult shuffling works.
Line “1” is connected to CY Line “1” so as to make the best use of the station land and of the existing tracks. And it needs to change the signal system and install the cross-over, which make it possible to arrive and depart on both sides.

Fig 4-7 Sojeongri station

4.4.2 Facility Improvement

The Sojeongni Station has Line “1” connected to CY Line “1” so as to make the best use of existing facilities and to additionally purchase as little private land as possible. For the purpose of applying the dis-shuffling model, Line “1” will be taken away and some parts of private land will be purchased to link it to CY Line “1” south, which means that the station will experience as little change as possible.
5. Economic analysis

The premises supposed for economic value analysis are as follows. First, it is supposed that the expenses for 9-station facilities improvements are all input in the early years of the project; next, the cost-benefit analysis includes reduced expenses from personnel expenses, operational expenses and traffic-wasted expenses (supposed that these conditions last during the period of analysis); finally, the increased amount of container cargos, attended by the introduction of the dis-shuffling model, is calculated as that of container cargos which will be transported in road vehicles.

An example of the effective analysis of JR freight’s E&S model is applied to an effective analysis of personnel operation and the reduced time. Expenses include direct expenses for civil engineering, track, construction, communications and others, and indirect expenses such as incidental expenses, reserve expenses, land-compensating expenses, indirect reserve expenses and the like. The period of analysis is set as 30 years; the discount rate as 5.5%.

The analysis, reflecting these conditions and premises, reveals that B/C is about 1.15 and it reaches the conclusion that the project for introducing the dis-shuffling model is economically valid.

6. Conclusion and future prospects

The purpose of this report is to come up with a method for improving cargo-treating facilities at stations. In order to build the method, it conducts advance studies of a loading-and-unloading work suitable for container specifications, locomotive improvements, and the work-line expansion in consideration of cargo train lengthening.
And it sets some basic conditions for improving physical distribution bases:

- Minimal purchase of land by using as much existing land as possible
- Securing the effective length of track (600 meter or longer) by using existing tracks
- Making an efficient alternative for improving insufficient facilities for train operation
- Preparing tracks for train operation at physical distribution bases
- Securing the validity through analyzing economic effects when 9 stations are improved.

For securing the dis-shuffling model stably, it is necessary to make a prediction of the trend of cargos in consideration of a functional integration with adjacent CYs and take into more concrete consideration facilities and equipment purchase, an increase in train operation and others. This paper, on the basis of minimization of these obligatory conditions, conducts an orderly analysis of facilities and equipment improvements at two stations, the Hoedeok Station and the Sojeongni Station, which are expected as foothold stations.