A STUDY ON PORT-HARBOR AND INTERNATIONAL INTERMODAL TRANSPORTATION
—ESPECIALLY CENTERING AROUND THE WEST COAST OF KOREA—

港湾と国際複合一貫輸送に関する研究
—特に韓國の西海岸を中心として—

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- ESPECIALLY, CENTERING AROUND THE WEST COAST OF KOREA -

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Chapter 1: Introduction

1. Notion of International Intermodal Transportation

"United Nations International Multimodal Transportation of Good Treaty" was concluded by United Nations Convention on International Multimodal Transportation of Goods in May 1980. Definition of "International Multimodal Transportation of Goods" stipulated in Article 1 of the General Provisions of the treaty reads, "International multimodal transport" means the carriage of goods by at least two different modes of transport on the basis of a multimodal transport contract from a place in one country at which the goods are taken in charge by the multimodal transport operator to a place designated for delivery situated in a different country". In other words, "Multimodal Transport Contract" means a contract whereby a multimodal transport operator undertakes, against payment of freight, to perform or to procure the performance of international multimodal transport. Therefore, the combined transportation operator of international cooperative and continuous transport are granted with the guarantees of (a) Singleness of transportational subject, (b) Singleness of transportation, (c) Unitary freight tariff and (d) Singleness of transportation liability. As an example; Such material forms as Land Bridge Service, the diverse cooperative and intermodal transportational system and its economic nature are pattern of international intermodal transportation.

Thus, International Intermodal Transportation assumes liability for all sections of transportational route and maintains the constancy of freight by transporting cargos from the door of consignor to the door of consignee with organic combination of more than two different modes of transport. Also, in view of national economy, international intermodal transportational system minimizes total transportation cost and is a synthetic transportational system most suitable for rapid and safe transportation.1)

2. Problems of International Intermodal Transportation

The characteristic of international intermodal transportation through the medium of container is preference between its route and relative parties. The main routes which are linked with this country are (1) American Land Bridge (ALB): A route through which cargos are transported to European countries after being transshipped on the East Coast of the United States acrossing American Continent being connected with railroads at harbors on the West Coast of the United States after acrossing the Pacific Ocean. (2) Canada Land Bridge (CLB): Acrossing the territory of Canada by railroad after acrossing the Pacific. (3) Sea and air transportations via the West Coast of North America: Transportation to European countries loading on aircraft in Vancouver, North America and Europe after acrossing the Pacific. (4) Sea and air transportation via South-East Asia: Transportation to European countries by transshipping on aircraft after transporting to Hong Kong, Singapore and Vancouver. (5) Intermodal transportation via European route: Intermodal transportation to the inlands of European countries by transporting to European ports through European route (via Suez Canal). (6) Mini Land Bridge (MLB) (shipping company service): Transportation to Gulf ports on the East Coast of North America acrossing the continent after transshipping on railroad at ports on the West Coast of North America after acrossing the Pacific. (7) Interior. Point. Intermodal (shipping company service): Transportation to the inland of North America after transshipping on railroad at ports on the West Coast of North America after acrossing the Pacific. (8) Riverst. Interior. Point. Intermodal (RIPI)

1). NACFC: Trailer/container traffic, Special Rules for Containers Measuring Less Than 400 Cubic Feet Inside Dimension, p 255.

(shipping company service): Transportation to the inland of North America after transshipping on trucks at ports on the East Coast of North America after coming to the ports via Panama Canal. (9) Intermodal Transportation between Korea and America (forwarder service): Forwarder service applicable to (6) and (7). (10) Intermodal transportation between Korea and Japan: Transportation to the inland of Japan after transshipping on railroad or truck at Shimonoseki Port after transporting to Shimonoseki Port by Kwanbu Ferry from Busan or by container ship from Inchon Port. (11) Intermodal transportation between Korea and Taiwan: Transportation to the inland of Taiwan after transporting to ports of Taiwan such as Kaohsing, Keelung and others ports transshipping at these ports. Also, there is another route through which cargos are transported from Korea to the inland of Taiwan by way of Keelung port. (12) Intermodal transportation between strait localities of Korea and the South-East Asia: Transportation to the inland of Korea after transporting at Hong Kong, Singapore or Bangkok. (13) Intermodal transportation to Africa: Transportation to the inland of Africa by railroad or truck after transporting to Lagos and other places. (14) Intermodal transportation to Australia: Transportation to the inland of Australia by transshipping on railroad or truck after transporting to Sydney or Melbourne. (15) Intermodal transportation to the Middle East: Transportation to the inland of the Middle East by acrossing the continent by truck after transporting to Dubai, Dammam, Kuwait and Basro Port by container, etc. The above routes are operated by such carriers as shipping companies and airlines who operate their modes of transportation for themselves and, in addition to these are diverse by such diverse enterprises as transportation handling enterprises, overland carriers, warehousemen and shipping agents as NVOCC (Nonvessel Operating Common Carrier by Warer). However, international intermodal transportation service cannot fulfill its function sufficiently as transit transportation. Therefore, overall regulation by public law is necessary for international intermodal transportation that can change the function of containerization from hard phase to soft one.
For example: Problems such as terms and conditions of trade, financing, insurance, liability of carrier, B/L and various freights should be systematically solved so that transportation can be undertaken with Add on Rate and Network Liability System by issuing through B/L. Especially, terms and conditions of trade, financing, insurance, liability of carrier, freight and Letter of Credit may be referred to July, August and September issue of "Problems of International Intermodal Transportation" written by me and published by "Cargo Press".2)

3. Policy of Readjusting Port-Harbors to cope with Containerization

To cope with the increase of the quantity of goods transported by containers, it is urgent task to frame a policy for readjusting port-harbors by securing sufficient capacity of marine transportation and by expanding port-harbor facilities. From the beginning of 1980s, Korea began to act a leading role in the world in the field of the capability of shipbuilding and of manufacturing container. Also, the number of container owned is also ranking high in the world. In view of economic prerequisites and of the trend of international intermodal transportation, the formulation of policies for marine transportation and port-harbor will be accelerated for the re-arrangement of port-harbors of this country to cope with prospective containerization.
Neverthless, in "Post Development" published by UNCTAD, it was asserted that, as the most ideal form of current container development system, and in the case of traditional port cities like Busan of Korea, a container transportation system in which

2) Jae Ha Kim: "Problems of International Intermodal Transportation"; pp 45 - 49. "Trade transportation"; Aug. 1986; "Ibid"; pp 45 - 48; Sep. 1986; Press Cargo, August and September 1986.

container terminal soly undertakes loading and unloading of container while such incidental function as storage function, sorting function and custom clearance function are transferred to I.C.D. that is geographically near from final consignee or initial consignor may be recommended.3) Also, in "Measures for Rationalization of Container" published by KAIST (Korean Academic Institute of Science and Technology) and the Ocean Research Institute, the uselessness of local container port-harbors was asserted by mentioning, "..... now adequacy can no longer be found in the reason for the existence of local container port-harbors in this country. Accordingly, one port-harbor for one route of one country or one harbor for plural routes of one country should be recommended". In extremity, they asserted one port for one route or one continent.4)

Corresponding to these assertions, the scale of Busan Port is lagging behind its increasing volume of container owing to the delayed start of the construction of its container pier, which was resulted in a blockade of further growth of the port-harbor. On the other hand, in order to be prepared for probable development of room for further development of Inchon Container Port, an exclusive container port is constructing in Kwangyang Bay on the South Coast. In addition to these, in view of prospective relation with Communist China and of syntheatic development of territory, a plan was formulated for the development of Biin Port on the West Coast to construct a large-scaled container port of international level. Another plan was framed for the containerization of international intermodal transportation that connects respective transportational organ of sea, land and air together after constructing Ocheon Feeder Port and Mado Feeder Port as base ports. The intended purpose of these plans is, in view of efficiency and principle of competition, to change the routine circulation system, a type of "following after demand" in which service is adapted to demand to a reverse type of "developing demand" with mutual assitance (cooperation and tie-up) of relative parties by curtailing administrative power to a possible extent in view of publicity. Therefore, confront tasks are rapid development of the capability of international intermodal transportation system that gives option to users and improvement and expansion of new container port-harbors which are competition prerequisites in demand for traffic service and readjustment of port-harbors to cope with intermodal transportation of containers based on the background of plan for the construction of new ports. There are 1,868 port-harbors in Korea and, among these, 44 are designated port-harbors. Among the remaining 1,409 port-harbors including fishery harbors, there are Inchon Container Port, Busan Container Port and Kwangyang Container Port that is to be completed in 1987. This means that, where there are many local ports, the theory of one port for one routs of one country or that of one port for plural routes is nonsense. Also, it is considered that transferring the function of warehousing and sorting to ICD except for service of mother ship and marshalling function which container port-harbors must perform is contrary to the function of intermodal transportation. Futhermore, the West Coast of this country is a vast space that has a strong possibility of constructing new ports of international level and such ports will be able to handle ever-growing quantity of cargo to be transported by container. If ICD transfers custody, distribution and storage functions of port-harbor to inland, ICD of inland port type that is not collecting and distributing center of cargo can be a harmful factor that hinders the rapidity, economizing and safety of international intermodal transportation, unlike the function of European ICD that is like an inland post where such functions are perfectly fulfilled at exclusive container pier.

3) UNCTAD; Port Development; pp 99; 1978.
4) Ocean Research Institute of KAIST; "A study on measures for rationalization of container transportation"; p 141; 1983.

Chapter 2 International intermodal transportation and direction of overland transportation of container.

1. International intermodal transportation and direction of transportation by container truck. International intermodal transportation is formed in traffic market through competition among each means of traffic and free selection by users. It is a pluralistic cubic system covering trucks, trains, marine transportation, air transportation. Therefore, it is an indispensable premise for the construction of intermodal transportation system of sea, land and air by characterizing the system with the peculiarity of each means of transportation by most adequately allocating budget to them in order to most suitably cover the entire territory with this system. Especially, in trailer transportation system, computerization of information handling is indispensable for the construction of such system. The readjustment of public road transportation which makes the central system of trailer transportation as the starting and ending marks of intermodal transportation is the node of port-harbor transportation system which is the core of international intermodal transportation. Connection between port-harbor and intermodal transportation may be expected by constructing piers for containers to make preparation for the increase of the quantity of both home-made and foreign-made goods to be transported and by expanding and improving road transportation in the rear based on a plan concerning the quantity of goods to be transported by containers (TEU). 1). A plan for the organization of road network in the rear. Express-highways plans to be connected or expanded under the 2nd Plan for Multiple Purpose Development of the Land, the 5th Five-Year Plan for Economic and Social Development and plans for the development of Kwang Yang Bay and Biin Port as follows:

Table 1. Plan for the expansion of transportation network facility.

Classification	Description	Section	Scale of project (km)	Period of Project
Road	expansion of express-highways	Taejon-Kwangju	170.7(4 lanes)	1982-1986
		Seoul-Taejon	152.3(8 lanes)	1985-1987
		Masan-Jinju	51.6(4 lanes)	-1991
		Taegu-Masan	84.2(4 lanes)	-1991
	construction of express-highway	Taegu-Chun-chon	330.0	1987-1990
	Expansion of express-highways	Jeonju-Namwon	58.9(4 lanes)	-1988
		Namwon-Kure	36.4	-1988
Railway	Double tracking of Honam Line	Yiri-Songjungri	101.2	1981-1988
	Kyung Bu Line CTC	Suwon-Dong Taegu	285.6	1984-1988

Material : Jae Ha Kim; " A study on policy of Marine Transportation and Port-Harbor in Korea ; p 22; The Korea Port Economics Association, 1986

(1). In order to connect between Biin and Daejeon, construction of an industrial express-highway with 4-lane and a length of km should be started.
(2). In abreast with the double-tracked railroad, 2 2-lane express-highway should be parallel with the river-side road along Kum River Bank (Kunsan - Daejeon, 100km) that is to be completed in 1987. (3) Construction of a 4-lane express-highway between Inchon and Mokpo along the West Coast Line (estimated cost: 40 billion Won) and double-tracking of the West Coast Railroad should be started at the same time with the completion of bank at the mouth of the Kum River. (4). The 4-lane express-highway that connects Jinju, Namwon I.C. and Kwangju should be connected with the 88 Express-Highway and the West Coast Express-Highway at Namwon.

2). Problem of transportation by container trucks. Container transportation enables ships to obtain high working ratio. At the same time, a study should be made to give a high productivity to the trucking industry. Especially, in overland transportation of containers, reliable and rapid withdrawl of containers and overland transportation of empty containers should be assigned to truckers and a certain system should be established so that such system can be profitable to truckers. 1) Also, tasks in relation to overland transportation of containers and in abreast with the development of intermodal transportation system are as follows: (1). Systematizing overland transportation and construction of powerful transportation network. (2). Re-organization of transportational capacity to be equipped with powerful capability of collection and delivery. (3). Improvement of the ability of handling informations by introducing computer for the management of containers, relative machinery, equipments and facilities. (4). Improvement and expansion of road facilities and supplementation of existing regulations and systems of overland transportation for the establishment of international intermodal transportation system. 3). Cost of inland transportation. There is a trend of prolonging the distance of international transportation caused by the expansion of trade by the Pacific nations, of increasing the quantity of goods transported by containers and of building and using

1). NACFC: Trailer/Comtainer traffic, Special Rules for Containers Measuring Less Than 400 Cubic Feet Inside Dimension, p 255.

large-sized container ships. As a result, international intermodal transportation system, when Inchon Port is used for goods of export or import, the cost of transportation is only 300,000 Won for 100 tons of cargo. However, cost of inland transportation to Busan is 1,400,000 Won. Therefore, cost to Inchon Port is low by 1,100,000 Won. In the case of container cargo, cost is low at Inchon Port by approximately 200,000 Won on the basis of each 40 feet. 2) In the case of Han Jin Marine Transportation Co., Ltd., they abolished, in August 1980, differential freight system that had been applied to Inchon and Busan Port. Even if differential freight is charged, cost at Inchon Port is lower by 770,000 Won if cost of overland transportation is included. 3)

Table 1. When differential freight is not charged

Classification	Seoul-Inchon-Yokohama	Seoul-Busan-Yokohama
Freight tariff	W243,540,000	W210,000,000
Cost of overland transportation	43,020,000	185,870,000
Stevedoring charge	16,710,000	16,820,000
Total:	W303,270,000	W412,698,000

Table 2.
When differential freight is charged

Classification	Seoul-Inchon-Yokohama	Seoul-Busan-Yokohama
Freight tariff	W210,000,000	W210,000,000
Cost of overland transportation	43,020,000	185,870,000
Stevedoring charge	16,710,000	16,820,000
Total:	W269,730,000	W412,693,000

Material : Jae Ha Kim; "Ibid" p 23, The Korea Port Economics Association; 1986

Nevertheless, 80 percent of exporters and importers of Seoul prefer to Busan Port since they are lack of the consideration of total cost system for saving cost in material circulation.

Table 3. Results of using harbors by business organizations in the sphere of the influence of Inchon Harbor.

Classification	Import				Export			
	Total	Inchon Harbor	Busan Harbor	Other harbors	Total	Inchon Harbor	Busan Harbor	Others harbors
Total:	34,032,479	32,066,278	1,727,269	238,932	6,679,434	4,285,230	2,292,535	101,600
%	100	94.2	5.0	0.8	100	64.1	34.3	1.6
1983	16,791,292	15,863,220	846,120	81,952	3,446,699	2,267,967	1,429,399	49,333
%	100	94.4	5.0	0.6	100	66.8	32.8	1.4
1984	17,241,187	16,203,058	881,149	156,980	3,232,735	2,017,263	1,163,136	52,336
%	100	93.9	5.1	1.0	100	62.4	35.9	1.7

Material : Office of Customs Administration; Investigation and Statistics Bureau, 1986

As shown above, in the performance of inland transportation with containers, the pattern of container transportation is determined by inland transportation if the terms and conditions of marine transportation are same with those of inland transportation. However, as to transportation by container train, cost of transportation is increased for a short distance owing to excessive capital cost. In the case of long distance and of inland transportation of consignors are apt to prefer transportation on highways because of cost of maintenance of terminals and such hindering factors against the intended improvement of the effect of intermodal transportation system as employing a second means of transportation when cargo has to be delivered to final cargo owner. In economic analysis for the selection of the most suitable place for container piers and, in case cost of container transportation on the highway occupies 50 to 80 percent of all expenses, cost of container transportation on the highway in the areas of Seoul, Busan, Daegu, Kwangju, Namwon, Kwangyang Biin, Ocheon and Mado are respectively determined reflecting estimated O/D volume of container of each area after computing unit cost of the business of container transportation on the highway and the total cost of the business. 4)

2) Gil Soo Park, "A comparative study on the cost of transporting goods of export and import at Inchon Harbor and Busan Harbor", the second volume, pp 70-73.

3). Series No. 76 of "Hae Soo Harbor" published by Office of Maritime & Port Authority.

4) Office of Maritime & Port Authority, "Topographic survey for the selection of place for the construction of container pier", one of five volumes, 1985, pp 35-44.

Thus, international intermodal transportation greatly save time of transporting cargo to an area in a short or medium distance and such transportation is greatly effective as a strategic means of international intermodal transportation. Port-harbor, railroad and airport respectively shares a part of the whole process of transportation and ultimately they are connected by a terminal to display the function of international intermodal transportation. Intermodal transportation system should greatly uplift the gravity of trucking by displaying, to the maximum extent, the peculiarity of intermodal transportation which road traffic has. 2. International intermodal transportation and direction of transportation by container train. In Korea, quantity of goods transported by container train was 692,000 TEU in 1979. The quantity is increasing every year and if the quantity of 1979 is assumed to be 100, the quantity was 377,000 TEU in 1985 or an increase by 70 percent. Assuming that this tendency of increase is constant, it is anticipated that the quantity will be increased to approx. 1,166,000 TEU in 1986 and approx. 1,819,006 TEU in 1999. A comparison of the share of railroad with the whole quantity of national transportation shows that the share of railroad was 5.9 percent in 1980 and 6.6 percent (increased by 0.7 percent) in 1985. A comparison of the share of Seoul-Busan with the whole quantity of national transportation shows that the share of Seoul-Busan was 15.1 percent in 1980 and 22.5 percent or an increase by 7.4 percent in 1985.

Table 4 Yearly tendency of container cargo.

Unit: (1,000 TEU)

Classification \ Year		1980	1981	1982	1983	1984	1985
National (increasing rate)		692 (100%)	825 (119%)	852 (123%)	962 (139%)	1,184 (170%)	1,173 (170%)
Seoul-Busan (increasing rate)		270 (100%)	305 (113%)	313 (116%)	331 (123%)	352 (130%)	377 (140%)
Railroad (increasing rate)		41 (100%)	51 (124%)	63 (154%)	74 (180%)	78 (190%)	85 (207%)
Share % Railrod	Seoul-Busan	39	37	37	34	30	32
	National	5.9	6.1	7.3	7.6	6.5	6.6
	Seoul-Busan	15.1	16.7	20.1	22.3	22.1	22.5

Meterial : Preared J.H. Kim ; 1985.

※ In the adoption of quantity of cargo to be handled at each berth in framing plan for container yard and equipments, capability of stevedoring per berth gradually increases in accordance with the scale of facility to be installed by step. Therefore, in the determination of the capacity of various ground facilities such as CY, CFS and stevedoring equipments, when the capacity of initial stage of facility is applied in the application of stevedoring capability per berth, it is anticipated that a phenomenon of shortage of the capacity of facility will occur in abreast with the gradual increase of the scale of pier. On the other hand, when capability of final stage is applied, surplus investment may be made on the initial state. In order to prevent this constradiction, in this plan, all of 207,000 TEU was applied in the determination of the scale of ground facility on the basis of the possible handling capability of Kwang Yang Bay that is berths, the average value of entire scale of facility. This quantity is nearly same with the quantity (209,000 TEU/Berth in 1982) handled by RCTOC (4 beths at both #5 and #6 Pier) that is currently operated at Busan Port or quantity (208,000 TEU/Berth in 1983) handled at Hong Kong Port (7 - 8 berths).

1). Capacity of railroad transportation of containers.

In Korea, assuming that the scale of facility will be the average value of 7 berths of the whole scale in 1989, estimated quantity to be transported by railroad will be 102,191 TEU in 1989.※

On the basis of 330 working days per year based on working diary, average quantity to be transported by railroad will be 310 TEU (2,074 units) per day and 402 TEU per day in highest-demand season. However, railroad transportation of container will be 96 TEU (64 units) per trip, which is double quantity transported by a train consist of 24 freight cars (48 TEU). Therefore, quantity in high-demand season will be 480 TEU (320 units) per day by five trains. Therefore, index in highest-demand season is 1.21 (480 ≒ 402), and quantity can be multiplied in many ways suc as operating 2 trains per day or 4 trains per day and so forth. However, as an example of allocation of estimated quantity of containers to be handled at railroad terminal within the premises of container terminal In the case of operating 4 trains per day for round-trip respectively for 200 days in a year and 3 trains per day for 60 days and 2 trains per day for 50 days, the allocation of the frequency of operation is as follows:

Table 5. Allocation of the frequency of operating container train.

Number of day	Frequency of operating trains per day for round-trip	Railrod Quantity of goods TEU	UNIT
200	4 (384 TEU)	76,000	51,200
60	3 (288 TEU)	172,280	11,520
50	2 (192 TEU)	9,600	6,400

Material : Office of Maritime & Harbor Authority; " Topographic Survey and Selection of Place for the development of Container Piers" p 63.

From the table on the left-hand side, we can see that, on the basis of the same given conditions of stevedoring facilities at Seoul and Busan as existing conditions, the number of container (TEU) transported by train can be increased to approx. 200,000 TEU per year comparing with 57,500 TEU in 1979. If additional capacity

can be obtained by increasing the number of train for daily operation to 8 trains per day for one-way trip respectively or by increasing the number of freight car to 40 per track, the capacity of railroad will reach up to approx. 270,000 TEU per year and this value is same with the estimated value for 1986 and 1991 for transportation between Seoul and Busan. Presently, Office of National Railroad has 400 freight cars for containers and they must have 400 more container train in 1986. If they fail to increase the number of container train to be operated between Seoul and Busan, the number of container TEU to be handled by truck will be 205,000 TEU in 1986 and 220,000 TEU in 1991 comparing with 195,000 TEU of 1979. Therefore, Office of National Railroads should hereafter get out of Kyongbu Axis (Seoul - Busan) and should establish container terminals at Daejeon, Yiri, Namwon, Kwangju and Kwangcheon in order to handle long-distance cargo. These 5 terminals are anticipated to receive and forward approx. 230,000 TEU by way of Busan, Kwang Yang, Biin, Ocheon and Mado. Also, it is anticipated that some 490,000 TEU will be received and forwarded in 1991. If railroad transports 50 percent of this volume, the volume will be increased to approx. 110,000 TEU in 1986 and to 245,000 TEU in 1991. 2). Measures for the transportation by container trains. Material measures for the development of freightlines transportation for effective door-to-door transportation and for the establishment of intermodal transportation system are as follows: (1). Establishment of effective transit system linked with trucking. (2). Introduction of computer system for information system. (3). Expansion of the capacity of transportation by container train. (4).Long-term plans for the construction of a double-tracked river-side railroad parallel with the West-Coast Express-Highway which will connect Inchon and Mokpo and which will be completed in 1991 and for the construction of other double-tracked railroads to connect Biin and Daejeon, Kwang Yang and Nam Won, Po Hang and Mokpo and Namwon and Jinju. 3. Overland transportation of container and function of I.C.D. Inland depot is a place where small cargos are consolidated after being collected from the inland of the country. More detaily, LCL cargos transported to truck terminal or train terminal are filled up in a container at an inland depot that acts the role of inland container base or inland container depot from which container filled up with LCL cargos is transported to container port. Inland depot or inland clearance depot is set up at a conurbation (business of population center place), an important focus in inland traffic network and is usually located about 50 to 60 km away from port-harbor or factory for the purpose of transporting consolidated cargos by container truck or freightliner. Owing to its scale that renders economic effect, inland transportation cost can be minimized. In other words, all container cargos are collected at ICD located in a conurbation by the consolidation role of ICD and then the cargos are regularly transported to container port or consignee. Therefore, it acts a role of consolidation and distribution of cargos which greatly reduces the increasing trend of average cost. Also, with systematic coordination and possibility of control of such functions as CY function, manufacturing function, stock management function and warehousing function for maximum profit and minimum cost, inland depot, from the notion of modern marketing, alters ports to an interface for international intermodal transportation and also transfer routine port function to ICD that is away from pier while LCL cargos are broken ay CFS and improvement of custom formalities promotes efficiency of port. With the establishment of ICD base, trunk road transportation and local distribution are classified and large quantity of cpntainer transportation and speedfying it become possible in this system, cargos are transported from coastal railroad terminal to container pier with road trailer between sections of trunk road transportation in TOFC (trailer on freight car) method or in COFC (container on freight car) method taking advantages of speedfying railroad and minimizing original cost in long-distance. This system can ease traffic congestion and is an economic intermodal transportation system that includes the features of short-distance highway transportation and long-distance railroad transportation system, small loads of many consignors are loaded in a full container at road terminal (RT) and then carried by container truck to the door of consignee at the destination. Locations for the construction of ICD may be selected to Seoul Area, Honam Area and Kyongsang Area on the basis of topographic factor and volume of container. Here, Seoul Area covers Kyunggi-do Province and Kangwon-do Province excluding Seoul and Inchon. From this area, Kyongbu express-highway and Youngnam express-highway are connected together at Obong Railroad terminal. For central Area, with a lever of existing Kunsan Port, the gateway to Daejeon situated in the center of the territory. Biin Port, Ocheon Port and Mado Port which are

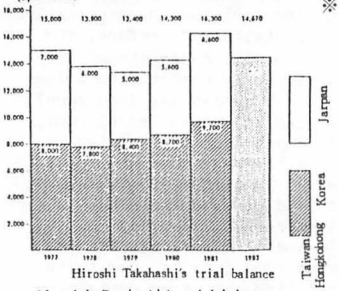
to be constructed, an inland depot of cargo collection and distribution type may be constructed at Kwangcheon the center of express-highways which connect Jeonju and Janghang, Biin and Daejeon and Inchon and Mokpo and of the double-tracked railroad of the West Coast that connects Cheonnan, Mado, Kwangcheon, Janghang, Kunsan and Yiri together. On the other hand, for Kyongsang Area, a groupage depot may be constructed at Kumcheon, the center of Kyongnam Circum which covers Jinju, Masan and Ulsan excluding Busan and of Kyongsang Circum which covers Andong, Daegu and Pohang. Honam Area connects Namhae express-highway and 88 Express-Highway and is situated on the border between Kyongsangnam-do Province, Jeonabuk-do Province and Jeonanam-do Province which cover 13 counties. Also, it is the center of the South-West part of this country and an inland depot of inland port type that will be unique in this country may be constructed at Namwon that is near from Kwangju whose gateway will be Kwangyang container port that is being constructed. Thus, in abreast with the development of the intermodal transportation of marine containers, inland container transportation system will act as feeder for marine transportation. Especially, when international intermodal transportation system steps into full-scale operation, marine container transportation will depend upon the achievement of inland container transportation. Therefore, the success or failure of international intermodal transportation will cause direct and serious competition between railroad and highway because virtually competition arises in the collection of container cargo from inland. However, as we can see from regular express cargo train system and intercontainer system enforced in the United Kingdom, France and other European countries where inland container transportation system is developed and from Piggy Back System enforced in the United States, container transportation on railroad and highway are combined in the form of mutual supplementation, rather than competitive relation. Also, in intermodal inland transportation system, road transportation display the function of feeder service from railroad terminal. Therefore, highway transportation not only loads flexible and diverse size of cargo but also makes intermodal transportation smooth by carrying from door to door owing to its mobility. On the other hand, as railroad transportation can carry containers in quantity and fast, it performs collection and transfer of cargo more efficiently than highway transportation does. Now we can see from the above discussion that the construction of 4 ICDs for Seoul Area, Central Area, Honam Area and Kyongsang Area can be defined as the construction of groupage depots as "ICD" of cargo collection and distribution type, excluding the "inland clearance depot of inland harbor type" at Namwon of Honam Area. The present construction of Obong Railroad terminal, the plan for Office of Customs Administration for the construction of storage place for exclusive use for inland containers and the construction of general CFS and ICD by Korea Maritime and Port Authority are not for the purpose of expanding Busan Port that is now in its limit. Now the writer proposes the neccessity of developing 3 large base port of international level on the West Coast to be prepared for the increase of demand for port in 1990s and for the prospective possibility of trade with Communist China and the establishment of ICD to improve the efficiency of intermodal transportation of container by transferring the function of CY and CFS to inland for the establishment of international intermodal transportation system of containers.

Chapter 3 Conclusion

1. Conversion of Container Transportation Market to Multi-Calling at Port-Harbors

In door-to-door intermodal transportation and in competition among land, sea and air, competition power of marine transportation is relatively disadvantageous. Main competition is developed on overland transportation. The freight rate of marine transportation is uniform regardless of tonnage whether it is a single ton or 1,000 tons. Furthermore, as international intermodal transportation is a transportation in which capital is concentrated, the Freight Conference considers that the emergence of transportation of container by nonconference vessels is impossible. However, the rapid increase of container hull caused the improvement of container pier as a result of the structural change of container transportation market and the improvement caused harbor function as a new pardigm.1)

〈Fig. 1〉 Total volume of cargo (trial) transported on North American Pacific Coast Line.



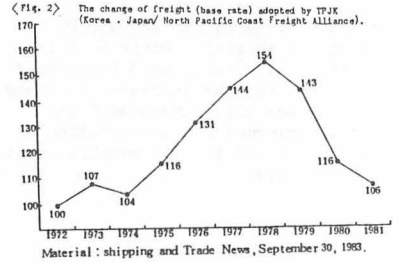
Hiroshi Takahashi's trial balance

Material: Dazahasida's trial balance

※ "Shipping and Trade News": March 30, 1983.
Volume was tried based on the talking agreement 10107 made by Korea. Japan/North Pacific Tariff Alliance (TPJK), Japan. Korea/West Canada Tariff Alliance (JKWC) and Hong Kong. Taiwan/North Pacific.

Comparing with the average of 14,000,000 to 15,000,000 tons of the volume of hull recently during six years shows more than 2 times of vessel surplus state. As to the reflection of freight index, we can see from 〈Fig. 2〉that surprising the fall of freight was such that the index of 106 in 1981 was in the same level of freight prevailed several years ago. Owing to the withdrawl of Sea Land Company from alliance for 2 years and 5 months, serious competition against nonconference vessels was resulted in an abrupt falling of freight index down to 106 in 1981 from 143 of 1979.2) This change in container transportation market and the levelling of service for containerization expedited pursuit of the most adquate route of inland transportation and cutdown of transportation cost. As a result, the followings became necessary: (1) Creation of synthetic harbor space to be prepared for the magnification of the size of container: (2) Provision of more delicate service by establishing intermodal transportation routes: Existing MLB (Mini Land Bridge: A railroad service route that connects harbors on the East Coast of North America and Fulf harbors after acrossing North American Continent) and IPI (Inter Point Intermodal) introduced by TPKJ (Korea·Japan/North Pacific Coast Freight Alliance) are Micro Bridge Service that transports cargo to the inland point of North American Continent, i.e. development of Unit Road System.3)

〈Fig. 2〉 The change of freight (base rate) adopted by TPJK (Korea . Japan/ North Pacific Coast Freight Alliance).



Material : shipping and Trade News, September 30, 1983.

Thus, the structural change of container transportation market caused conversion to multi-calling at ports. Also, the productivity of container pier widened the domain of local harbors from mere feeder service or tramper port for international inter-

1) Jae Ha Kim: "Container port activation and intermodal transportation", a thesis included in a collection of Korean, Chinese and Japanese academic thesises and read on Korea-China-Japan International Academid Conference in March 1986.

2) Takehikio Kimura; "Structural change of container transportation market and port"; pp 36-37. The Japan Port Economics Associćiation, No. 21.

3) Takehiko Kimura; "Ibid"; pp 35-36.

modal transportation to the wide-ranged and deep-rooted pursuit of economic rationality and socially adapted purposes in coastal industry, development of community and city, formation of harbor, circulation and environment. In this situation, conversion to multi-calling at ports should be taken into consideration as a new and paradigmatic container service for the development of local harbor from the viewpoint of protestantismic ethics of state, community, city, enterprise, people's economy and the society and even of ethical ideology of capitalistic idea (Protestantishe Ethik und der Geist des kapitalismus).

2. International Intermodal Transportation and Direction of Long-Term Development of Local Container Port-Harbor

Considering that, even with the activiation of Inchon Port and expansion of Busan Port to its limit, port facilities will be in short for 38,000,000 tons of cargo out of prospective 480,000,000 tons of cargo to be transported by containers in 2001, 4) constructions of new port-harbor is much more advantageous than the redevelopment of Busan Port even for the establishment of International Intermodal Transportation system. Therefore, plans should framed until 1987 for the construction of Yeocheon Petro-Chemical Complex, completion of the construction of Kwangyang Iron Refinery Complex, expansion of pier for iron refinary, readjustment of Yeosoo Port as a base port for service, Kwangyang Port as international container port-harbor, expansion of pier at Samil Harbor for chemical raw materials, readjustment of Yeulchon Harbor for light industry on the reclaimed land of 26,000,000 m^2 along with the coast of Yeulchon-myun Township, Yeocheon-kun County, Jeonlanam-do Province to be prepared for coming Pan-Pacific Age with a goal of constructing international container port. Also, in relation to the largest industrial complex of this country located at Yeulchol-myun Township, the capacity of Yeulchon Port should be expanded to a total length of 5,000 meters for container including the existing pier that can receive 250,000 DWT at the most. Further, in order to be prepared for prospective demand for port of the nineties and possibility of trade with Communist China, foundation of container pier should be formed at Ocheon Port and Mado Port based on the new Bi In Container Port that is in international level in size. This formation of foundation should be prepared when the development of Busan Port comes to its limit.

Further, any harbor is a prerequisite for the function of international intermodal transportation and it is indirect high effect on the maximum utilization of port capital and on the development of relative industries.5) In other words, expansion of port facility and effective operation of port which fall within the range of international intermodal transportation system reduce the import price of goods and improve competitive power for export, 6) together with international intermodal transportation. On the contrary, ineffective operation of port in one's own country and insufficient port facility cause the increase of expenses and congestion surcharge and consequently transportation cost is raised and lost the function of international intermodal transportation in international competition.7) Especially, only effective management of port or international scale for rationalization of container can establish international intermodal transportation system.8) In other

4) Jae Bok Lee: "Past ten years of port construction cost and port development direction" p. 16 "Port No. 10" the Korea Port and Harbor Association.
5) UN: Port development; A handbook for planning in development countries; TD/BC, 4/175, New York; p. 1, 1978.
6) Seatrade, Monthly, Journal; Vol. 5: p. 29; No. 12: London.
7) F. Voigt; The importance of the transport system for economic development process, Economic Commission for Africa, Sales No. E/CN, 14/c.
8) R. Robinson: "Modelling the port on operation system"; Economic Geography, Vol. 56; pp 31-33; London.

words, in international intermodal transportation, container port is First), intra-port subsystem of international container port that defines the physical limit of container port and Second), port-interland subsystem that includes inland area starting from container port and Third), port forland subsystem which includes regular liner and port of destination or port of origin. As we can see from the above, construction of new container port is an important problem in the decision of a policy to meet ever-growing demand for transportation by container and supply of service and for international intermodal transportation of sea, land air that is suitable for containerization through container port of system.

3. Conclusion Remark

"Harbor and international intermodal transportation" is the common subject to be discussed at the 24th (Conference (1986) to be sponsored by Japanese Harbor Economic Institute. My problem consciousness concerning this subject is as follows. (1) Economic growth→e pansion and intensification of overseas market→reducement of circulatory expenses, a problem may be arisen in view of low cost, rapid and safe transportation when Korean goods are exported to U.S. market. (2) Intermodal transportation is not merely overland transportation→port→marine transportation, even after unloading, international intermodal transportation is the most reasonable means of transportation for port→overland transportation (or air transportation). (3) From international viewpoint, intermodal transportation that includes relatives countries was mainly propelled by the industry and "what influence does it render to port of a country?" is considered to be the key point of port and intermodal transportation. On the other hand, the terminology of "Intermodal Transportation System" was generally used in the industry and relative Government department in this country. However, its meaning is not yet scientifically defined. Especially, problems which may be arisen out of international intermodal transportation are: First), Diversification of the route of international intermodal transportation. Besides such forwarding agents as shipping companies and airlines who operate main transportational means for themselves, services are offered by utilizing the services of these forwarding agents. In other words, services of transportation are carried out by intermodal transportation agents, overland transportation agents, warehouse-men and port operators like so-called NVOCC (Non-Vessel Operating Common Carrier by Water). Route connecting port with European circle and the United States which have a wide-range of interland is the very domain to be studied. Furthermore, in this domain, transportation service motivated by competition for route is problem-atic. Most of all, International Intermodal Transportation System arose basic pro-blem to traditional and customary practise of transactions in trade and other systems for which marine transportation was constituted as a base for international trade.[9] In other words, the kernel of problem to be looked into is a through review of con-ditions of trade, financing, insurance, liability of carrier, bill of lading, various systems of freight and establishment of new order for what the system should be.

Nevertheless, according to an academy announcement invitation letter forwarded to me from Prof. Toshio Kitami, Chairman of Japanese Harbor Economic Institute for seem-ing object of discussing concerning local harbors and function of intermodal trans-portation, it seems to me that he wanted me to study over instances occuring in Korea and, in response to his request, I attempted a social scientific and descriptive study with a problematic sense on the policy for the formation of foundation for the construction of international intermodal transportation system in Korea and, especially on "port and international intermodal transportation system" centering around the West Coast of Korea.

9) Harbor Operation; "Perspective of Harbor operation"; Series 5; pp. 11-12.

Table 1. Comparison of estimated volume of goods by steps of development and actual volume transported for the development of container terminal at Busan Harbor.

Classification		1976	1981	1986	1991
Actual volume transported	Export	186	429		
	Import	164	315		
	Total:	350	744		
1st-step	Export	52	135	224	
	Import	52	135	224	
	Total:	104	270	448	
2nd-step	Export	102	140	196	246
	Import	90	120	169	209
	Total:	192	260	365	455
3rd-step	Export			583	924
	Import			583	925
	Total:			1,166	1,849

Material : KAIST 1985.

(1) Before a pier was constructed at Busan Port in 1978 for exclusive use for container, container volume already reached above 500,000 TEU and even after the construction of the 5th Pier, 40 percent of the entire volume was handled through CY/CFS of off-dock and, in the mean time, the 6th Pier was opened in 1983, container volume reached up to 884,000 TEU which was far above the prescribed capacity of the 5th and 6th Piers combined which was 72,000 TEU and the actual handling volume was only 61 percent of the entire volume and the remaining was handled by CY/CFS off-dock, which was virtually resulted in the additional burden upon exporters and importers and furthermore it was the very cause of weakening competitive power in international competition. It was evaluated that all these result came from the insincere research report by KAIST which gave a base for the errorneous enforcement of policy.10) Furthermore, there was a remarkable gap between the basic achievement value for 1976 and the planned value for the same year. As a result, owing to the shortage of then port facility, in feeder service with Japan, cargo owners had to bear a heavy burden of 190 Dollars per TEU (price in 1980) incurred from transportation cost by mother ship of container and cost of container by feeder, and such costs were caused by uneconomical transportation costs such as cost for trans-shipment, CF, cost for transit to off-dock and CY/CFS and handling charge.

Thus, development of Busan Port reached trial and error. Take a instance, problem was inland CY of Busan Port. It was estimated that 15 billion Won was necessary for the construction of an unit of CY. Presently, the areas of pier for exclusive use for container is 200,000 pyung while that of inland CY is 300,000 pyung. The proportion of pier to inland CY is 38 to 62 percent while proportion in the function of virtual operation of container is 14 percent for pier and 86 percent for inland CY. In consequence, it is obvious that the construction of a large-scaled container port of international level is indispensable in abreast with the trend of constructing and using large-sized container ships.

Table 2. Classification by the class of container ships which stopped over at Busan Port.

Unit: Ship

Period	0-10,000 DWT	10,000 - 20,000 DWT	20,000 - 30,000 DWT	30,000 - 40,000 DWT	40,000 - 50,000 DWT	50,000 & above DWT	Total
Jan.-Dec. 1979	1,296	349	69	35	13	66	1,828
Proportion	70%	19.1%	3.8%	1.9%	0.7%	3.6%	100%
Jan.-Jun. 1984	11	185	203	159	98	7	663
Proportion	1.7%	27.9%	30.6%	24.0%	14.8%	1.1%	100%

Material: Jae Ha Kim" A study on Policy of Marine Transportation and Ports in Korea; p 21; The Korea Port Economic Association: 1986

The number of ships smaller than 10,000 DWT class was 1,296 in 1979 or 70 percent of the entire number. In 1984, the number was 11 or 17 percent of the entire number or a decrease to 1/40. In 20,000 to 30,000 DWT class, the number of ship which multi-calling at Busan Port was 69 or 3.8 percent or an increase by 30.6 percent (203 ships). In 30,000 to 40,000 DWT class, number of ships which multi-calling at Busan Port was 466 ships or 61 percent of the entire number of 765 ships. In 1983, 765 ships out

10) KAIST: "Survey for adequacy for the 3rd Step development of Korean ports"; Vol. 11, 1981.

of the entire number of 1,162 ships an increase to 66 percent. The reason was that, in order to save transportation cost, ships of 30,000 GTW class were generally used in the past. However, it is a worldly trend that full container ships of genernalization are widely used not only in this country but also every country is hurridly constructing international container port with a water depth of more than 14 meters.
(2) Considering this international trend and perspective of dispersing container ports in localities and the change of the composition of world trade, the direction of readjustment of piers under multi-calling at ports service shows that, in Korea, 24 percent of readjustment is performed in average every year, 10.1 percent in Janpan, 22 percent in Taiwan, 11 percent in Hong Kong and 26 percent in Singapore.11) A plan should be propelled for the re-development of Inchon Container Port on the on the West Coast aiming at international intermodal transportation in view of the present tendency of international container main route (Singapore——Hong Kong——Keelung—— Kobe) to change to regular sea route network that covers Shanghai, Tientsin, Tsintao and Dairen, foreseeing the possibility of trade with Communist China.

Table 3: Plant for Developing Piers at Container Harbors

* Developing Inchon Harbor: Additional Construction of 8 Births (1986 to 1997)		
- Breakwater	:	300 meters
- Quay (50,000 DWT)	:	2,240 "
- Volume of dredging	:	25,600,000 m^3
- Stevedoring facility	:	20 cranes (including 4 to be additionally provided for existing pier).
* Developing Bi In Harbor: Construction of 6 berths (1986 to 1997)		
- Quay (50,000 DWT)	:	3,080 meters
- Volume of dredging	:	36,600,000 m^3
- Stevedoring facility	:	22 cranes
- Floodgate(50,000 DWT):		1
- Floodgate(20,000 DWT):		1
* Developing Ocheon Harbor and Mado Harbor: Construction of 2 Additional Berths (1986 to 1997)		
- Breakwater	:	1,690 meters (South side: 690 meters, North side: 1,000 meters)
- Quay (50,000 DWT)	:	2,800 meters
- Volume of dredging	:	4,846,000 m^3
- Stevedoring facility	:	20 cranes

* Developing Ko Kunsan Harbor: To secure site by filling up, with dredged clay, inside coast line that connects islands after selecting the most safe place against wind and waves by utilizing the heavily indented coast line between Sunyu Island, Shinshi Island and Munyo Island is initial task to be performed. After securing site, the outer harbor of Kunsan will be moved to the front side of the site if development of Biin Harbor is not realized.
* Either Biin Harbor or Kunsan Harbor will be selected for location.

※ Prepared by J.H. Kim: July 1986.

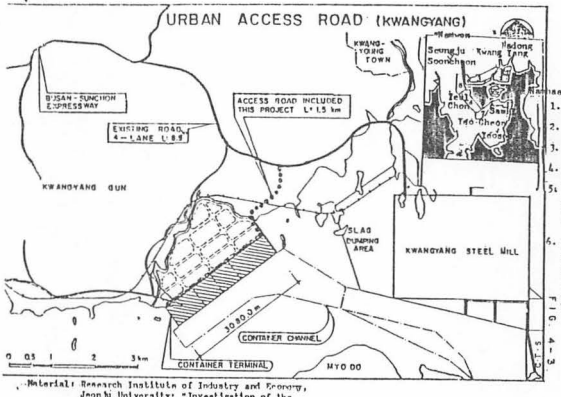
(3) Functioning container pier is more important than speedfying SL-7, the superhigh speed container ship. Especially, a plan is framed to construct a container aircraft transportation system consist of container truck, container trains and container aircraft and such system will be linked with intermodal transportation on land, sea and air centering around container port.
(4) In Korean system of inland transportation of container, 75 percent of total volume is shared by container trucks. The perspective of public road transportation on highway is bright seeing that the entire volume of cargo is transported by container trucks from container pier at Busan Port to Busanjin and between Obong Terminal and warehouses, cargo owners or factories. In America, container truck is replaced by trailer because the horse power of its engine is half of that of truck. The number of container truck registered in America is 13,400,000 - 40 percent of the total

11) Cargo Press Co.: "A study on international intermodal transportation, pp. 28-30; "Monthly Trade & Transport", Aug. 1986.

number of truck operated all over the world. Of these, 55 percent is scrapped every year. Thus, 50 percent of overland transportation is replaced every year by new type trailer. However, Korea has to plan for transportation by container trailer. Furthermore, domestic production of truck or chassis should hurry up. In addition, domestic assembly or manufacturing is difficult.

(5) Not to speak of the construction of double-tracked railroad on the West Coast to circulate around Busan, Kwangyang, Biin, Kwangcheon, Seocheon and Inchon, readjustment of system for exclusive railroad transportation of containers, manufacturing of train for exclusive use for container, construction of inland depot (Base railway station for transportation and container disposition depot) of cargo collection and distribution type, establishment of large-scaled network of freight liner, construction of effective relay transportation system on the axis of liners, development of containers for exclusive use for each item of goods, introduction of lease system, rational operation of on/off rail transportation and re-establishment of port and inland transportation system are necessary for international intermodal transportation system.

Fig 1.32



Material: Research Institute of Industry and Economy, Joongbu University; "Investigation of the reclaimed land of the new ... on the West Coast of Korea" p. 119

(6) In international intermodal transportation system, is indispensable single carrier's liability or uniform liability system in which a carrier become the principal body and other transportation organ become subcontractor for transportation under a contract linked mutually by different transportation organs of land, sea and air. Also, diversification of liner by harmonizing the low freight of marine transportation with the rapidity of air transportation, establishment of multiple warehouses for exclusive use for agents, formation of warehouse complex within the premises of cargo terminal, provision of middle or long-term facilities for air cargo through Government-controlled systematization of data of cargo to be cleared through the customs and readjustment of international intermodal transportation system are necessary.

On the initial premise of activating Inchon Port as a container port of the Far East and, at the same time, of functioning Busan Port and Kwangyang Port as international container ports until they come to respective limit, this thesis enumerated measures in the above for the increase device of international intermodal transportation through the supply of scientific informations and reasonable distribution of resources. Also, this thesis presented problems to determine the intention of policy whether the cited measures are for reasonable international intermodal transportation or what influence would they render to international intermodal transportation of containers.

Finally, this analysis made on the phase of civil engineering works, cost for the

construction of a container pier on the soft ground on the South Coast and cost for the construction of a dock at container port on the West Coast are same. Rather than the result of a general review of the cost of constructing piers at Busan Port or Kwangyang Port and at Inchon Port or Biin Bay, upkeep cost, management expenses, working expenses, inland transportation cost, construction or expansion of linking express-highways, social expenses such as the price-rise of peripheral lands, volume of cargo to be transported and so forth, a prerequisite was set with the triangular traffic network construction of land, sea and air for systematizing Inchon Port and New Biin Port international intermodal transportation, together with Busan Port and Kwangyang Port in view of prospective relation with foreland Communist China and of overall development of territory.