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A Systems Approach to the Korean Container Port Development

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1. INTRODUCTION

Following extensive debate over the last few years on the future of the Korean container port system, the two ports system of Pusan and Kwangyang seems to have emerged as the favoured path for port development. The government is continuing the development of Kwangyang container port and is proceeding with the Gadukdo port project. Kwangyang started service in early 1998 with the first phase scheme and the second phase scheme is under construction. Gadukdo container port, which is regarded as an extension of the existing Pusan port, will see the start construction work at the end of 1998, and is envisaged to come on stream in 2008. However, it is apparent that these development has not been based on a systems approach. Neither the government nor the port authority appear to have followed consistent principles in leading the developments, there has been no masterplan and developments has been influenced by non-economic factors such as the prejudices of policy-makers and the self-centred development ambition of local government.

Moreover, Korea is now faced with its most serious ever financial crisis. IMF has called on Korea to embark on full-fledged restructuring as a condition for the provision of the rescue fund. More than ever, it is necessary to adopt economic criteria in order to achieve optimal development. At least developments should be based on consistent principles as might be contained in a masterplan which sets out explicit development economic criteria.

The approach of Shneerson(1981), who has developed a dynamic port system investment model integrated with optimal port charges, represents good example of an integrated and consistent approach to the port investment modelling. However, we note that although the Shneerson model has much theoretical merit it is hard to implement and make operational. In particular, we are unable to identify how many alternatives are needed for the model and how much computation is needed to obtain solutions for the model.

A wealth of technical tools, including good solution algorithms for numerical models, are widely available. These have been developed by researchers working in many areas besides transportation. With the development of personal computers, it is easier to design a more pragmatic modelling approach reflecting the limitations of the data, time and resources available for a study. This study attempts to develop realistic and relevant investment planning models for container port developments with aid of a number of such methods.

2. MODEL STRUCTURE

The version of the port development problem considered in this paper depends on the model created by Shneerson. However, the distinctiveness of the study arises from its demonstration of the usefulness and pragmatism of heuristic algorithm by way of matching mathematically a framework for dynamic programming with a mechanism for linear programming.

First, some basic notation is introduced.
A nation consists of N regions, and the total demand for container cargo over time is given at time t by:

$$Y = (Y_1 \cdots Y_t \cdots) \tag{1}$$

The national demands for container cargo at time t, Y_t , are exogenous.

The demands for region i at time t, E_t^i, are derived from a function for distribution of regional container traffic described in Eq(24).

$$E_t = (E_t^1 \cdots E_t^N) \tag{2}$$

The modal split of each region's cargo at time t , F_{tk}^i, is based on a function for modal split described in Eq(25).

$$F_t = (F^1_{t,Road}, F^1_{t,Rail}, F^1_{t,Coastalshipping}, F^2_{t,Road}, \cdots F^N_{t,Coastalshipping}) \tag{3}$$

Also, there are P ports, where D_t^j, is throughput in port j at time t .

$$D_t = (D_t^1 \cdots D_t^P) \tag{4}$$

Port capacities at time t are given by:

$$K_t = (K_t^1 \cdots K_t^P), \tag{5}$$

The configuration of new port development at time t is:

$$I_t = (I_t^1 \cdots I_t^P) \tag{6}$$

That is, $I_t = \Delta K_t$

It is assumed that decision-making on port development is made at certain intervals which are normally in excess of a year. Such developments typically have a large budget and are undertaken from a long-term perspective. For this model, we divide the whole period concerned into a number of stages. Investment at each stage is constrained by budget i.e.

$$0 \leq I_t \leq B, \quad \forall\, t \in [0, \mathrm{T}] \tag{7}$$

where B, the maximum budget allowed for a given interval.

Given a number of feasible alternative investment proposals they must be evaluated. It is difficult to take into account all possible relevant factors consistently and completely.
It is especially difficult to define and measure the social benefits and costs caused by large infrastructure developments. To avoid these difficulties, the social benefits are considered to be constants. Accordingly, the problem is confined to the minimisation of the total system costs.

The objective function consists of the total system costs associated with container port development and these total system costs fall into three categories:
(i) construction costs,
(ii) transportation cost, that is, costs directly related to the transportation and
(iii) costs related to the infrastructure or the use of it such as terminal congestion costs.

Transportation costs(ii) may also include additional costs due to congestion.

Firstly, we calculate the transportation costs per year as a function of the optimal container traffic flow. At this point, it is noted that under a given investment project the optimal container traffic allocation between regions and ports is determined together with the calculation of transport costs. The mathematical formulation becomes as follows:

$$\textit{Minimise} \qquad f(K_t, Q_t) = \sum_{i=1}^{N}\sum_{j=1}^{P}\sum_{k=1}^{M} T_{tk}^{ij}\ Q_{tk}^{ij}$$

(8)

Subject to

$$Y_t = \sum_{i=1}^{N} E_t^i \qquad \text{for } i = 1, 2, \cdots N$$

(9)

$$\sum_{i=1}^{N} E_t^i = \sum_{i=1}^{N}\sum_{k=1}^{M} F_{tk}^i \qquad k = 1, 2, \cdots M$$

(10)

$$F_{tk}^i = \sum_{j=1}^{P} Q_{tk}^{ij} \qquad j = 1, 2, \cdots P$$

(11)

$$D_t^j = \sum_{i=1}^{N}\sum_{k=1}^{M} Q_{tk}^{ij}$$

(12)

$$Q_{ik}^{ij} \geq 0$$

(13)

where

T_k^{ij} = cost of transporting one unit between region i and port j using transportation mode system k, adding congestion cost to the cost in the case of "Road" transport mode.

Q_k^{ij} = amount of container traffic shipped from region i to port j using transportation mode k.

Secondly, additional costs occur owing to over-burdened container traffic allocated to each port:

$$C(K_t, D_t) = \sum_{j=1}^{P} d_t^j \ (D_t^j, K_t^j)$$

(14)

where

d^j = additional costs in ports of container cargo unit incurred by insufficient handling capacity in port j .

Lastly, we include the construction costs corresponding to the port investment project proposed:

$$Z(K_t, I_t) = \sum_{j=1}^{P} U_t^j (K_t, I_t)$$

(15)

where

U_t^j = construction costs per terminal.

The way we solve this problem is to work with the function $V_t(K_t, I_t)$ which denotes the total system costs of a certain proposal from the year t to the end of the planning period T. There is no more new investment at T. Since the planning period ends at time T, any investment considered will take place before that year.

$$V_t(K_t, I_t) = \{ f(K_t, Q_t) + C(K_t, Q_t) + Z(K_t, I_t)\}$$

(16)

with

$$V_T = \{ f(K_T, Q_T) + C(K_T, Q_T)\}$$

(17)

$$K_1 = \overline{K}_1, \quad \hat{I}_t \geq 0$$

(18)

This is a dynamic optimisation problem. Dynamic programming techniques may be used to determine the amount and the priority of investment. For this problem, we start with the smaller problem where the decision has nearly been made and has only

one more stage to make. The obvious optimal solution for this smaller problem is made from its current development state to its ultimate development state. At each subsequent iteration, the problem is enlarged by increasing by the number of stages left to make to complete the development. For this enlarged problem, the optimal solution for what to make next from each possible state can be found relatively easily from the results obtained at the preceding iteration. The details are as follow.
Define

$$X_1^*(K_1) = \underset{I_1}{Min}\{V_1(K_1, I_1)\}$$

(19)

$$X_t^*(K_t) = \underset{I_t}{Min}\{V_t(K_t, I_t) + X_{t-1}^*(K_{t-1})\}$$

(20)

where $V_t(K_t, I_t)$ = total system costs of alternative I_t at time t
$X_t^*(K_t)$ = optimal total costs at time 1, 2 …, and t given the state K_t

There is an important point that we need to clarify regarding the mathematical definition of this recursive equation. First, note that $X_t^*(K_t)$ is a function of the argument K_t only. This requires the right side of the recursive equation to be expressed in terms of K_t rather than K_{t-1}. This is accomplished by recalling that

$$K_t - I_t = K_{t-1} \qquad (21)$$

We can write the Dynamic programming recursive equations substituting Eq(21) into Eq(20) as

$$X_1^*(K_1) = \underset{I_1}{Min}\{V_1(K_1, I_1)\}$$

(22)

$$X_t^*(K_t) = \underset{I_t}{Min}\{V_t(K_t, I_t) + X_{t-1}^*(K_t - I_t)\}$$

(23)

Constraint (9) ensures that the supply of every region is satisfied. However, modal split also needs to be determined in a way which satisfies the constrains. No individual shipper or carrier's behaviour is explicitly shown in this model. The allocation of a region's traffic by transport modes based on the following procedure.

First, the regional container volume is estimated by the following function:

$$E_t^i = Y_t[(E_{t-1}^i / \sum_{i=1}^{N} E_{t-1}^i)(X_t^i / \sum_{i=1}^{N} X_t^i) / (X_{t-1}^i / \sum_{i=1}^{N} X_{t-1}^i)]$$

(24)

where

E_t^i = the estimate of container volume in i region at t

$i = 1, \ldots N$

$\sum_{i=1}^{N} E_{t-1}^{i}$ = the demand of container volume over all the regions at t -1

X_{t-1}^{i} = the area (in square km) of the industrial complex in i region at t -1

$\sum_{i=1}^{N} X_{t-1}^{i}$ = the area of all the industrial complexes at t -1

In order to determine the modal split of regional container volume we make the important assumption that the "Road" option is passive, while two other modes have an active strategy to increase their shares. "Road" offers a more flexible service than the other modes. Therefore, it is assumed that "Rail" and "Coastal shipping" traffic is allocated up to their respective capacities and the difference is accommodated by "Road". This is shown as follows:

$$F_{t,Road}^{i} = E_{t}^{i} - (F_{t,Rail}^{i} + F_{t,Coastalshipping}^{i}) \qquad (25)$$

It is assumed that the annual growth rates of the handling capacities of "Rail" and "Coastal shipping" can take two levels - high and low. Accordingly, there are four possible modal split scenarios.

3. DATA DESCRIPTION

The capability of this model to determine credible solutions for investment plans depends on the mathematical model formulation and on the reliability of the data used. As discussed above, total system costs have been chosen as the objective function to be minimised. These system costs are composed of inland transport costs, construction costs and terminal congestion costs.

The estimates of unit cost per TEU are based on the following:

(a) We have estimated inland transportation costs by modes using raw data from cost-based analyses of O/D(origin/destinations) by transport modes as executed by a leading transport company. Thus, on the basis of primary data between 131 points and Pusan we have been able to estimate a relationship bewteen Road transport cost and distance.Similarly, estimates of Rail transport costs by distance have been based on a survey of primary data between 29 different points and Pusan. In addition, we have attempted to estimate congestion cost for road transport on certain routes. This is based on another set of raw data representing the different levels of delay by sections on the main motorway.

(b) The estimate of port construction is based on data from the investment proposals for " New Container Port Plan" studied by KMI. These proposals include details ranging from the costs of foundation engineering work costs to terminal construction costs. The construction costs have been converted to construction cost per berth.

(c) As with road congestion it is assumed that terminal congestion cost is based on the opportunity cost of delayed container cargo. Thus, it has been necessary to estimate the average value of export container cargo per TEU. The value of exports has been calculated on the basis of the statistics published in 1995 "Exports by H.S. Heading No" by the Korea Customs Service. The delay time functions are estimated by regression analysis based on the relationship between delay time per TEU and excess demand for handling capacity in port. Thus, given the excess level of handling capacity and the average value of export container cargo, terminal congestion costs can be estimated for the period in question. The functional relationship for congestion is based on experience of Pusan. It is unlikely that a relatively new port will experience the same congestion costs as an existing port. Thus, in the case of every alternative at each stage, terminal congestion costs per TEU at ports to be built are based on different and smaller proportions as compared with that estimated at Pusan.

4. COMPUTATION OF THE MODEL AND INTERPRETATION OF THE RESULTS

To overcome the computational complexity of this problem, a simplification has been used. This takes the form of dynamic(Multi-stage) programming with a limited number of proposals for port investment projects to be determined at certain intervals.

It is assumed that investment occurs at six yearly intervals. This is supported by the knowledge that in Korea, the construction period for a typical container terminal is normally six years, although there can be some variation. Thus we assume four sub-periods called stages, which make up the whole period of this study. A limited number of alternative proposals are considered for each of the six year stages, starting at 2003, 2009 and 2015.

On the other hand, among all the proposals considered, some might not be feasible because of the restrictions or constraints placed on the problem. For example, there might be a budget limitation. Additionally, some of the proposals might be mutually exclusive. Other proposals might be contingent so that one proposal cannot be selected unless another proposal is also selected. Thus, depending on the restrictions present, the number of feasible alternatives can be considerably reduced by stages as shown in Table A1 or A2. The following assumptions are adopted for this study:

(1) Each berth is assumed to handle 240,000 TEU per year.
(2) In this model, the total number of additional berths allocated at all three stages is 34. This is based on the assumption that demand at the end year of the third stage is satisfied. The substate at each stage is constrained by the investment budget.

(3) A container port terminal normally consists of 4 or 6 berths. This figure is determined by economies of scale in provision.
(4) According to its development plan, the total number of berths to be built at Kwangyang is assumed to be no more than 20 and at Kadukdo, no more than 21.

Thus, at each stage, a feasible set of alternatives for terminal development may be defined. The addition of berths at any port would incur both port construction costs as well as the cost of the lowest cost traffic allocation and would imply a particular cost structure at the following stage. The economic worth of the costs associated with each investment alternatives can be measured in different ways. Present Value and Annual Worth(AW) methods are two commonly used approaches. Here we prefers to express the net economic worth of an investment alternative as a single sum amount. Hence, the present value method is used. The method converts all the costs to a single sum equivalent in 1997 prices using a given interest rate. A further practical difficulty is to decide upon which interest rate to use in the calculations. This could be public sector discount rate, money market rate, corporate bond rate, deposit rate, or lending rate. At this point, we have to consider the inflation rate in our choice of interest rates because the real interest rate is obtained by subtracting the inflation rate from the nominal interest rate. The corporate bond rate is regarded as the nominal interest rate in this study. In the last five years, the average corporate bond rate was calculated at 13.86 % and for the same period, inflation was 5.11 %. The *ex post* real interest rate was therefore 8.75 %. Thus, we initially adopt 10 % as the standard rate. Subsequently, we use sensitivity analysis in order to analyse the effects of different interest rates, i.e.7 %, 13 %, respectively.

The share of each transport mode in each region's container traffic is based on the current capacities of each mode. In practical the modal split of each region's container traffic would depend on the annual growth rates of "Rail" and "Coastal Shipping", but we do not know these growth rates. Accordingly, the model is run at scenarios which represent the alternatives of high and low levels of the growth rates by "Rail" and "Coastal Shipping". Thus, the four scenarios are "Coastal Shipping" are : (1) "Rail" : 3%(growth) and "Coastal Shipping" : 6%(growth) ; (2) "Rail" : 3% and "Coastal Shipping" : 9% ; (3) "Rail" : 6% and "Coastal Shipping" : 6% ; (4) "Rail" : 6% and "Coastal Shipping" : 9%. Road acts as a residual.

We have determined the optimal development of container ports for the whole period. Table A1 shows total system costs of all stages considered under scenario 1, 2, 3 and 4 using i = 10 %. Total system costs of all stages under scenario 4 using i = 7 %, i = 10 %, i = 13 % are presented in Table A2. In order to identify the overall optimal solution, we must find the lowest total system cost under Scenario 4 from Table A1. We see that the top five projects for new container port development are as follows:

<Table 1> Top Five Optimal Alternatives under i = 10 %.

Alternative			Present Value
Stage 1	Stage 2	Stage 3	for Total System Cost*
(0,8,0)	(0,12,0)	(0,0,14)	9.53

(0,8,0)	(0,10,0)	(0,0,16)	9.55
(0,10,0)	(0,10,0)	(0,0,14)	9.64
(0,8,0)	(0,8,4)	(0,4,10)	9.66
(0,8,0)	(0,6,6)	(0,6,8)	9.73

Notes: The figures in brackets are additional berths at Pusan, Kwangyang, Gadukdo, at each stage.

* All figures in $ billion

The optimal plan over the whole period is the initial through the development of 8 berths in Kwangyang - this lasts until 2002; then 12 berths in Kwangyang from 2003 to 2008 and finally 14 berths in Gadukdo from 2009 to 2014.

On the basis of this investment programme we can also predict the development of optimal inland container traffic flows over the plan period. Thus at the beginning, Kwangyang port will attract the majority of the container cargo from Sudo by Road. With the entry into service of Gadukdo port after 2014, part of this container traffic will switch to Gadukdo port. Cargoes from Sudo by Rail and Coastal Shipping will head to Pusan port and as soon as Gadukdo port starts service, Gadukdo port will take all the container cargoes by Rail. For container cargoes originating in Pusan, Kyongnam and Kyongbuk, Pusan port and Gadukdo port will take exclusive charge because of their geographical proximities to these regions. Container cargoes by Road originating elsewhere will be handled at Kwangyang port, while the container cargoes by Rail will be concentrated at Pusan and after 2014 will be taken over by Gadukdo port.

5. CONCLUSIONS

In this paper, we have applied the systems approach in order to identity an optimal container port development plan in Korea. At each stage, we formed a set of feasible alternative. Total system costs were calculated by using a mathematical model which combines linear and dynamic programming. Total system costs of all feasible combinations have been calculated. A combination having the lowest total system costs has been identified as the optimal container port investment scheme. The top five optimal alternatives have also been identified. Consideration of the top five optimal alternatives show that Kwangyang port should be given priority for the new container port development over other ports being planned. Gadukdo development should follow only after Kwangyang port has been developed completely, Gadukdo development should follow. Additionally, we have run the model under different assumptions about annual growth rates by Rail and Coastal Shipping and for different interest rates. This results in virtually no change in the top five alternatives - only with the higher interest rate i.e. 13 %, is the optimal project is altered. However, the change does not seem to be very significant since Kwangyang port maintains its general priority over Gadukdo port.

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Appendix

<Table A1> Present Value of Total System Costs by Alternatives up to Stage 3

The output of Stage 1,	The decision state of Stage 2,	The decision state of Stage3,	Total System Costs*		
			$i = 7$ %	$i = 10$ %	$i = 13$ %
(0,4,4,)	(0,4,8)	(0,10,4)	14.53	10.32	7.58
		(0,8,6)	14.67	10.40	7.63
		(0,6,8)	14.80	10.49	7.69
	(0,6,6)	(0,10,4)	14.31	10.15	7.45
		(0,8,6)	14.44	10.24	7.51
		(0,6,8)	14.58	10.32	7.56
		(0,4.10)	14.71	10.41	7.62
	(0,8,4)	(0,8,6)	14.22	10.07	7.39
		(0,6,8)	14.35	10.16	7.44
	(0,10,4)	(0,6,6)	14.27	10.13	7.45

		(0,4,8)	14.41	10.22	7.50
	(0,10,0)	(0,6,10)	13.99	9.86	7.20
		(0,4,12)	14.13	9.95	7.25
	(0,12,0)	(0,4,10)	14.05	9.92	7.26
	(0,0,10)	(0,16,0)	14.46	10.26	7.54
		(0,12,4)	14.73	10.43	7.65
		(0,10,6)	14.86	10.52	7.71
(0,8,0)	(0,4,8)	(0,8,6)	13.97	9.81	7.12
		(0,6,8)	14.10	9.90	7.18
		(0,4,10)	14.24	9.98	7.23
	(0,6,6)	(0,6,8)	13.88	9.73	7.05
		(0,4,10)	14.01	9.82	7.11
	(0,8,4)	(0,4,10)	13.80	9.66	6.99
		(0,0,14)	14.06	9.83	7.10
	(0,10,4)	(0,0,12)	13.99	9.81	7.11
	(0,10,0)	(0,0,16)	13.73	9.55	6.87
	(0,12,0)	(0,0,14)	13.66	9.53	6.87
	(0,0,10)	(0,10,6)	14.14	9.92	7.18
		(0,12,4)	14.00	9.83	7.13
(0,10,0)	(0,4,8)	(0,6,6)	14.10	9.98	7.30
		(0,4,8)	14.24	10.06	7.36
		(0,0,12)	14.50	10.23	7.47
	(0,6,6)	(0,4,8)	14.29	10.07	7.35
		(0,0,12)	14.02	9.90	7.24
	(0,8,4)	(0,0,12)	14.07	9.92	7.23
	(0,10,4)	(0,0,10)	14.00	9.90	7.24
	(0,10,0)	(0,0,14)	13.74	9.64	7.00
	(0,0,10)	(0,10,4)	14.14	9.99	7.31
		(0,8,6)	14.27	10.08	7.37
		(0,6,8)	14.41	10.17	7.42
		(0,4,10)	14.54	10.25	7.48
(0,12,0)	(0,4,8)	(0,4,6)	14.25	10.15	7.49
		(0,0,10)	14.51	10.32	7.60
	(0,6,6)	(0,0,10)	14.30	10.16	7.48
	(0,8,4)	(0,0,10)	14.09	10.01	7.36
	(0,0,10)	(0,8,4)	14.28	10.16	7.50
		(0,6,6)	14.41	10.25	7.55
		(0,4,8)	14.54	10.33	7.60

Notes: The figures in brackets are additional berths at Pusan, Kwangyang, Gadukdo, at each stage.

* All figures in $ billion

<Table A2> Present Value of Total System Costs by Alternatives up to Stage 3

The output of Stage 1,	The decision state of Stage 2,	The decision state of Stage3,	Total System Costs* Scenario			
			1	2	3	4
(0,4,4,)	(0,4,8)	(0,10,4)	10.50	10.47	10.35	10.32
		(0,8,6)	10.59	10.55	10.43	10.40
		(0,6,8)	10.67	10.64	10.52	10.49
	(0,6,6)	(0,10,4)	10.34	10.30	10.19	10.15
		(0,8,6)	10.42	10.39	10.27	10.24
		(0,6,8)	10.51	10.47	10.36	10.32
		(0,4.10)	10.59	10.56	10.44	10.41
	(0,8,4)	(0,8,6)	10.26	10.23	10.11	10.07
		(0,6,8)	10.35	10.31	10.19	10.16
	(0,10,4)	(0,6,6)	10.32	10.28	10.17	10.13
		(0,4,8)	10.40	10.37	10.25	10.22
	(0,10,0)	(0,6,10)	10.05	10.01	9.90	9.86
		(0,4,12)	10.13	10.10	9.98	9.95
	(0,12,0)	(0,4,10)	10.11	10.07	9.96	9.92
	(0,0,10)	(0,16,0)	10.45	10.42	10.30	10.26
		(0,12,4)	10.62	10.59	10.47	10.43
		(0,10,6)	10.71	10.67	10.55	10.52
(0,8,0)	(0,4,8)	(0,8,6)	9.99	9.96	9.85	9.81
		(0,6,8)	10.08	10.05	9.93	9.90
		(0,4,10)	10.16	10.13	10.02	9.98
	(0,6,6)	(0,6,8)	9.92	9.88	9.77	9.73
		(0,4,10)	10.00	9.97	9.85	9.82
	(0,8,4)	(0,4,10)	9.84	9.81	9.69	9.66
		(0,0,14)	10.01	9.98	9.86	9.83
	(0,10,4)	(0,0,12)	9.99	9.95	9.84	9.81
	(0,10,0)	(0,0,16)	9.72	9.69	9.58	9.55
	(0,12,0)	(0,0,14)	9.70	9.67	9.56	9.53
	(0,0,10)	(0,10,6)	10.10	10.07	9.95	9.92
		(0,12,4)	10.02	9.98	9.87	9.83
(0,10,0)	(0,4,8)	(0,6,6)	10.16	10.13	10.01	9.98
		(0,4,8)	10.25	10.21	10.10	10.06
		(0,0,12)	10.42	10.38	10.27	10.23
	(0,6,6)	(0,4,8)	10.09	10.05	9.94	9.90
		(0,0,12)	10.26	10.22	10.11	10.07
	(0,8,4)	(0,0,12)	10.09	10.06	9.95	9.92
	(0,10,4)	(0,0,10)	10.07	10.04	9.93	9.90
	(0,10,0)	(0,0,14)	9.81	9.77	9.67	9.64
	(0,0,10)	(0,10,4)	10.18	10.15	10.03	9.99
		(0,8,6)	10.27	10.23	10.12	10.08
		(0,6,8)	10.35	10.32	10.20	10.17
		(0,4,10)	10.44	10.40	10.29	10.25
(0,12,0)	(0,4,8)	(0,4,6)	10.33	10.30	10.18	10.15
		(0,0,10)	10.50	10.47	10.35	10.32
	(0,6,6)	(0,0,10)	10.34	10.31	10.19	10.16
	(0,8,4)	(0,0,10)	10.18	10.15	10.04	10.01
	(0,0,10)	(0,8,4)	10.35	10.31	10.20	10.16
		(0,6,6)	10.43	10.40	10.28	10.25

(0,4,8)	10.52	10.48	10.37	10.33

Notes: The figures in brackets are additional berths at Pusan, Kwangyang, Gadukdo, at each stage.

* All figures in $ billion