Determining the Priority of Transport Policies:

A Korean Case Study using Preference Voting Method

To date, transport policies in Korea have been planned and implemented as part of a larger policy based on the achievement of economic growth. As a result, previous transport policies have been focused mostly on the supply of transport infrastructure. The average annual economic growth of six percent and the twelve percent annual growth in motor vehicles until the late 90s led to an acceleration of the imbalance between the demand and supply of infrastructure. As such, there is a need to establish an innovative transportation policy that can increase national competitiveness and provide momentum for national growth in the 21st century. This research has developed strategies and policies based on interviews that were carried out with specialists in the transport field. The authors identified that the most important issues were the development of an inter-modal transport system, followed by the need for an integrated service system for public transport, the need to increase the competitiveness of the transport and logistics industries, and the furthering of transport safety.

Keywords ***transport policy, Data Envelopment Analysis (DEA), preference voting***

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1——Introduction

Previous transport policies in Korea have been focused on the supply of the transport infrastructure, and have been carried out in accordance with the government's economic growth policy. Although Korea has invested some 2 percent of total GDP in the provision of transport infrastructure over the last 20 years, an average annual economic growth of 6 percent, and a 12 percent annual increase in the number of automobiles have combined with the rapid increase in transport demands to create an imbalance in the supply of transport. Traffic congestion costs in 2000 were calculated at 19.5 billion US dollas[1)], accounting for some 3.7 percent of GDP. Furthermore, the national logistics costs arising from the traffic congestion problems in 2001 were estimated to be some 67.5 billion US dollas, or 12.4 percent of GDP. All of these factors have combined to weaken Korea's industrial competitiveness[2)].

For the most part, these traffic congestion problems have originated from the increasing dependence on automobiles, which in turn stems from the failure to establish adequate public transport systems in major cities, the expansion of residential areas in metropolitan cities, and the lack of an extended transport system to cope with the increasing distances traveled.

Existing transport policies have primarily been concentrated on carrying out the simple functions of transporting people and cargo. However, there is a need to establish an innovative transport policy in order to improve national competitiveness and create the engines needed to bring about economic growth in the 21st century. During the economic development drive, transport policies were regarded as a core element in the construction of the economy, and much focus was placed on supplying transport facilities. However, as a result of environmental and safety issues, and of the growing difficulties associated with securing the necessary financial resources, emphasis has increasingly been placed on assuring appropriate levels of investment and on the proper management of existing transport facilities. As such, in the future, transport policies should be designed to achieve the harmonization of efficiency and equity.

This research has identified four objectives of transport policymaking and developed 3-4 different transport policy measures for each. The objectives and measures based on interviews with specialists, practitioners and case studies of developed countries. The analytical method is adopted preference voting method employed in the Data Envelopment Analysis (DEA). Moreover, the author got responses from the specialists of urban transport, road, railroad, air and maritime. This research was able to suggest implementation measures and to prioritize the transport policies that Korea should adopt. The DEA is usually used to analyze the efficiency of a decision making unit (DMU). This research used an analysis model that is based on the preference voting method developed by Cook and Kress in 1990 (hereafter

referred to as the CK model). The CK model has been widely used as a decision management measurement technique to balance the shortcomings of traditional techniques based on preference voting, in which the ranked voting data can be changed depending on the weight value. Noguchi, Ogawa, and Ishii (2002) developed a priority determination model based on the concept of multiple purposes voting, and suggested an analytical model (the NOI model) for when multiple decision management factors exist. In keeping with this, an analytical study was carried out to determine the transport policy priorities, using the NOI model.

This paper is composed of the five chapters. Chapter 2 explains the DEA. Chapter 3 introduces the transport policies that Korea should adopt by 2020, based on the present state of transport policies and the benchmarking of the cases of other countries. In Chapter 4, the priority that should be given to the transport policies identified in Chapter 3 using the DEA preference voting method.

2——Data Envelopment Analysis (DEA)

2.1 Measurement of technical efficiency using the DEA

The DEA is a nonparametric approach which was developed by Charnes, Cooper, and Rhodes (CCR) in 1978, that is calculated using linear programming to measure the comparative efficiency (technical efficiency) of a DMU's series of outputs to inputs. Technical efficiency refers to the ratio of the sum of the weight values of the output to input. The weight values represent the comparative importance of the evaluation factors. In this paper, the weight values, sr and ti satisfy the non-negative condition, and the value of the efficiency is given a value ranging from 0 to 1. A DMU can be interpreted as having the highest efficiency when a value of 1 is assigned to it.

The weight value of DMU j_0 is calculated in (1) at the level needed to maximize efficiency under the given conditions. The CCR model found in (1) is formed once maximization has been achieved using linear programming. This is known as cross-efficiency.

The CCR Multiplier Model making it possible to calculate an optimal solution using the Simplex Method of linear programming.

$$Maximize \quad j_0 = \sum_{r=1}^{k} s_r \; y_{rj} \qquad (1)$$

Subject to

$$\sum_{i=1}^{k} t_i \; x_{ij} - \sum_{r=1}^{k} s_r \; y_{rj} \geq 0, \forall_j$$

$$\sum_{i=1}^{k} t_i \; x_{ij} = 1$$

$$s_r, t_i \geq \varepsilon \quad (\varepsilon = nonnegative)$$

s_r = weight value of output r, r= 1,2,…
y_{rj} = the size of output r of the DMU j
t_i = weight value of input i, i = 1,2,…
x_{ij} = the size of input i of the DMU j

2.2 The DEA using preference voting

The DEA, as mentioned above, has emerged as one of the most precise methods of measuring the efficiency of the inputs and outputs of a DMU[3]. In addition, the DEA can also process input and output variables that do not share common measuring factors. Therefore, the DEA is capable of simultaneously analyzing different units of inputs or outputs. The (2) of the CK model can be employed to identify the best policies, projects, products, or even the most outstanding professional athletes[4], by making use of the preference voting by specialists or consumers, which in turn makes use of the advantages of the DEA, that is, the use of the maximized weight value to calculate evaluation factor preferences[5].

$$Z_i(\varepsilon) = Maximize \sum_{j=1}^{k} W_j \; v_{ij}(\varepsilon) \qquad (2)$$

Subject to

$$\sum_{j=1}^{k} W_j \; v_{ij} \leq 1, \forall_i$$

$$W_j - W_{j+1} \geq d(j, \varepsilon), \; \forall \qquad (3)$$

$$W_k \geq d(k, \varepsilon) \qquad (4)$$

v_{ij} = the number of jth place votes of candidate i
(i= 1,…, m, j = 1,…, k)
$d(\cdot, \varepsilon)$ = discrimination intensity function

The (3) is conditioned on the fact that the weight value W_j of v_j should be bigger that the weight value W_{j+1} of v_{j+1}. By setting the weight value of the top evaluation factor candidate higher than or equal to the weight values of the second and lower candidates, each evaluation factor is optimized. This is known as the Assurance Region. The (3) and (4) of the CK model indicate that the weight should not be assigned minus values. ε indicates an unlimited small number and the non-negative condition has been satisfied. The $d(\cdot, \varepsilon)$ called the discrimination intensity function, is nonnegative and non-decreasing in ε, and satisfies $d(\cdot, 0) = 0$. The model NOI is used to classify the

weak ordering and strong ordering found in (5) and (6).

$$W_{mk-1} - W_{mk} \geq d(k-1, \varepsilon) = \varepsilon \geq 0$$
$$W_{m1} \geq W_{m2} \geq \cdots \geq W_{mk} \geq 0 \quad (5)$$
$$W_{mk} - W_{mk+1} \geq d(k, \varepsilon) = \varepsilon > 0$$
$$W_{m1} > W_{m2} > \cdots > W_{mk} \geq \varepsilon \quad (6)$$

However, the NOI model has certain built-in flaws in that the ordering can be changed based on the size of *e*. The weak ordering is advantageous for its ease of calculation, while a strong ordering can separate the top evaluation factors from the other orderings. In (7) the NOI model is applied using the strong ordering method, and in (8) using ε.

$$W_{m1} \geq 2W_{m2} \geq 3W_{m3} \quad \cdots > KW_{mk} \quad (7)$$
$$W_{mk} \geq \varepsilon = \frac{2}{nK(K+1)} \quad (8)$$

n: number of respondents
k: number of evaluation criteria

With regards to priority ordering using the traditional method seen in Table 1, the possibility of a contradiction occurring in the analysis cannot be ruled out as the priority ordering can be changed based on the weight values (W*i*=5, 3, 1 for *i*= 1, 2, 3) that are selected[6]. v_{1j} in Table 1 indicates the number of votes that evaluation candidate factor *i* received. When unifying evaluation factors, as is done in Table 1, that is to say, when specialists select their priorities with regards to criteria I, II, and III, evaluation methods based on (2) will emerge. However, as multiple evaluation factors have been added[7], as seen in Table 2, this research suggested (9) of the NOI model to calculate the importance rate ϕ_R (10). By multiplying this number with Λ_{MR} (11) and dividing by R (number of evaluation factors), we arrive at (12) as the ideal model with which to select the optimized candidate.

$$\eta_{rp} = Maximize \quad \sum_{s=1}^{S} u_{rs}\, x_{rs} \quad (9)$$

Subject to

$$\eta_{rp} = \sum_{s=1}^{S} u_{rs}\, x_{rs} \leq 1, \forall_p$$
$$u_{rs} - u_{rs+1} \geq d(s, \delta) = \delta > 0$$

$$\phi_R = (H_1, H_2 \cdots, H_R)^T \quad (10)$$

$$\Lambda_{MR} = (\lambda_1, \lambda_2, \cdots \lambda_R)^T$$
$$\lambda_1 = (\lambda_{11}, \lambda_{21}, \cdots \lambda_{M1})^T \quad (11)$$

…

$$\lambda_R = (\lambda_{1R}, \lambda_{2R}, \cdots \lambda_{MR})^T$$

$$a_M = \frac{1}{R} \times \Lambda_{MR}\, \phi_R \quad (12)$$

$$a_{mr} = \lambda_{mr}\, H_r, \ \forall m, r \quad (13)$$

According to a_M and a_{mr}, the importance rate of evaluation criteria candidates 1, 2 and 3 can be calculated, as can the final ordering through the use of weight values. The priority ordering can be changed even when the CK and NOI models are used depending on whether weak or strong orderings are employed. When applying the weak ordering method, the priority ordering can be changed in accordance with the size of ε.

Nevertheless, there is no doubt that precise ordering can be assured when (8), which is based on strong ordering, is applied to these models, and that subjectivity can be done away with by using the scientific approach, unlike Table 1, which is based on the traditional analytical method. These models can be used as a decision management technique through which transport policies can be prioritized by applying linear programming to calculate the importance rate based on the optimized weight values of the evaluation factors.

■**Table—1 Traditional method of determining priority ordering**

Weights	w_1	w_2	w_3	Ordering (i=1,2,3)
Candidate1	w_1v_{11}	w_2v_{12}	w_3v_{13}	$\sum_j^3 w_i v_{1j}$
Candidate2	w_1v_{21}	w_2v_{22}	w_3v_{23}	$\sum_j^3 w_i v_{2j}$
Candidate3	w_1v_{31}	w_2v_{32}	w_3v_{33}	$\sum_j^3 w_i v_{3j}$

■**Table—2 Applying multiple evaluation factors**

Evaluation Criteria	Evaluation factors	λ_{mr}
H_1	Candidate 1	λ_{11}
	Candidate 2	λ_{12}
	Candidate 3	λ_{13}
H_2	Candidate 1	λ_{21}
	Candidate 2	λ_{22}
	Candidate 3	λ_{23}
H_3	Candidate 1	λ_{31}
	Candidate 2	λ_{32}
	Candidate 3	λ_{33}

Note: λ_{mr} are score of respondents for certain evaluation criteria and factors

3——Objectives of 21st Century Korean Transport Policies and Related Implementation Measures

As seen in Figure 1, based on the benchmarking of the transport policies of the USA, England, and

Japan, and the collection of specialists' opinions, this research has identified the preferred objectives for Korean transport policies in the 21st century, as well as related implementation measures. Our analysis of the U.S. ISTEA (Intermodal Surface Transportation Efficiency Act), and TEA-21 (Transportation Efficiency Act for the 21st Century), of England's SAFETEA (Safe, Accountable, Flexible and Efficient Transportation Equity Act), and of Japan's "Comprehensive Transport Policies for the 21st Century", revealed that, rather than focusing on the expansion of existing transport facilities and increasing the efficiency of individual transport systems, developed countries have attempted to bring about the effective usage of IT-applied facilities, the actualization of the intermodality system, and the achievement of sustainable transport policies focused on the environment and safety.

The selection of objectives for Korean transport policies was based on the need to provide fast, convenient, and safe transport services, and on the need to contribute to the eventual achievement of national integration by promoting balanced development among regions and increasing the equity between the social classes. With regards to the intermodality system, this paper introduced measures to achieve intermodality between such modes of transportation using the information and communication systems. This intermodality system will help invigorate the economy, facilitate international exchanges, and to decrease the traffic congestion and air pollution problems caused by the excessive use of roads and highways to deliver goods.

With regards to the achievement of a sustainable transport system, this research selected the reduction of air pollutant emissions as the main objective for transport policies, and attempted to introduce related measures to achieve this objective. The main policy measures are: the strengthening of regulations concerned with emission gases, the granting of support for the development of low-fuel consumption technologies, as well as the achievement of a reduction in the demand for road transportation through the implementation of polluter pays principles, such as the imposition of a carbon tax, gas guzzler tax, congestion pricing, collection of parking fees, and carpooling exemptions. By easing traffic congestion problems, measures to decrease vehicles' air pollutant emissions can be used to establish a sustainable transport system.

As a result of the rapid advent of an aging society, the traffic congestion stemming from the increase in the elderly population's activities is expected to worsen in the future. In the case of the developed countries, safe transport measures have already been established for the elderly. The development of IT related technologies encourages the development of new transport systems in which the safety, comfort, and speed aspects are much improved. As it has become increasingly possible to apply these new transport technologies to the actual field, many developed countries have adopted IT related technologies within their transport systems.

This research also focused on the development of traffic technologies that can effectively manage the transportation of passengers and cargo between transport modes, such as ships/railroads and trains/trucks. New approaches to resolving traffic related problems have increasingly been introduced as a result of the development of environmentally-friendly low energy and pollution traffic methods related to the transport technologies, the strengthening of environmental regulations and the development of the Intelligent Transport System (ITS); which includes the development of high-tech applied automobiles and the construction of a new-generation road environment and the establishment of safe transport facilities/management technologies brought about by successfully changing the attitudes of vehicle manufacturers and road builders. Rapid globalization has increased the need to provide one-stop administrative services with regards to the transport of international passengers and cargo, to increase the on-line service system and paperless documentation for trade related matters, such as bills of lading (B/L). In the case of airports, which are closely related to globalization, the number of international passengers and the demand for air cargo has risen rapidly. Until the middle of the 1970s, U.S. transport policy was influenced by economic controls, such as the regulation of prices and of the approach to cities, and by the relation between labor and management. However, of late its transport policies have been focused on easing regulations, as well as on implementing safety and environment-oriented measures.

4——Transport Policy Priorities and Related Analysis

From July 18th to July 27th, 2003 a survey was conducted with the objective of assessing the priority order and rate of importance that should be given to the objectives and implementation measures for the Korean transport policies of the 21st century that have been identified in this paper,

and found in Figure 1. The survey was sent to 1,200 specialists in the urban traffic, road, railroad, air transport, maritime transport, and logistics fields. 205 respondents returned which translates into a 17.1 percent response rate.

75 percent of the survey participants were specialists who had in excess of 5 years of experience in their chosen field. 47.5 percent of the participants worked for research institutes, thus indicating a certain bias in the composition of the specialists. Additionally, although four implementation measures were selected for policy objective "III. Promotion of competitive transport and logistics industries", the participants were found to have confused policy objective III with measure "III.1 Strengthening the national competitiveness of the transport and logistics industries".

This research produced the transport policy priorities identified by the specialists, by multiplying the importance rates (ϕ_R and Λ_{MR}) of policy objectives I, II, III, and IV, which were included in the evaluation criteria found in Figure 1, rather than by selecting the optimized candidates based on the evaluation criteria found in Table 2

First of all, the weight values of the evaluation factors must be calculated by applying (2), which is based on linear programming. By calculating the efficiencies and geometric means of the evaluation factors based on these acquired weight values, this research produced the results seen in Tables 5, 6, 7, 8 and 9. When applying linear programming, this paper, to simplify the calculation, followed the weak ordering method found in (8) and substituted it for $d(k, \varepsilon) = 0.00001$, $\varepsilon = 0.0001$.

Let us take a look at the results of the survey. With regards to policy objective "I. Establishment of an effectively integrated transport system", the participants prioritized the implementation mea-

■Table—3 Responses of the specialists with regards to the policy objectives

Order / Policy objective	1	2	3	4	5
I. Establishment of an effectively integrated transport system	106	39	37	23	0
II. Provision of speedy and comfortable transport services	32	61	75	36	1
III. Promotion of competitive transport and logistics industries	32	62	48	63	0
IV. Construction of a sustainable, and human oriented transport environment	34	44	43	83	1
V. Other	1	0	1	0	203

Note: V. The other category includes suggestions of the respondents or cases where no answer was given.

■Table—4 Results of the survey on policy objective "I. Establishment of an effectively integrated transport system"

Orders / Implementation Measures	1	2	3	4	5
I.1 Establishment of transport networks to prepare for unification and Korea's role as a Northeast Asian hub	29	40	39	89	8
I.2 Establishment of an intermodality system	91	60	40	14	0
I.3 Establishment of a public transport centered transport system	43	46	64	51	1
I.4 Rationalization of the provision of financial resources and of an investment system	40	57	59	48	1
I.5 Other	2	5	2	2	194

■Table—5 Result of the application of (9) to the policy objectives found in Table 3

Objectives of the transport policies	0.1	0.2	0.3	0.4	0.5	G.M.	Rank
I. Establishment of an effectively integrated trans-port system x_{1s}	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1
II. Provision of speedy and comfortable transport services x_{2s}	0.9945	0.9947	0.9947	0.9947	0.9379	0.9830	2
III. Promotion of competitive transport and logistics industries x_{3s}	0.9935	0.9983	0.9983	0.9984	0.8250	0.9600	3
IV. Construction of a sustainable, and human oriented transport environment x_{4s}	0.9916	0.9941	0.9941	0.9941	0.7337	0.9350	4

■Table—6 Result of the application of (2), (3) and (4) to the policy objective "I. Establishment of an effectively integrated transport system" found in Table 4

I. Establishment of an effectively integrated transport system	1.1	1.2	1.3	1.4	1.5	G.M.	Rank
I.1. Establishment of transport networks to pre-pare for unification and Korea's role as a Northeast Asian hub v_{1j}	0.9997	0.5806	0.9997	0.9997	0.9997	0.8967	4
I.2. Establishment of an inter-modality system v_{2j}	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1
I.3. Establishment of a public transport centered transport system v_{3j}	0.9998	0.6835	0.9998	0.9998	0.9998	0.9266	3
I.4. Rationalization of the provision of financial resources and of an investment system v_{4j}	0.9993	0.7243	0.9993	0.9993	0.9993	0.9347	2

■Table—7 Result of the application of (2), (3) and (4) to the policy objective "II. Provision of speedy and comfortable transport services" found in Table 10

II. Provision of speedy and comfortable transport services	2.1	2.2	2.3	2.4	2.5	G.M.	Rank
II.1. Establishment of an integrated public trans-port service system v_{1j}	1.0000	1.0000	0.9985	1.0000	1.0000	0.9997	1
II.2. Strengthening of traffic demand related management measures v_{2j}	0.8869	0.8413	0.9984	0.8413	0.8413	0.8798	3
II.3. Establishment of an intelligent transport (ITS) system v_{3j}	0.7841	0.6970	1.0000	0.6970	0.6969	0.7670	4
II.4. Promotion of the efficiency of the management of transport facilities v_{4j}	0.9416	0.9182	0.9976	0.9182	0.9182	0.9383	2

■Table—8 Result of the application of (2), (3) and (4) to the policy objective "III. Promotion of competitive transport and logistics industries" found in Table 11

III. Promotion of competitive transport and logistics industries	3.1	3.2	3.3	3.4	3.5	G.M.	Rank
III.1. Strengthening of the national competitiveness of the transport and logistics industries v_{1j}	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1
III.2. Establishment of an integrated carriage system of goods v_{2j}	0.9096	1.0000	0.9999	0.9096	0.9096	0.9447	2
III.3. Establishment of a hub system for airport and harbor facilities v_{3j}	0.7167	0.9996	0.9998	0.7167	0.7167	0.8187	3
III.4. Privatization of transport facilities management v_{4j}	0.4691	0.9710	0.9725	0.4743	0.4743	0.6305	4

■Table—9 Result of the application of (2), (3) and (4) to the policy objective "IV.Construction of a sustainable, and human oriented transport environment" found in Table 12

IV. Construction of a sustainable, and human oriented transport environment	4.1	4.2	4.3	4.4	G.M.	Rank
IV.1. Development of a low energy consuming and environmentally friendly transport system v_{1j}	0.9996	0.8886	0.9996	0.9995	0.9706	2
IV.2. Improvement of the transport safety system v_{2j}	1.0000	1.0000	1.0000	1.0000	1.0000	1
IV.3. Assurance of the mobility rights of pedestrians v_{3j}	0.9905	0.4039	0.9982	0.9982	0.7946	3

■Table—10 Result of the survey on policy objective "II. Provision of speedy and comfortable transport services"

Ordering / Implementation Measures	1	2	3	4	5
II.1 Establishment of an integrated public transport service system	70	60	45	28	2
II.2 Strengthening of traffic demand related management measures	52	45	51	55	2
II.3 Establishment of an intelligent transport (ITS) system	27	40	62	76	0
II.4 Promotion of the efficiency of the management of transport facilities	53	60	45	44	3
II.5 Other	3	0	2	2	198

■Table—11 Result of the survey on policy objective "III. Promotion of competitive transport and logistics industries"

Ordering / Implementation Measures	1	2	3	4	5
III.1 Strengthening of the national competitiveness of the transport and logistics industries	105	51	30	19	0
III.2 Establishment of an integrated carriage system of goods	58	76	57	14	0
III.3 Establishment of a hub system for airport and harbor facilities	33	54	82	36	0
III.4 Privatization of transport facilities management	7	21	35	135	7
III.5 Other	2	3	1	1	198

sures in the following order: establishment of an intermodality system, rationalization of the provision of financial resources and of an investment system, establishment of a public transport centered transport system, and establishment of transport networks to prepare for unification and Korea's role as a Northeast Asian hub. With regard to policy objective "II. Provision of speedy and comfortable transport services", the participants prioritized the implementation measures in the following order: establishment of an integrated public transport service system, promotion of the efficiency of the management of transport facilities, strengthening of the management of traffic demand related measures, and establishment of an intelligent transport (ITS) system. In the case of policy objective "III. Promotion of competitive transport and logistics industries," the participants prioritized the implementation measures in the following order: strengthening of the national competitiveness of the transport and logistics industries, establishment of an integrated carriage system of cargo, establishment of a hub system for airport and port facilities, and privatization of transport facilities management.

Where policy objective "IV. Construction of a sustainable, and human oriented transport environment" is concerned, the participants prioritized the implementation measures in the following order: improvement of the transport safety system, development of a low energy and environmental-friendly transport system, and assurance of the mobility rights of pedestrians.

■Table—12 Result of the survey on policy objective "IV. Construction of sustainable, and human oriented transport environment"

Ordering / Implementation Measures	1	2	3	4
IV.1 Development of a low energy and environmentally-friendly transport system	83	64	56	2
IV.2 Improvement of the transport safety system	97	81	25	2
IV.3 Assurance of the mobility rights of pedestrians	22	57	122	4
IV.4 Other	2	3	2	198

Based on (9), the results of the analysis of the evaluation criteria (transport policy objectives) are the same as those found in Table 5: I. Establishment of an effectively integrated transport system, II. Provision of speedy and comfortable transport services, III. Promotion of competitive transport and logistics industries, and IV. Construction of a sustainable, and human oriented transport environment.

The importance rate, H_r of the policy objectives using (10) can be found in Table 13. The total efficiency λ_{mr} of the implementation measures based on (11) can be found in Table 14. The importance rates of the evaluation factors based on (13) using H_r and λ_{mr} are found in Table 15. This paper selected those policy candidates that applied (12), which is the NOI model, to the evaluation criteria. However, in the case of the priority of the implementation measures, (13) was applied as in this case, priority indicates the rate of importance of the evaluation factors. Figure 1 exhibits the importance (circled number) of all evaluation factors by ordering the priority of the policies based on the importance of the implementation measures.

■Table—13 Importance rates of the policy objectives based on (10)

Policy objectives / Rate of importance	I.	II.	III.	VI.
H_r	1.0000	0.9830	0.9600	0.9350

■Table—14 The importance rates of the implementation measures based on (11)

Policy objectives / Rate of importance	I	II	III	VI
λ_{1r}	0.8967	0.9997	1.0000	0.9726
λ_{2r}	1.0000	0.8798	0.9447	1.0000
λ_{3r}	0.9266	0.7670	0.8187	0.7946
λ_{4r}	0.9374	0.9383	0.6305	0.4616
λ_{5r}	0.7525	0.4877	0.2823	–

■Table—15 The importance rates of the implementation measures based on the importance rates of the policy objectives using (13)

Priority	1	2	3	4
a_{1r}	0.8967	0.9827	0.9600	0.9075
a_{2r}	1.0000	0.8648	0.9069	0.9350
a_{3r}	0.9266	0.7540	0.7860	0.7430
a_{4r}	0.9374	0.9223	0.6053	0.4316
a_{5r}	0.7525	0.4794	0.2710	–

5——Conclusion

The optimized solutions can usually be changed depending on the given conditions The solution can be utilized to set management priorities, by identifying the influence caused by changes in the value of the specified factor using a sensitivity analysis technique. However, this research did not include a sensitivity analysis technique when analyzing the surveys.

As a result of applying the DEA technique with preference voting to the Korean transport policies that should be implemented by 2020, the following policy measures were identified as being the most urgently needed: the establishment of an intermodality system, establishment of an integrated public transport service system, the strengthening of the national competitiveness of the transport and logistics industries, and the improvement of the transport safety system. Meanwhile, the policy measure, assurance of the mobility rights of pedestrians, which most developed countries place top priority on, was given the lowest priority of its group of measures, a fate shared by the measures establishment of transport networks to prepare for unification and Korea's role as a Northeast Asian hub, and the privatization of transport facilities management.

With regards to policy objective "I. Establishment of an effectively integrated transport system," which received the highest points in our analysis of the results of the transport policies, the implementation measure, establishment of transport networks to prepare for unification and Korea's role as a Northeast Asian hub, was given the lowest priority of all. Conversely, the implementation measure, establishment of an integrated public transport service system, which was attached to policy objective "II. Provision of speedy and comfortable transport services" was given the highest priority within this group. More specifically, the authors revealed that there is an urgent need to establish passenger and cargo transport exchange systems, an intermodality system centering on the traffic node, and an intermodality system involving air and road transport. Although the survey was focused on the polling of specialists, the results of the analysis were focused on the expansion of transport facilities, rather than on the effective usage of existing transport facilities.

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Notes

1) The exchange rate is based at the rate of 2000.
2) The Korea Transport Institute, *2002 National Transport DB Project*
3) Seiford [1996]
4) Noguchi et al. [2002]
5) Green et al. [1996]
6) Noguchi et al. [2002]
7) In the case of the selection of a DMU representative by the personnel committee, this analytical method has been applied to candidate preference voting and evaluation criteria alike.

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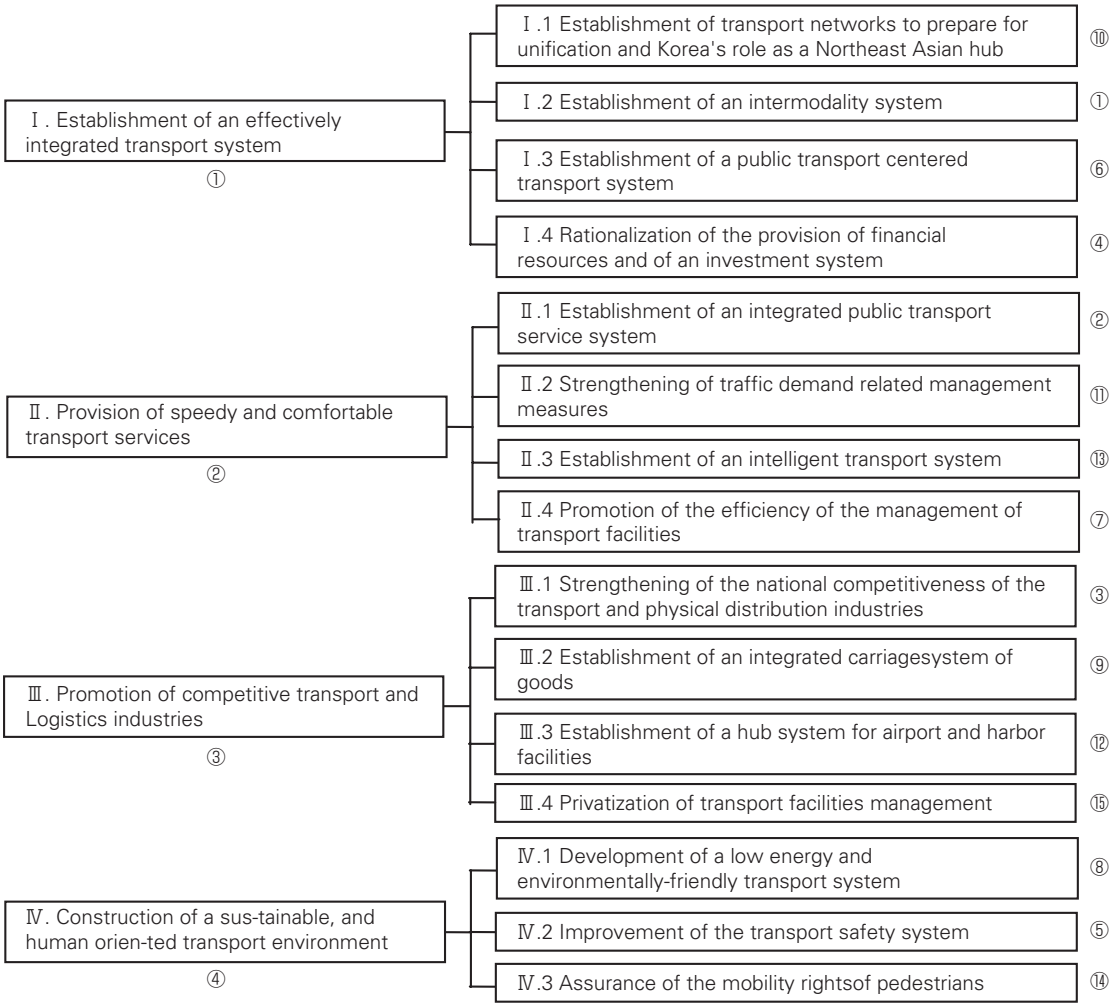

■Figure—1　Priority ordering of policy objectives and implementation measures

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交通政策優先順位設定に関する研究 —DEAの選好投票技法を用いた韓国におけるケーススタディー—

韓国において今までの交通政策は，経済成長の達成というより大きな政策目標の達成のための一部分として計画・実行されてきたことがあり，主に交通インフラの供給に重点が置かれてきた．しかし，1990年代後半まで年平均6％の経済成長率，年平均12％の自動車保有率の上昇が続いたことにより，インフラの需要と供給におけるアンバランスが生じている．それゆえ，今後は，国の競争力強化及び発展に寄与できるような革新的な交通政策を樹立する必要がある．この研究は，交通分野に従事する専門家を対象に行われたインタビュー及びアンケート調査を基に，DEAの選好投票手法を用いて，今後導入すべき交通政策の優先順位を導出している．分析の結果，総合交通体系の構築，公共交通の統合サービス体系の構築，財源調達及び投資体系の合理化などが高く評価され，交通弱者の移動権確保や交通施設の民営化推進などは相対的に低く評価されていることが示されている．

キーワード　；**交通政策，包絡分析法（DEA），選好投票**

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