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A CONCEPTUAL PLAN OF MASS TRANSIT SYSTEMS AT THE ADMINISTRATION CITY IN KOREA

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Abstract : This paper aims to introduce an optimal mass transit system at the administration city which are to be constructed away from the Daejeon metropolitan area in Korea. This city is assumed to be constructed in three phases by the population of 100,000, 300,000, and 500,000 people. In the beginning, a mass transit between this city and metropolitan nearby is considered, which is a kind of regional transport system. Then, a mass transit inside this city as urban transit is proposed. Based on the existing cases of mass transit systems abroad, three types of mass transit systems are elected as candidates. They are BRT, Maglev, and LRT. The criteria of selecting an optimal mass transit are based on both the results of AHP output and the characteristics of each system itself. Twenty experts are surveyed for AHP analysis. In conclusion, an optimal mass transit system for both regional and urban purposes is suggested to be BRT in the beginning phase. LRT or Maglev system is selected as urban transit at second and third phase with BRT as regional transport system unchanged. A total of 2.38 billion$ are estimated to construct the suggested new mass transit system for the administration city. Since the budget of government is out of short, the private capital investment is suggested in this study. The 3rd sector combining a government sector and a private sector is finally suggested as a best option to consider.

Key Words: Mass Transit System, BRT, Maglev, LRT, 3rd Sector, New City

1. INTRODUCTION

1.1 Backgrounds and Objectives of This Study

The administration city is to be constructed 40 ~ 50 km away from the center of existing Daejeon metropolitan area. Constructing this city is deemed to be one of the

solution to alleviate the traffic congestion as well as overpopulation of metropolitan area. Since this city is to be built at open area away from the existing cities, the framework of mass transit at the initial stage is thought to be one of the most important factors to achieve the above goal.

This paper aims to introduce an optimal mass transit system at the administration city in Korea. This new mass transit is considered to lead an urban land use development towards traffic congestion relief. That is, what is called, Transit Oriented Development (TOD). It will also be the model for the existing city construction in an environment-friendly way.

1.2 Contents of This Study

The administration city is assumed to be constructed in three phases. First phase is assumed to start with about 100,000 people. In the second phase, the population will reach up to 300,000 people. Third phase will be finished by the population of 500,000 people. Since this city is away 40 ~ 50 km from the center of metropolitan area, a new mass transit system at this city has been analysed in terms of three view points as follows:

- A mass transit between the administration city and surrounding cities including metropolitan
- A mass transit inside the administration city
- A traffic center connecting a new mass transit and other modes

Table 1. The Scope of The Study

The scope of the study	Contents
A case study of existing new mass transits	- The concept of a new mass transit - A case study of existing new mass transits - The bench marking of types of new mass transit
A conceptual plan of introducing a new mass transit	- A new mass transit between the **administration** city and surrounding cities - A new mass transit inside a new city - A traffic center connecting a new mass transit and other modes
Issues of project expenses and operation	- Expected expenses - Designating a concessionaire - The process of introducing a new mass transit

2. THE CONCEPT OF A NEW MASS TRANSIT AND ITS CHARACTERISTICS

A new mass transit is defined to be "A mass transit which has advanced traffic operation technologies such as signal control, communications, and automated operation on the existing rail-type and/or wheel-type mass transit".

New mass transits are categorized into 5 different types in terms of rail types and its operation. They are Automated Guideway Transit (AGT), Mono Rail, Street Rail, Maglev, and Bus Rapid Transit. Each of the new mass transits are compared in terms of flow capacity, maximum speed, and the number of rolling stocks.

Table 2. Characteristics of New Mass Transit Systems

	AGT			Mono Rail	Street Rail	BRT	Maglev
	Rubber wheel	Iron Wheel					
		Rotary	LIM				
Capacity (person)	60 ~ 90	75 ~ 100	60 ~ 130	45 ~ 336	110 ~ 250	60 ~ 240	60 ~ 120
# of rolling stocks	2 ~ 6	2 ~ 4	1 ~ 6	2 ~ 6	1 ~ 7	1 ~ 2	2 ~ 4
Flow capacity (hour·direction)	7,000 ~ 25,000	17,000 ~ 20,000	25,000 ~ 30,000	3,200 ~ 20,000	5,000 ~ 15,000	5,000 ~ 12,000	25,000 ~ 30,000
Max. speed (km/h)	60 ~ 80	70 ~ 80	80 ~ 90	56 ~ 85	80	50 ~ 60	80 ~ 500

3. CASE STUDY OF EXISTING NEW MASS TRANSITS

3.1 Domestic Cases

No cities are operating a new mass transit yet in domestic area. However, local government such as Busan city, Hanam City has currently been constructing a new mass transit system with private participation.

In Seoul, a BRT system has been introduced at 6 main corridors with the median BRT lanes since July 2004. However, this system is on operation only in Seoul city, resulting in traffic bottlenecks at the Gyung-gi Province which is adjacent to Seoul city. This BRT system is supposed to expand Gyung-gi Province soon.

3.2 Foreign Cases

3.2.1 Astram Line, Horishima, Japan

Astram Line at Hiroshima in Japan is being operated to connect the CBD area and surrounding cities. Its system is automated guided transit (AGT) one with rubber wheel. The length of Astram Line is 18.4㎞ the number of station is 21, and 6 rolling stocks are being operated at the same time.

3.2.2 VAL at Lille in France

VAL at Lille in France is known as the first city in introducing no manned operating system. The maximum capacity is to be 6,000 person/hour/direction.

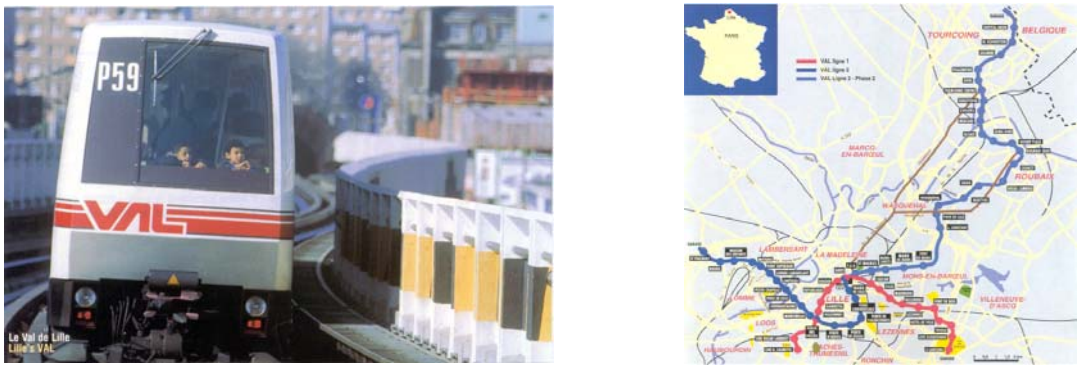


Figure 1. The Rolling Stock and Line Map of VAL

3.2.3 BRT at Curitiba in Brasil

Curitiba city in Brasil has adopted a BRT system instead of rail-type of mass transit since the budget of Curitiba was out of short. Nevertheless, the BRT system has been evaluated as one of the best new mass transits.

Since this BRT system is operated on the exclusive lanes, this system is called as Surface-Subway. 5 trunk corridors reaches into 58Km as well as several feed lines are about 270Km. About 70% of commuters use this BRT system in Curitiba.

Figure 2. BRT System at Curitiba

3.2.4 Maglev system at Pudong in China (Transrapid)

Transrapid has been operated since January 2004. It is known to be the earliest Maglev system in the world. It runs between Shanghai and Pudong area.

Figure 3. Maglev System at Pudong in China

3.3 The Bench Marking of Types of Mass Transit

Based on the case studies earlier, three types of mass transit systems have been selected as candidates. They are BRT, Maglev, and LRT. BRT system is known to be economic mass transit in the beginning stage. Maglev is selected due to the symbol effects for the new city. Finally, LRT is chosen since the various operation is possible regardless of the trunk line or feed line.

Table 3. Candidates for New Mass Transit Systems at the administration City

	Reasons for selecting as candidates
BRT	- A comparatively low expenses than other mass transits
Maglev	- New image for a new city
LRT	- Various operation for trunk lines as well as feed lines

4. A NEW MASS TRANSIT BETWEEN THE ADMINISTRATION CITY AND SURROUNDING CITIES

4.1 Optimal Mass Transit System

The administration city is assumed to be constructed in three phases as mentioned earlier. The population and size of the new city will be expanded gradually. It is shown in the figure below.

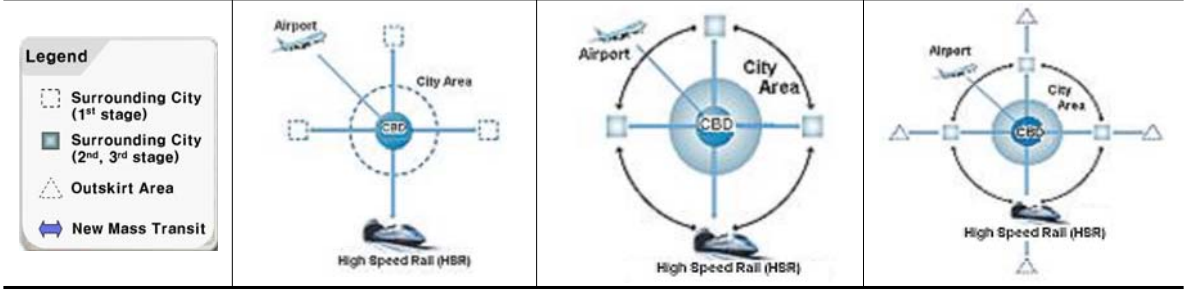
	First Phase	Second Phase	Third Phase
Population	100,000	300,000	500,000
Trips expected	250,000 trips/day	750,000 trips/day	1,250,000 trips/day
			

Figure 4. The Population and Size of the administration City By Phases

The criteria of selecting a new mass transit between the administration city and surrounding cities is to combine the results of AHP output and the characteristics of each system itself.

Twenty experts are surveyed and AHP (Analytical Hierarchy Process) is applied. The criteria are boiled down into 6 factors. They are i) the convenience of mass transit such as accessibility, exact schedules etc., ii) the cost including construction, operation and maintenance, iii) flow capacity, iv) image to the new capital, v) environment friendliness and vi) traffic safety. The candidates for mass transit systems are BRT, Maglev, and LRT as explained earlier.

Table 4. Criteria for AHP for Selecting Mass Transit Systems

Criteria	Contents
Convenience	- Accessibility, on-time arrival/departure, easy transfer between modes
Cost	- Costs for Construction, maintenance, operation, etc.
Capacity	- Flow capacity for the demand
Image	- Image for the new city concerned
Environment	- User-friendliness for environment during and after construction
Safety	- Risk against traffic accidents

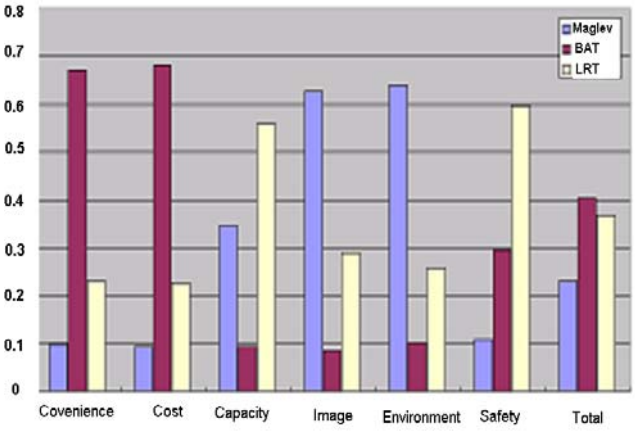


Figure 5. Comparative Weights By Criteria

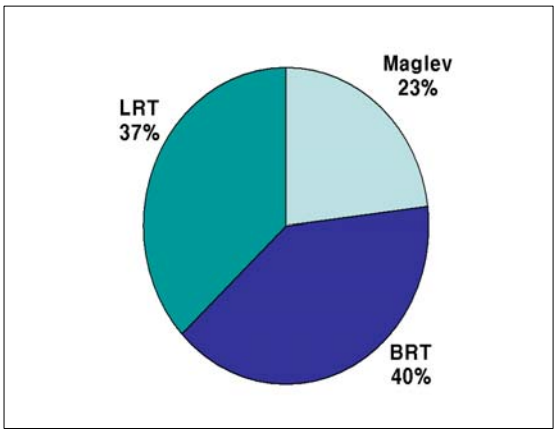


Figure 6. The Overall Grade for Each System

Since trips expected in third phase is analyzed to be about 22,000 trips/hour, all the three systems can deal with these trips in the condition of the following situation. They are i) 10% of peak hour factor, ii) modal share of a new mass transit is 60%, and iii) inter city trip ratio will reach to 30%. This assumption is rather conservative compared to the those for the existing cities.

In conclusion, a new mass transit between the administration city and surrounding cities is suggested to be a BRT system.

4.2 Conceptual Plan for BRT between The Administration City and Surrounding Cities

4.2.1 BRT Exclusive Road

It is to provide an exclusive BRT road along with the general road. Two different road can be separate by barrier like street trees etc. Two lanes are enough to carry BRT in the most cases. It is shown in the figure below.

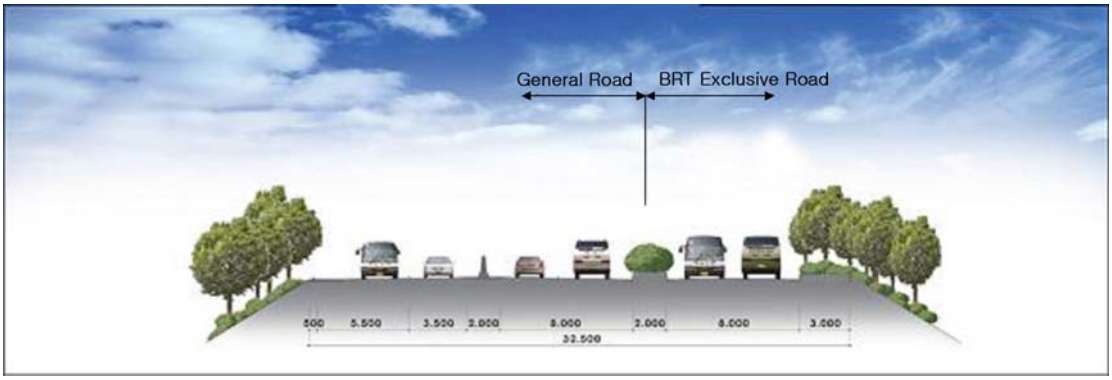


Figure 7. Cross Section View of An Exclusive BRT Road Along With General Road

4.2.2 BRT Exclusive Lanes

It is to assign an exclusive lanes for BRT, which can be seen in the most metropolitan area in Korea. An exclusive lanes can be designed in either median lanes or roadside lanes.

The median BRT

The roadside BRT

Figure 8. Two Types of Exclusive Lanes for BRT

5. A NEW MASS TRANSIT INSIDE THE ADMINSTRATION CITY

5.1 Optimal Mass Transit System

The criteria of selecting a new mass transit inside the administration city is same as it is done for a new mass transit between a new city and surrounding cities. Based on AHP results, Maglev is found to be the best one out of three ones. It is followed by LRT and BRT.

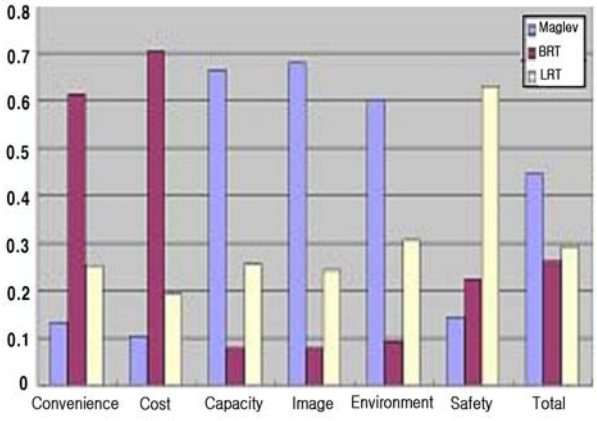


Figure 9. Comparative Weight By Criteria

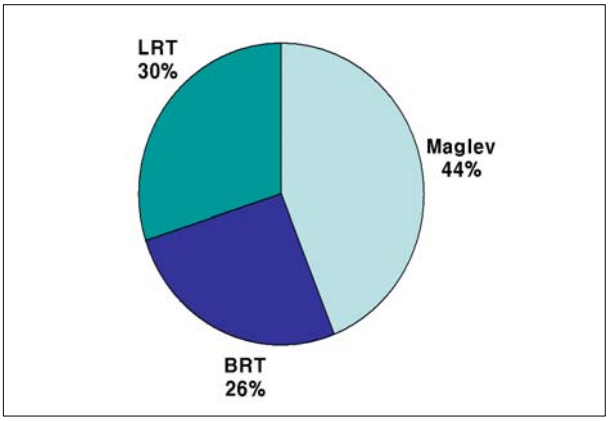


Figure 10. The Overall Grade for Each System

Since trips expected by phase is about 11,000 trips in first phase, about 32,000 trips in second phase, and about 53,000 trips in third phase, the BRT system is allowed in the first phase. However, LRT or Maglev are required in second and third phase in the condition of the following situation. They are i) 10% of peak hour factor, ii) modal share of a new mass transit is 60%, and iii) inter city trip ratio will reach to 70%. This assumption is still rather conservative compared to the those for the existing cities.

In conclusion, a new mass transit inside the administration city is suggested to be BRT in the beginning and LRT or Maglev at second and third phase.

5.2 Conceptual Plan for BRT Inside The Administration City

5.2.1 Corridor Network

This is to make a couple of corridors to serve traffic with a new mass transit system. Higher density development can be done along the this corridor. This corridor can be divided by buildings into the mass transit road and general road as shown in the figure.

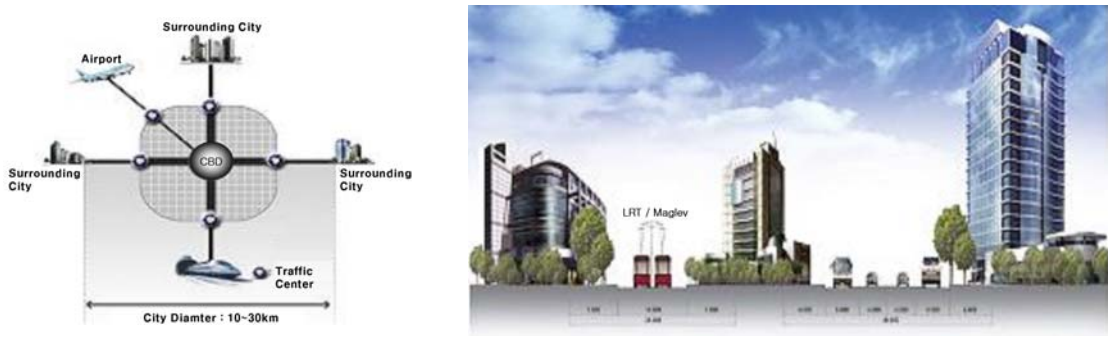


Figure 11. The Concept of Corridor Network and Cross Section View

5.2.2 Radial Network

It is to make several corridors radiating from the center of the adminstration city. In this case, the CBD area, usually in the center of the city, can be developed at higher density with a little of lower density development along the corridors. Along the corridors, mass transit can be combined with the general mode as shown in the figure.

Figure 12. The concept of Radial Network and Cross Section View

5.2.3 Grid Network

It is to develop a grid type of network as shown in figure below. It is a middle model between corridor network and radial network in terms of land development.

Figure 13. The Concept of Grid Network and Cross Section View

6. A TRAFFIC CENTER CONNECTING A NEW MASS TRANSIT AND OTHER MODES

A traffic center is to be constructed at the node connecting more than two lines. It will be also constructed gradually as the network are being developed. Two types of traffic centers can be considered.

6.1 City-type Traffic Center

The city-type traffic center has to deal with trips by captive riders. It will be constructed at CBD area, terminals, stations at new mass transit. It can be designed in the ground level or vertical level depending the location terrain.

Figure 14. The General Concept of City Type of Traffic Center

6.2 Outskirt-type Traffic Center

The outskirt type of traffic center has deal with both captive and choice riders. It will be constructed at high speed railway station, airport, and surrounding cities. It can be designed in the ground level or vertical level depending the location terrain.

Figure 15. The General Concept of Outskirt Type of Traffic Center

7. ISSUES OF PROJECT EXPENSES AND OPERATION

7.1 Expected expenses

A total of 2.38 billion $ are estimated to construct the suggested new mass transit system in the adminstration city.

Table 5. Expected Expenses for New Mass Transit

	Total (million)	BRT		LRT		Traffic Center	
		length (km)	cost (mil)	length (km)	cost (mil)	places (set)	cost (mil)
1 phase	660	60	600	-	-	3	60
2 phase	880	30	300	10	500	4	80
3 phase	840	30	300	10	500	2	40
Total	2,380	120	1,200	20	1,000	9	180

7.2 Designating a Concessionaire

Since the budget of government is out of short, the private participation investment are suggested in this study. The 3rd sector combining a government sector and a private sector is finally suggested as a best option to consider.

The procedure by private participation investment is listed in flowchart below from the designating the project to the completion of construction.

7.3 Suggestions

This report can be utilized as a guide line in doing the real master plan and implementation design for a new mass transit. In the initial stage, the land acquisition has to be completed for those of the third phase in order to avoid general difficulties in acquisition. This area can be used as a buffering facility for protecting traffic accidents. The budget saving effects are also expected by avoiding trial-and error procedure for introducing a new mass transit.

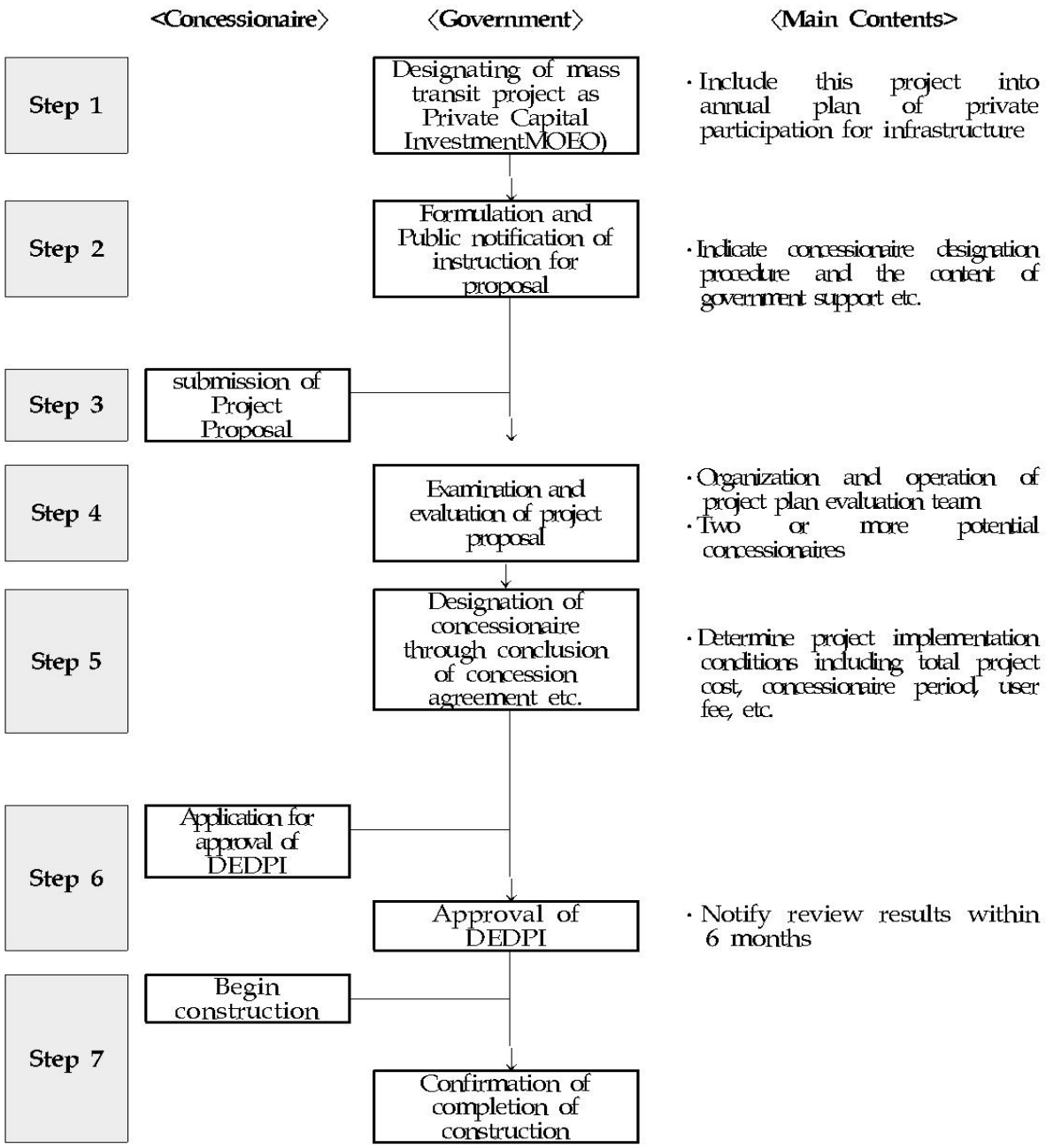


Figure 16. The Procedure of Project Implementation by Private Participation

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