Proceedings of the Eastern Asia Society for Transportation Studies, Vol. 5, pp. 1510 - 1521, 2005

ITS MODEL DEPLOYMENT INITIATIVES FOR TRANSITIONAL COUNTRIES

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Abstract: The goal of ITS MDI project in Korea was to come up with a deployment project that could test versatile systems in two or more regions under different environments for maximized synergy effect of ITS systems. In the first MDI project in Korea in late ninties, for instance, eight different systems, including ITS center, central and local governments along with eight different system providers were involved in the project. Two adjacent regions including Kwachon and Seoul were selected for the system installation. The evaluation of the first MDI project was completed and it turned out to serve real benefits of those citizens. Korean ITS MDI project could be an appropriate model for ITS for developing countries. Therefore, this paper will focus on introducing the procedure, evaluating the nature of ITS MDI, and bring forth lessons as well as experiences of ITS for developing countries**.**

Key Words: ITS MDI, Transitional Countries, ITS, Benefit

1. BACKGROUND

After the Seoul Summer Olympic Game in 1988, the number of car had dramatically increased and as a result it reached 10 million in 1997 in Korea. This trend has been caused serious transportation problems now and eventually threatening the competitiveness of the nation in this global era. Transportation problems can be summarized into two categories in terms of congestion and accident.

The congestion has hold down the average vehicle speed in the metropolitan areas in Korea to merely 23km/hr daily. Table 1 illustrates the current transportation data in the 7 major metropolitan cities in Korea.

Table 1. Current Status of 7 Major Metropolitan Cities in Korea

			Seoul	Pusan	Taegu	Inchon	Kwangju	Tagjeon	Ulsan
Population (Thousand)			10,321	3,818	2,517	2,505	1,359	1,368	1,024
Household (Thousand)			3,491	1,187	790	809	421	427	315
Area (km2)			605.5	753.2	885.6	958.0	501.4	539.9	1,055.7
Vehicle (Thousand)	Total		2,199	720	615	558	287	327	261
	Auto		1,653	516	438	412	202	239	200
Average Vehicle Speed (km/h)	Peak Hour	CBD	19.59	20.94	27.6	19.6	23.55	22.1	22.5
		Sub-urban	24.96	29.3	34.65	24.9	31.02	25.5	45.2
	Daily Average	CBD	17.72	24.15	28.3	23.11	22.76	23.5	23.5
		Sub-urban	25.9	24.73	36.25	29.45	31.31	27.4	47.1

Source: News Released Statistics, Surface Transport Planning Division, Ministry of Construction and Transportation, December 2002

Meanwhile, number of traffic accidents in Korea is high enough to be in the top of dishonorable list among the OECD nations. In late nineties, approximately 526 traffic accidents, 25 deaths and 940 casualties occurred per 100 thousands of population per year. In addition, Korea has a relatively high fatality rate against the number of accident in comparison with that of U.S and U.K.

To cope with traffic problems, Ministry of Construction and Transportation (MOCT) eventually put gear forward on ITS by establishing the National ITS Strategic Plan. According to the strategic plan, the city of Kwachon and other model cities were chosen as the sites for the integrated model deployment projects.

The objectives of the Kwachon project, the first integrated project, are as follows. In the first place, ITS will provide real benefits to residents of Kwachon area. Secondly, it will render the benefits of ITS to policy makers by providing quantitative evidence for further national expansion. Thirdly, private sector can test its system performance in real traffic situation. Lastly, Kwachon could serve as technical site for the 1998 ITS World Congress in Seoul.

In Kwachon project, eight different systems, including ITS center, central and local governments along with eight different system providers were involved in the project. Also 2 adjacent

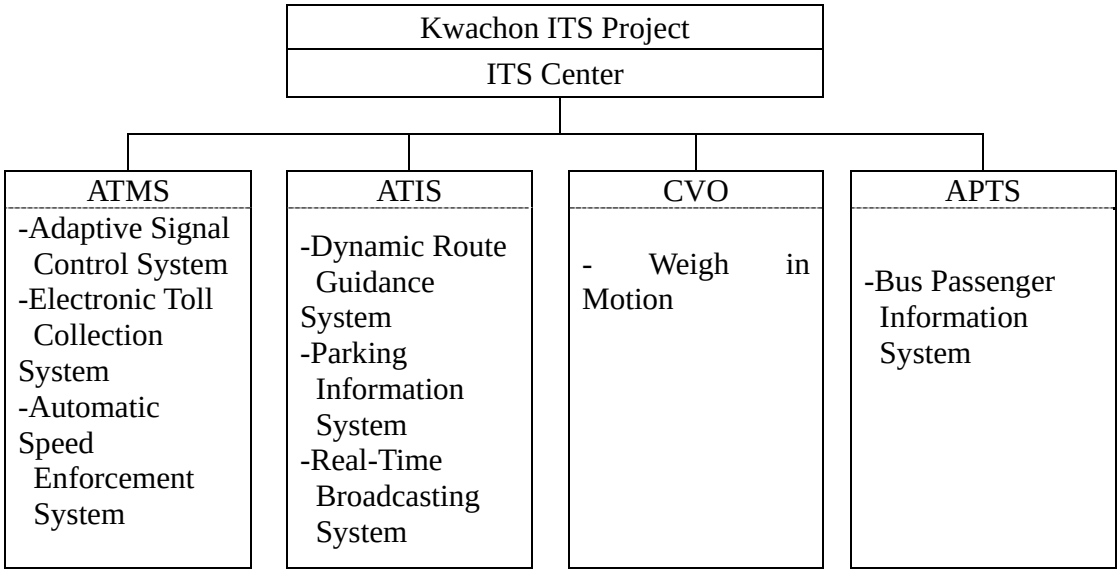
regions including Kwachon were selected for the system installation. The evaluation of the Kwachon project was made and it turned out to serve real benefits of Kwachon citizens. Kwachon project could be an appropriate model for ITS developing countries. This paper will introduce and evaluate the nature of the first MDI in Korea and bring forth lessons as well as experiences of ITS for developing countries.

2. SCOPE OF KWACHON MDI

In the process of selecting Kwachon as the test site, some crucial factors were considered. First, the city of Kwachon, unlike other cities, has financial autonomy. Local government of Kwachon can maintain and repair the facilities without the financial support from the central government. Second, the type of the road network of Kwachon is square grid road network. Third, Kwachon is furnished with well-developed mass transit system. Kwachon provides real-time transferable intermodal transportation information and it is a best test site for Bus Information System. Fourth, the fact that the location of the government complex is in downtown Kwachon can create promotional effects.

2.1 Basic Plan

The descriptive range of the project was decided in this phase and following figure illustrates it well as follows:



2.2 Before Study and System Installation

The aim of before study was to find the quantitative and qualitative analysis of the expected effects of before/after the system installment by means of interviews prior to the system installment. And this served as the fundamentals in evaluating ITS and factors deciding Measurement of Effectiveness (MOE). Table 2 reveals the item for before study.

Table 2. Items for Before Study

Objective	Field Survey Item
Quantitative Analysis	- Directional Volume at Intersection - Link Travel Speed
Qualitative Analysis	- Rider's Awareness and Demand Survey - Parker's Awareness and Demand Survey - Toll Gate User's Awareness Survey

Field observer conducted field survey of directional traffic volume on and off peak time. Directional vehicle delay at intersection was calculated by TRANSYT-7F software package. The total average vehicle delay time at 13 intersections was estimated to be 3,656 sec./vehicle. In the mean time, floating vehicle method was adopted for the measurement of speed. Travel speed and running speed were also checked by link. On-site interviews and postcard surveys were carried out simultaneously for qualitative analysis.

The budgets for the phases were as follows: Private sector and local government shared the budget of infrastructure in Kwachon project. Uncommon characteristic was that the ratio of private allotment to public subsidy was relatively high in case of Kwachon. However, the ratio was expected to be different in the upcoming projects because Kwachon was the first government-led project and that private sector had simply sacrificed its expenses with the hope of future compensation through its participation in the future projects.

Table 3. Project Funding Unit: Million U.S$

	Basic Plan	System Installation	Evaluation
Federal Government	0.25	3.25	0.25
Local Government	-	0.88	-
Private Sector	-	6.00	-
Subtotal	0.25	10.13	0.25
Total		10.53	

3. EVALUATION

3.1 MOE Identification

According to ITS evaluation result, some major identifications of U.S. were safety (number of crashes and number of fatality), time, throughput, cost, and customer. And each MOE's was further categorized into measured, predicted and anecdotal method according to ITS components. In Kwachon project, however, the significance of MOE was the expected effectiveness of ITS on end users, system operators and policy makers.

Table 4. MOE'S

System	Aspects	Before and After Study		System Performance Test
		Quantitative Analysis	Qualitative Analysis	
ASCS	User	· Delay Time · Travel Speed · Travel Time	· Convenience	· Delay
	Operator	-	-	· Saturation Rate · Spillback Prevention · Delay Time · Running Speed
	Policy Maker	· Throughput	· Save Man-power · Accident Rate	
BIS	User	· Waiting Time	· Convenience	· Timeliness
	Operator	· Rider Demand		· timeliness · Efficiency
	Policy Maker	· Mode Change		· Timeliness
DRGS	User	· Accuracy	· Convenience	
	Operator			· Accuracy
	Policy Maker			
PIS	User	· Save Time		· Efficiency
	Operator	· Parking Demand		· Accuracy
	Policy Maker	· Mode Change		· Accuracy
ASES	User	· Accident Decrease		
	Operator	· Speed Decrease		· Detection Rate · Detection Error

	Policy Maker	· Air Pollution Decrease		
ETCS	User	· Save Travel Time		
	Operator	· Save Man-power		· TAG Detection Rate · AVI · Money Clearing
	Policy Maker	· Saving Area for Toll Gate		
WIM	User	· Enforcement Time Saving		
	Operator	· Man-power Saving · Cost Saving		· Accuracy
	Policy Maker	· Save Maintenance Cost		
ITS Center	User			
	Operator	· Save Man-power		· Accuracy
	Policy Maker		· Efficiency	

3.2 Evaluation Results

Before and After Study

- Intersection Traffic Control System

Evaluation result revealed that average vehicle delay on directional volume on intersection decreased to 56% in Kwachon. The average vehicle delay time has decreased by 44% in certain intersection not leading to Kwachon detour road. The average vehicle speed of link increased from 28.56 km/hr to 35.8km/hr, a 26% increase. Traffic flow difference between before and after study period was measured to be only 0.76% from the Cordon Line result. And what this means is that the volume of the traffic is somewhat stable and has no influence on the delay and the change of speed.

- Public Transportation System

In case of Bus Information System, about 37% of interviewees were positive about the bus arrival time information. 33% were known to have utilized the information provided by the Bus Arrival Information. And 41% of the buses are installed with the IVU equipment. 12.7% of the interviewees mentioned the effectiveness of the Bus Information System. 52.3% were positive

about the enhanced service quality. In addition, 21.5% of interviewee responded that their waiting time for buses decrease by 1 to 10 minutes.

- Parking Information System

For Parking Information System, 56% of parkers trusted the accuracy of the provided information. 55% of parkers agreed that the system had enhanced the quality of service in parking lot. 68.5% were positive about the expansion of the system. 40.2% utilized the parking information, where as 46% of system users replied that their loitering time was curtailed. The usage of the rate of parking lot, related with parking demand, has increased effectively according to the before and after study.

- Electronic Toll Collection System

93.2% were positive in adopting the ETCS in before study whereas only 48.1% in after study. 97.2% were positive about free-installment but after study showed the number decreased to 59.9%. 25.3% were ignorant of ETCS test taking place in the tollgate while 54.6% knew the fact and 25.3% had the tags on. 58.8% of the total of 148 interviewees favored the after-paid method for the tollgate payment.

- Automatic Speed Enforcement System

The result of the accident decreased by 5.6% while there was no death casualty reported after the installment of ASES. There was 55.8% of decrease in speeding.

- Other Systems

64.7% knew about the Vehicle Management System and 47.8% believed that VMS contributed in solving the traffic problems. 79.4% considered the system to be somewhat correct whereas only 25.4% knew that the system was in operation. 5.9% answered that the system had decreased the overload vehicles. 75% knew well about the Automatic Speed Enforcement System, 74.7% about the Electronic Toll Collection System, 74.4% about Bus Information System and 64.7% about the Adaptive Signal Control System.

Table 5. Summary of Before and After Study Result

System	MOE	Results
Adaptive Signal Control System	Volume	0.76% increase
	Vehicle Delay	56% decrease in entire region 44% decrease in a intersection that has no influence on by-pass
	Vehicle Speed	25.5% increase

Bus Information System	Information Accuracy	36.8% positive
	System Usage	33.8%
	Mode Shift from Auto to Bus	12.7%
	Service Level Increase	52.3%
	Waiting Time Decrease	21.5% 1~10 minute(s) decrease
Parking Information System	Information Accuracy	56.1%
	System Usage	40.2%
	Service Level Increase	54.8%
	Loitering Time Decrease	46.1%
Electronic Toll Collection System	System Recognition	74.7%
	Fee Charge Method	58.8% (post paid)
Automatic Speed Enforcing System	Number of Accident	5.6% decrease

System Performance Test Result

- ITS center

The focuses of the performance test were on the data management of sub-system and that of communication center within system. The data management of sub-system checks the condition of the references of sub-system server and equipment. Most of the system as well as the management of the data were stable in short.

- Adaptive Signal Control System

The error rate of loop detector was about 9% while that of visual detector was 16.7%. 20.5% of error rate was discovered in Saturation Rate whereas 23.9% was evidenced from Occupancy Rate. Capability of CPU, communication functions and storing devices were normal. The error rate of detail for information through VMS was 17.4%.

- Bus Information System

50 to 90 seconds' difference in the expected arrival time and real arrival time was evaluated as success. Wireless communication rate between the beacon on the road and that of the bus turned to be 90%. The communication between the beacons and the center is trustworthy.

- Navigation System

The average error is only 48.5 meter for the GPS-loaded vehicle and its real position.

- Parking Information System

The average error rate of the parking information System was 7%.

- Automatic Speed Enforcement System

System A showed recognition rate of 98.5%, false rate 0.8% whereas System B showed the rate 85.4% and 1.0% respectively. For reference, the National Police Agency has specified recognition rate to be over 80% and false rate within 20% for the system.

- Electronic Toll Collection System

85.7% recognized correct (with 4.9% false rate) is derived from the report. Every vehicle can save 51 seconds in average if the supposition is made on the distance of 1700 km. This can save about 1.9 million US$/year excluding the management cost.

- Weigh in Motion

The error rate of 2.7% in average was shown from the Axel weight and total vehicle weight.

Some of the quantitative evaluation results of system performance test are revealed in Table 6.

Table 6. Summary of System Performance Test Result

System	MOE		Result			
Center	Subsystem Data Management		Appropriate			
	Communication		Appropriate			
Adaptive Signal Control System	Error	Volume	Loop Detector		Image Detector	
			9.1%		16.7%	
		Saturation Rate	20.5%			
		Occupancy Rate	23.9%			
		VMS Information	17.4%			
		Queue Length	30.6%			
Bus Info. System	Error	Information Accuracy	70 seconds			
Car Navi. System	Error	Positioning	48.5m			
Parking Info. Sys.	Error	Information Accuracy	7%			
Automatic Speed Enforcing System	Error	Detection Rate and Detection	System A		System B	
			Detection Rate	Detection Error	Detection Rate	Detection Error

			99.5%	0.8%	85.4%	1.0%
Electronic Toll Collection System	Error	AVI Accuracy	99.9%			
Weigh In Motion	Error		2.7%			

4. ISSUES AND LESSONS

4.1 Master Plan and Detail Plan

More considerate decision-making is necessary in selecting the project site. The city of Kwachon has comparatively less serious internal traffic congestion than that of other cities in Korea. It is the volume of the passing traffic that is generating the traffic problems in the city. The officials consider this as hindrance and that the benefits of ITS can not be directly transferable to the citizens of Kwachon. As a result, the effectiveness of ITS from Kwachon is not applicable to other city without filtering.

The consensus was made among various stakeholders in its early stage in case of the metropolitan MDI (MMDI) projects in U.S. But in case of Kwachon, the system management was unstable from the start without consensus. The partial testing of Electronic Toll Collection System is the good example.

In the selection of the system infrastructure, Kwachon project was intended for department-store-type system rather than that reflects the needs of the end users. It is true that benefit of ITS can be maximized when two or more systems integrate each other, but the very fact that excessive system can also be a technical burden for integration should not be disregarded. This is closely related to the budget limitation and that the partial system installment will only decrease the inherent benefit of the system.

System deployment, the benefit of ITS, is critical issue in recent years. And most of the countries adopt top-down approach in implementing ITS. In this viewpoint, establishing the national as well as the regional level of architectures is crucial. It is because it has very close relationship with many regional systems. ITS deployment plan should merge with regional plans such as transportation plan. Since ITS is not the panacea for transportation problems, it must be

coordinated and well integrated with various regional plans. And organization of the committee is also crucial factor in pursuing the goal of the project in the practice. It is also essential to form steering committee, advisory board and to identify the roles of the task forces in early stage of the project.

4.2 System Deployment

It turns out that turnkey-based contract has many benefits in among various contract methods in ITS. Since design and system installation were separated in case of Kwachon project, trial & error and design change were inevitable. And this in turn delayed the installation period and consumed excessive efforts. Legal and systematic consolidations are essential factors prior to the deployment of the system. Specifically, harmonizing the jurisdictional problems required special efforts. In order to minimize these efforts and time, various pre-meetings and formation of a committee are essential in advance. Meanwhile, it is necessary to review the legal system in the planning stage for many countries in the process of introducing ITS. The failure of real-time Traffic Broadcasting System due to the legal problem is the very example. For instance, real-time Traffic Broadcasting System can raise funds when it is allowed for commercial advertisement via wide-vision-type VMS. But according to the advertisement law in Korea, it was impossible and the project was discarded.

4.3 Evaluation

ITS deployment project should focus on the need of the end users. In this manner, the selection of MOE must reflect the need of the end users. Field survey for data measurement should be planned as well. Time and budget can be saved from these processes. The completion of the system is prerequisite for the evaluation. Active public relations are essential after the evaluation. The figure that merely 60 to 70 percent recognize the system in Kwachon project reveals the essential need for active publicity. Parallel with public relations, developing educational programs for both central and local government officials concerned with transportation is also crucial.

5. CONCLUSION

Kwachon project brings up several topics. Firstly, various systems, regions, jurisdictions and the characteristics of MDI, were simultaneously examined in the project. Although all issues

were not clearly marked, they were discussed and pondered upon in short period of time. Secondly, 8 different private companies in Korea provided each individual system and all systems were integrated successfully. It was very impressive for the private sectors to open their system specifications and database. Thirdly, experience of the Kwachon project has resulted to the legislation of Transportation System Efficiency Act of Korea, similar to TEA-21 and ISTEA 21 of U.S. In addition, the project created the legal team specializing on the ITS project inside the Ministry of Construction and Transportation. Lastly, experience from the project had provided accumulated know-how for expansion of ITS to other regions. In short, it can be concluded that ITS must rely on the need of end users and it is just impossible without the financial and technical support of the private sectors.

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