Japan International Transport Institute
8th Annual Conference on U.S.-Japan Cooperation in Transportation
November 14, 2001 • Capital Hilton Hotel

Introducing ITS in Asian Countries

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Foreword

It is my great honor to have this opportunity to introduce the topic of ITS in Asian countries. First of all, I'd like to speak about my involvement with ITS in Asia. Since joining Sumitomo Electric in 1971, I have been involved in virtually all major ITS projects in Japan, including Comprehensive Automobile Communication Systems, Freeway Management Systems, Digital Road Maps, Navigation Systems and Vehicle Information and Communication Systems. After I joined ITS America as an International Fellow, the former president advised me to study the status of ITS in developing countries, especially in Asia. For this purpose, I have visited 20 countries and regions in Asia and Latin America over the last three years. I am currently conducting a case study of ITS implementation in Bangkok at the request of the Asia-Pacific Telecommunity. I have published four reports with ITS America and the Asia-Pacific Telecommunity.

Today, I would like to focus on two subjects: macroscopic ITS status, and ITS implementation strategies in Asian countries. Also, I will touch on three ITS projects in Japan: the Traffic Control System (TCS) in Tokyo, the Vehicle Information and Communication System (VICS), and Electric Toll Collection.

1. Macroscopic ITS status in Asian countries

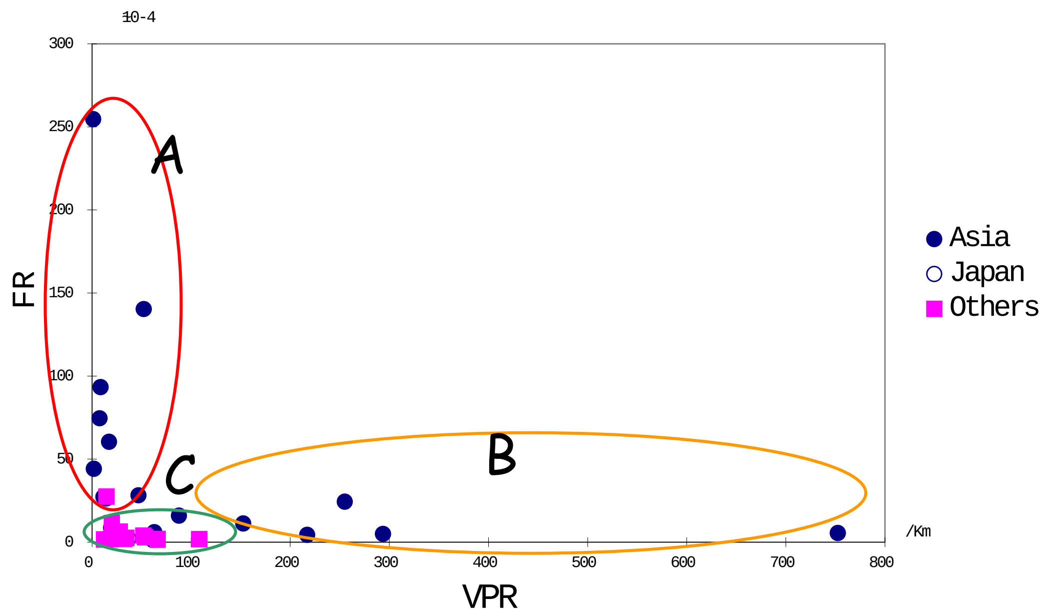
1.1 Traffic conditions in Asian countries

Traffic problems, including accidents, congestion and pollution are some of the most troublesome emerging social problems in the world. They result in needless injuries and deaths, long term health hazards, and erosion of quality of life. The most effective way to alleviate congestion is to construct alternative roads, but it becomes difficult to do so because of ever-rising land expenses and constrained downtown areas. ITS has been gaining the attention by traffic experts as a potential approach to solving traffic problems.

Until recently, ITS had been regarded as a system for developed countries, with initial discussions surrounding North America, Europe, Australia and Japan. However, looking at traffic problems such as accidents and congestion, we recognize that the situation in developing countries can be similar to or worse than the situation in developed countries.

In general, Asian countries have more traffic problems in comparison to other regions due to the rapid economic growth and explosive increase in automobiles. Heavy congestion in the big cities due to overpopulation is very obvious. Two and three-wheeled vehicles such as motorcycles and mopeds are very common, and in some countries they outnumber four-wheeled vehicles.

"Vehicles Per Road-Kilometer" is a measure of congestion. It is defined as the number of four-wheeled vehicles in a given region, divided by total kilometers of available road. *"Fatality Rate"* is defined here as the number of traffic fatalities, divided by the number of four-wheeled vehicles in a given region, in tens of thousands. A cross-country comparison of these factors, as shown in this slide, yields some interesting conclusions:



Vehicles Per Road-Kilometer vs Fatality Rate

Countries were classified into three groups, A, B and C. Most developed countries belong to Group C. Most Asian countries other than Japan belong to Group A or B. Each group shows specific characteristics. Countries in Group A display high Fatality Rates in spite of low Vehicles Per Road-Kilometer. These countries have basic traffic problems such as insufficient infrastructure. Countries in Group B exhibit high Vehicles Per Road-Kilometer and rather low Fatality Rates. In these countries it appears that the construction of road networks has not sufficiently kept up with the rapid increase in the number of vehicles. The possibility of congestion is high. Group C countries exhibit low Vehicles Per Road-Kilometer and low Fatality Rates due to more advanced infrastructure and ITS systems. Some developing countries belong to this group also. This comes as a result of traffic problems being less evident due to fewer vehicles.

1.2 The four groups and their ITS characteristics

Other data indicate that Asian countries can accurately be classified into four groups, as the slide shows.

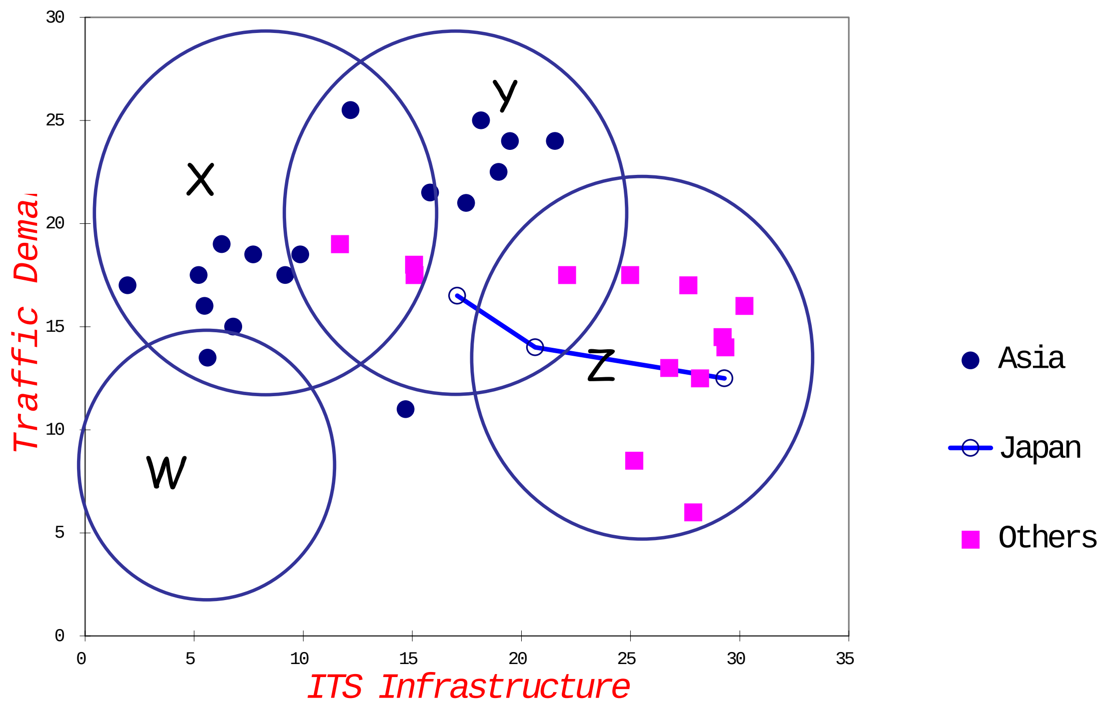
For the purposes of classification, the following factors were considered:

Both *Infrastructure* and *Supporting Conditions* are essential for ITS development and deployment. "*Infrastructure*" refers to paved road networks, road appurtenances, mass-transportation, a telecommunications network, high-quality inspected vehicles, traffic signals, pedestrian walkways, etc. "*Supporting Conditions*" refers to a well-organized body of promotion, maintenance, enhancement and administration of infrastructure, as well as awareness of traffic rules by drivers and pedestrians. Education not only in traffic laws but also in basic road etiquette is called for in several Asian countries, for drivers and pedestrians alike.
The above two factors, *Infrastructure* and *Supporting Conditions*, are referred to as *ITS Infrastructure*, and are both required to promote ITS effectively and smoothly.

To evaluate ITS Infrastructure in each country, I chose seven items, by regression analysis, which have a high correlation to Fatality Rate. Those seven items are: (1) paved roads rate, (2) telephone availability, (3) television availability, (4) number of vehicles per capita, (5) buses in use ÷ passenger cars in use, (6) literacy and (7) GDP per capita.

To evaluate *Traffic Demand,* the following two factors were considered: (1) Fatality Rate and (2) Vehicles Per Road-Kilometer (which is a measure of congestion).

- Group W: Low ITS Infrastructure and low traffic demand
- Group X: Low ITS Infrastructure but high traffic demand
- Group Y: High ITS Infrastructure and high traffic demand
- Group Z: High ITS Infrastructure but lower traffic demand



ITS Infrastructure vs Traffic Demand

As ITS Infrastructure increases and the overall economy develops, Traffic Demand increases from W to X to Y. But Traffic Demand then *decreases* slightly from Y to Z. This trend reversal suggests to us that after implementing ITS Infrastructure, traffic problems are solved to some extent. ITS must of course be working effectively for this situation to develop. Therefore, ITS demand, which is a measure of the necessity for ITS, increases from groups W to X to Y to Z. Higher ITS demand means that ITS works more effectively. If we compare data from Japan in the years 1970, 1980 and 1997, we see that ITS demand increases with time. Clearly, ITS demand increases with economic growth.

1.3 ITS in Japan

Now, I would like to introduce three major systems in Japan: the Tokyo Traffic Control System, the Vehicle Information and Communication System (VICS), and Electric Toll Collection (ETC). Japan started developing ITS in the late 1960s for Signal Control Systems and Freeway Management Systems. In 1973, a well-known national pilot project called the Comprehensive Automobile Communication System (CACS) was launched. CACS was eventually succeeded by the Vehicle Information and Communication System (VICS), which is in commercial use at present. Last March, nationwide Electronic Toll Collection began service.

Tokyo Traffic Control System

A central computer, which controls signal timing and variable message boards, processes huge volumes of traffic data sent from vehicle sensors and roadside TV. This system covers nearly 8,000 intersections in the metropolitan Tokyo area.

The Vehicle Information and Communication System (VICS)

VICS is a Japanese ITS success story. VICS became commercially available in April 1996, and 2 million units have been shipped as of March of 2000. VICS provides drivers with real-time road and traffic information, including congestion and estimated drive times, the location of accidents and roadwork, speed limits and lane regulations, and parking lot locations and availability. VICS displays this information on in-vehicle navigation systems.

Electronic Toll Collection (ETC)

Electronic Toll Collection consists of two major systems, Road Side Equipment (RSE) and On-Board Equipment (OBE). The systems communicate via two-way radio, using 5.9 GHz DSRC technology. The Road Side Equipment is connected to the toll computer in an office adjacent to the toll booth, and conducts the necessary processing. In March 2001, 63 toll plazas were equipped with RSE and commenced the first Electronic Toll Collection service in Japan. According to the implementation schedules at the Ministry of Land, Infrastructure and Transport, a total of 900 booths, or 70 % of all toll plazas in Japan, will be equipped.

2. ITS implementation strategy in Asian countries

Until recently, ITS activities have been carried out mainly by developed countries, however, ITS is gradually expanding into developing countries. Studying past ITS experiences of developed nations is beneficial to developing countries in order to avoid past problems and take the shortest, most efficient route to implementation. This phenomenon is known as “late-comer benefits” or “short-cut benefits”.

Based on my Asian studies and my ITS experiences in Japan and the US, I have learned several lessons.

2.1 ITS Infrastructure

Successful ITS projects in developed countries do not necessarily work well in developing countries because of differences in ITS Infrastructure and traffic demand. ITS works differently in different situations. The benefits to be gained from ITS projects are related to the surrounding environment. Developing countries must examine several conditions when deciding to move forward. Promoting ITS involves dealing with multiple jurisdictions, politics, funding and engineering. Cost-benefit analyses, in addition to examining the state of Traffic Demand and ITS Infrastructure, are key to decisions on ITS implementation. Past experience in ITS deployment is useful in developing and deploying ITS in a new country for the first time.

There have, in fact, been several inappropriate investments in past years. Traffic Control Systems in Manila and Bangkok are not working well due to lack of adequate maintenance, and currently policemen manually direct traffic. Electronic Toll Collection in Kuala Lumpur and Traffic Control Systems in Jakarta are serviced by several suppliers with varying specifications.

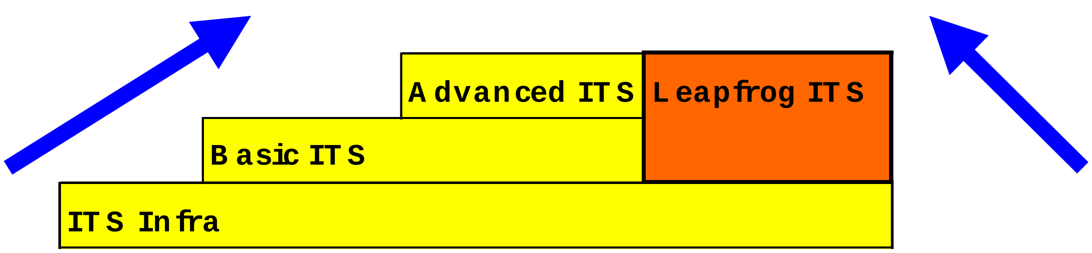
Those examples serve as good learning experiences for future implementation strategy. Needless to say, supporting conditions, in addition to infrastructure, are key issue for ITS implementation.

2.2 Basic ITS and Advanced ITS

Starting in 60s, Japan went through three stages of ITS. Each stage has the following characteristics:

1) In the early stage, ITS infrastructure, such as traffic signals and road appurtenances, were very effective at reducing traffic fatalities. From the mid 60s to 1975, the Fatality Rate decreased by almost half, in spite of a slight increase in Vehicles Per Road-Kilometer. The decrease in Fatality Rate each year was much larger than in other time periods.
2) After ITS Infrastructure was initially implemented, traffic control systems and expressway management systems were introduced by the public authorities. In spite of the increasing number of vehicles, the Fatality Rate declined slightly while vehicle kilometers increased. The increase of vehicle kilometers per year was much larger during this stage than all others.
3) Advanced ITS is required in order to achieve a breakthrough from the current status. The Vehicle Information and Communication System (VICS) is expected to reduce travel times for each driver, and as a result, diversify traffic flow and reduce congestion. VICS was promoted by a public-private partnership. Electronic Toll Collection (ETC) and Advanced Safety Vehicles (ASV) have launched commercially, and the Automated Highway System (AHS) was demonstrated last year in preparation for future commercial use.

Past approaches in Japan have provided us with a further lesson for ITS implementation: ITS may be classified into two major groups, *Basic ITS* and *Advanced ITS*. Basic ITS is more infrastructure and public sector based system. Advanced ITS is based on basic ITS, and is promoted by public-private partnerships or by the private sectors. After implementing ITS Infrastructure, basic ITS may be installed, followed by advanced ITS. This approach may be called the step approach.



Step approach and leap-frog approach

2.3 Two ITS approaches and late-comer benefits

The step approach implements ITS step by step in conjunction with other elements, such as ITS Infrastructure. To be sure, ITS works best when based on a fully implemented ITS Infrastructure. Even with a fully equipped, advanced system, if users misunderstand or misuse the system, it will be an ineffective system. ITS users are mainly comprised of the general public such as pedestrians and drivers. Furthermore, system operation and maintenance are very important issues. Publicity and educational activities are necessary factors. Such supporting conditions are imperative, and generally take time to implement.

Meanwhile, recent technological innovations provide the possibility of a short-cut route. The diffusion of Internet and cellular phones are expected to have beneficial effects. Developing countries can avoid ITS detours, a phenomenon known as latecomer benefits. This is the "leapfrog approach." Fundamentally, ITS must be implemented by the step approach in conjunction with related elements such as infrastructure and supporting conditions, but some systems or parts of systems can be introduced without incremental steps. Internet, cellular phones and other innovative technologies are expected to encourage the leapfrog approach. The important issue for the Advanced Traveler Information System is how to collect accurate, real-time traffic information. At VICS in Japan, public authorities receive traffic information through their traffic control systems. The best way to collect information may be through detectors like loop-coil, ultrasonic, or video image sensors, but implementing sensors in each intersection and on every highway is expensive and time-consuming. Using a vehicle's cellular phone as a probe is one solution. This method locates the moving vehicle by cellular radio wave and measures the travel time.

Consequently, with a strong foundation based on the "step approach", we may also effectively incorporate some elements of the "leapfrog approach."

3. Conclusions

In conclusion, in this presentation, I have attempted to introduce the current state of ITS and implementation strategies in Asian countries. Learning from past experiences in the US and Japan, I propose a combination of the step approach and the leap-frog approach. I sincerely hopes that my investigation will contribute to the future development of ITS and the improvement of traffic problems.