

# INNOVATIONS IN APPLYING INTELLIGENT TRANSPORTATION SYSTEMS IN DEVELOPING AND TRANSITIONAL COUNTRIES

T. Yokota & R. Scurfield

Transport and Urban Development Department, World Bank  
tyokota@worldbank.org, rscurfield.worldbank.org

H. Ishida

Institute of Policy and Planning Sciences, University of Tsukuba  
ishida@shako.sk.tsukuba.ac.jp

K. Kato

Road Bureau, Ministry of Land, Infrastructure and Transport

[kkato@road.go.jp](mailto:kkato@road.go.jp)

H. Yamagata

Nomura Research Institute Ltd.

hiyori13@alum.mit.edu

## ABSTRACT

ITS has long been considered to be an “advanced” tool primarily for the wealthy and developed economies. This situation is changing rapidly. The study has reviewed the current status of ITS in numerous developing and transitional countries, to understand the background and requirements of ITS deployment in these regions. It has revealed that the rapidly falling costs of IT equipments, the prevalence of tried and tested “off the shelf” ITS solution has enabled ITS deployment in these regions. Another important aspect was the prevalence of other general purpose IT infrastructure, such as mobile phone networks, and the Internet, and digital road maps, which has allowed new services, or old services to be provided in a different way with much less outlay in an innovative manner. Innovation happens better under certain conditions, such as ensuring a proper and fair market to emerge through government incentive, such as private sector promotion, standardization and the architecture setting. Other points, such as promoting the cooperation of different disciplines and creating promotional organizations to provide ample information can also help. Also, it is important to promote ITS itself to ensure an expanding market for the players to operate in. Social and organizational issues need to be addressed for this purpose. The need for constant system updates, maintenance and training needs to be stressed. The study also identifies the institutional arrangements that support the effective deployment of ITS, and summarises the findings into a toolkit that can assist the decision makers to identify the promising solutions and the issues that accompany them.

## KEY WORDS

ITS / DEVELOPING COUNTRIES / DEPLOYMENT / TRANSITIONAL COUNTRIES / INNOVATION

## 1. BACKGROUND

The importance of road transportation has been increasing, especially in the developing and transitional countries where rising income has allowed the explosive increase of motor vehicles. On the other hand, this has created numerous issues for these economies. Major challenges include;

- Meeting the demand for mobility for both people and freight
- Mitigating traffic congestion

- Reducing the environmental impact of cars, trucks, and buses
- Reducing the number of traffic-related deaths and reducing the severity of crashes in general
- Managing the transportation infrastructure

These are also issues for the developed economies, although the severity may vary. Main response to these challenges was to build more roads, but due to limited resources, new constructions have not been able to catch up with the growth of traffic and other problems.

Over the past 10 years, countries around the world have begun to employ a new set of approaches and technologies to meet the challenges of surface transportation, using the rapid advance of information and communication technology (ICT). This approach is often referred to as Intelligent Transport System (ITS), which has seen wide adoption around the world. Although this approach is generally considered as a more “advanced” approach that are mainly reserved for the developed economies, it is rapidly finding its way into developing and transitional economies.

However, there has been little attention to the specific issues concerning the developing and transitional economies. Although there are documents that mention transitional countries as a side issue the issue (PIARC 1999), a specific and comprehensive study regarding these regions was lacking

It is under this background that the World Bank and the Ministry of Land, Infrastructure and Transport, Japan (MLIT) has set out to identify the issues and challenges for ITS deployment in developing and transition countries. The study is designed as a toolkit, which can assist the decision makers to identify the promising solutions and the issues that accompany them.

The study is organized as a toolkit. Instead of simply being a descriptive reference. In addition to providing a comprehensive explanation on various ideas and technologies, it aims to provide a set of tools that can be used in the field, in order to choose the appropriate application/system, and various issues to be addressed can be addressed for those systems are easily understood.

The study focuses mainly on three regions, East Asia, Eastern and Central Europe and Latin America. The findings of the study, however, should be applicable to many other regions as well. This paper summarizes the main results of this study.

## **2. THE EMERGENCE OF “AFFORDABLE” ITS IN DEVELOPING/TRANSITIONAL ECONOMIES**

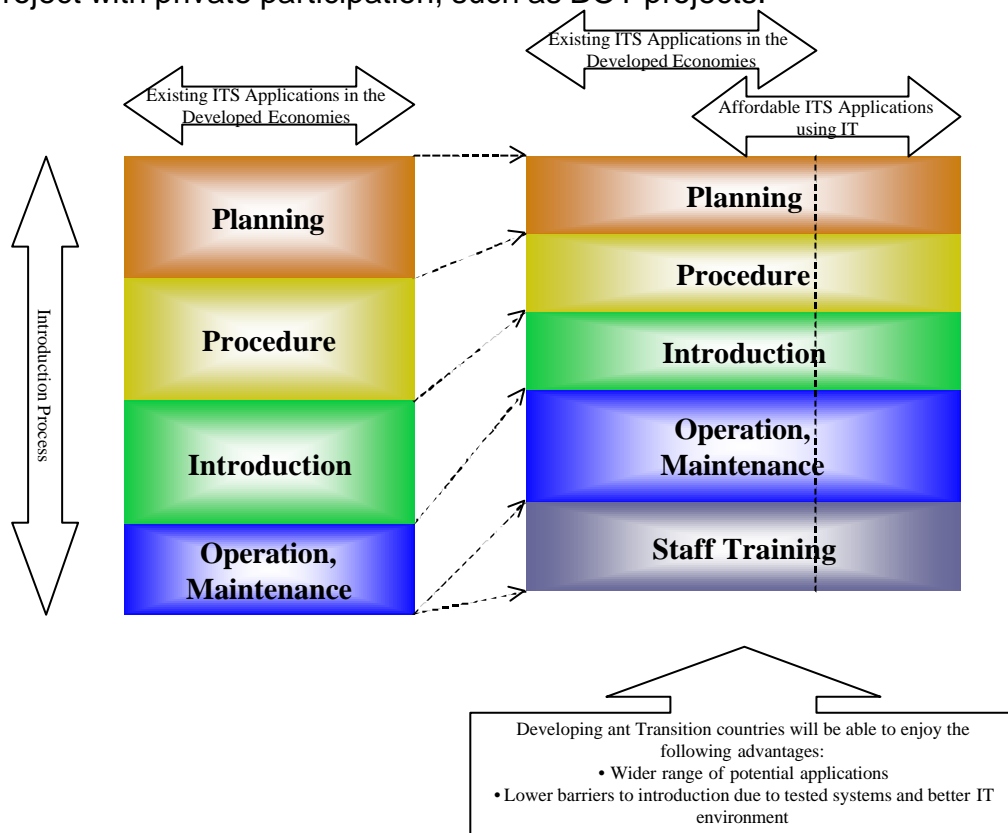
The actual applications of ITS in the developing and transitional economies are, in many cases, quite similar to those of the developed countries. However, it should be pointed out that the ease of introduction of such systems have improved significantly. The conditions that made it easier include;

- Latecomer’s advantage: (1) products are now cheaper and more refined than in the past; and (2) developing and economic-transition countries are able to install ITS infrastructure at the same time that physical infrastructure is being, built at a far lower cost than doing these separately (as has mainly been the case in developed countries)

- Rapid spread of IT including cellular phones and the Internet help provides some ITS infrastructure without special investment
- ITS services are available that are particularly beneficial to developing and economic-transition countries

These conditions allow for a different approach to ITS deployment in developing and transitional Economies. ITS introduction has become much easier in terms of cost performance and necessary infrastructure outlay. Improvement of general purpose IT environment (ex. Mobile phones and Internet) has allowed a wider variety of ITS application (Figure 1).

There are also some region specific reasons that push the introduction of ITS in each area. One of the most significant factor is the increased requirement from regional economic integration, such as EU. The continuing wave of privatisation in various road sector activities also play a role. The cost benefits that are afforded by ITS are often significant in various project with private participation, such as BOT projects.



**Figure 1 - Expanded Choice Range of ITS Applications and Simplified ITS Introduction Process in Developing and Economic-transition Countries. Source: World Bank and MLIT 2003.**

### 3. CHARACTERISTICS OF THE “AFORDABLE ITS”

Although the traffic problems faced by developing and transitional economies are similar to those of the developed economies, the environment may be significantly different. Some of the major differences include;

- Underdeveloped road network

- Severe budget restriction
- Explosive urbanization and growth
- Lack of resource for complicated maintenance and operation
- High unemployment / less demand for automation

The survey shows that ITS in the developing and transitional economies seem to function well when they take these conditions into account. The most effective ITS deployment has characteristics such as:

- Deployment is able to proceed in parallel with the development of other road transport infrastructure and public transportation systems.
- Deployment is able to make good use of spreading use of the Internet, mobile phones and digital road maps.
- They are flexible enough to cope with rapid urban development and growth.
- The cost of deployment is moderate
- Functions are basic and simple.
- Maintenance is easy.
- Systems are able to incorporate human work where appropriate and economic.

#### **4. Innovative Deployment of ITS**

By taking advantage of the points above, developing and transitional economies have managed to deploy ITS in a different manner than those in the developed economies.

##### **4.1. Road Conditions Monitoring System**

Many parts of Eastern Europe have harsh climates, with hot summers and cold, snowy winters. Road manager require real-time knowledge of road surface conditions, so that actions be taken to ensure safety in the event of problems such as drifting snow. Such systems have been deployed in some areas and are used in road management.

The trunk road linking Bucharest and Brasov in Romania has sensors at several points to measure road surface temperature and nearby air temperature. The data is relayed to the control center through the GSM network.

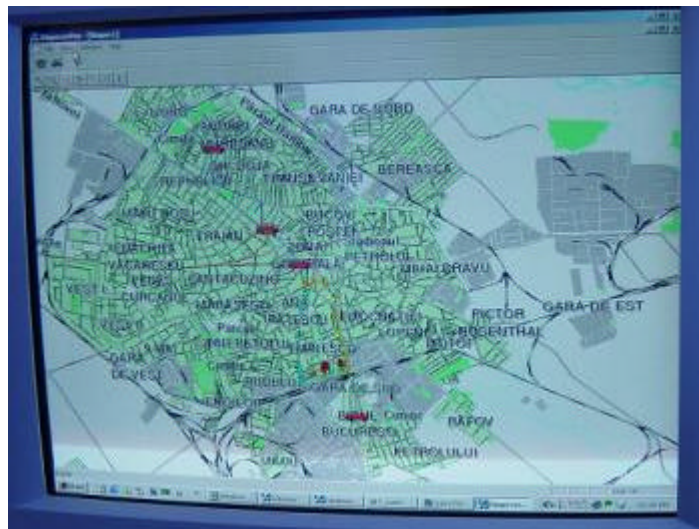
The use of existing infrastructure contributed to the lower cost, and the functions are basic and simple, while its ability to provide the necessary information is adequate for the problem at hand.

##### **4.2. Public Transport and Cargo Monitoring System**

Public transport systems may be extensive in many developing and transitional countries, although the increase of motor vehicles have lowered their revenue, which led to the vicious cycle of low service and low usage. It is sometimes possible to break this cycle through the use of innovative operation, increasing the service level and lowering the maintenance cost.

For example, in Ploiesti (Romania), antennas and onboard unit have been installed on buses on certain routes. Under the new service, position information acquired by GPS is transmitted by GSM to the center. The data is processed by a standard PC, which can

send arrival time forecasts to users, which is very well received by the citizens. This also helps to detect any trouble on the busses extremely easy to detect.

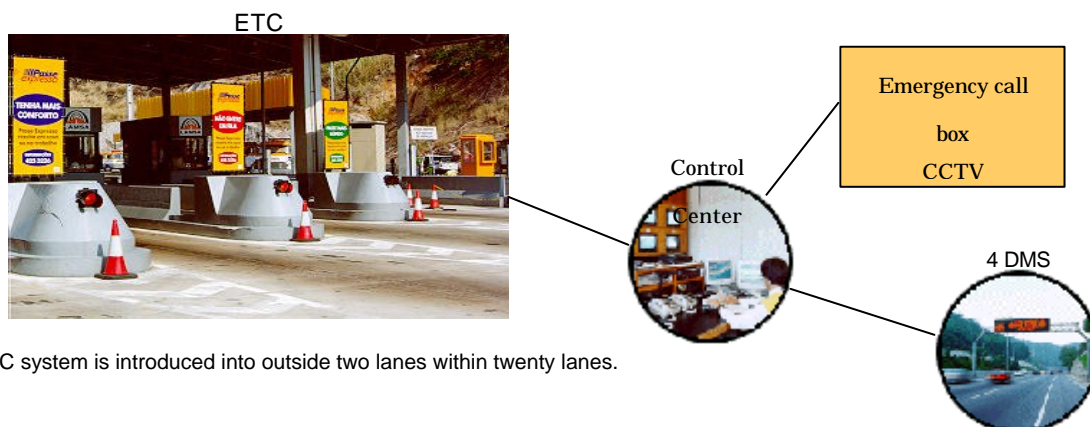


**Figure 2 - Bus Operation and Control System (Romania) Source: World Bank and MLIT 2003.**

Similar systems have been deployed for commercial fleet vehicles, which requires tracking for vehicles and the cargo. Combining off the shelf products, it has become extremely easy to produce such systems in developing countries.

#### 4.3. Simultaneous Construction of ITS Systems

The simultaneous construction of ITS with the road infrastructure itself helps enormously to decrease the deployment cost. During the construction of the Lihna Amarela (22km), an automatic toll collection system, changeable signboards, systems for measuring traffic volume and vehicle types and monitoring cameras were introduced. At the tollgate, an automatic collection system has been introduced for two of the 20 lanes. The unique characteristic is that ITS equipment was introduced during the actual construction of the road.



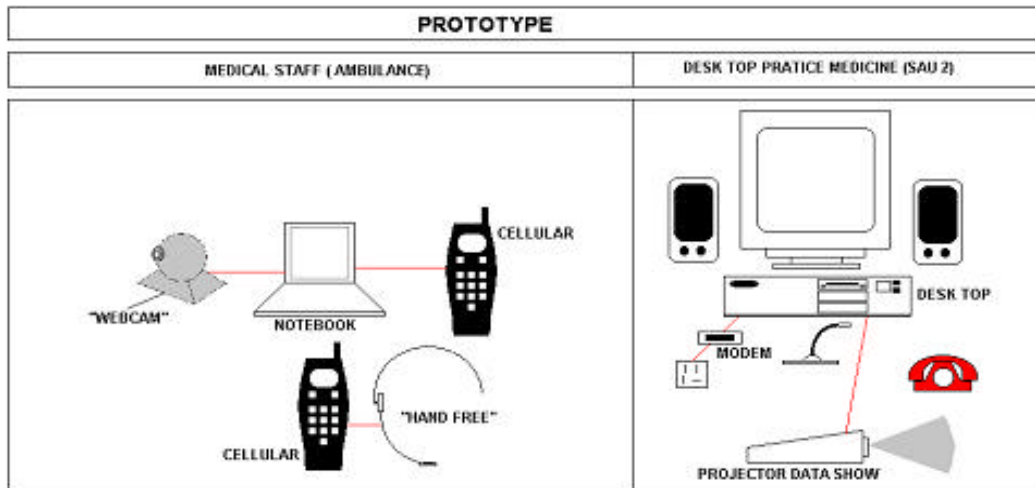
ETC system is introduced into outside two lanes within twenty lanes.

**Figure 3 -. Source: World Bank and MLIT 2003.**

#### 4.4. Use of Mobile Phones for Incident Response

ABCR (Brazilian Association of Highway Concessionaires) has introduced an emergency system for toll roads by which injuries can be captured by a digital camera and sent from the ambulance to the hospital via the Internet. In this manner instructions can be given to the ambulance and the hospital can be ready to quickly handle the situation.

Since the service of the Internet is provided as-is, and does not provide any guarantee, it is usually not considered fit for critical medical uses. However, if the limitations are well understood,



**Figure 4 - ABCR's Emergency Picture Information System (Brazil). Source: World Bank and MLIT 2003.**

#### 4.5. Information Collection and Provision Systems That Rely on Human

ITS is usually considered to be all about automation. However, Systems for the collection and dissemination of information are under-developed in countries with developing and transitional economies. Even data on subjects such as traffic conditions is lacking. Most services rely on human, particularly for the collection and dissemination of information

For example, in Bangkok (Thailand), a private radio station operates a traffic information service that compiles traffic information from 200,000 listener members. Information from listeners is collated, and the station broadcasts the information which they believe is reliable. Also in Bangkok, traffic managers watching images from CCTV cameras installed on toll roads may make judgments on the traffic situation and type in VMS messages manually, in Thai.

The diffusion of cellular telephones in countries with developing and transitional economies has been remarkably rapid in recent years. This provides opportunities for traffic information through SMS services in these areas.

Such combination of human effort, and widely used technology such as mobile phones have made much simpler application of ITS possible in these areas.

## **5. Points of Innovation**

The above examples show several innovative approaches in ITS deployment.

- **Use of Existing Infrastructure**

All of the above examples show some use of the existing infrastructure, as opposed to the use of dedicated systems. These existing systems include the Internet, mobile phone systems, GIS and GPS. These infrastructures were not developed with ITS in mind. The innovative use of these resources, however, provides a promising and cost effective way to implement ITS.

The use of existing infrastructure has changed ITS in other areas. For example, mayday systems used to be considered as one of the major applications of ITS. Due to the rapid adoption of mobile phones around the world, however, it has become rather unrealistic to think of mayday services within ITS only.

These approaches were themselves more or less some cost effective solutions tailored to the condition of each case. However, they are innovative in the sense that they suggest a new way to think about ITS. Especially in developed countries, ITS was mostly considered as a closed dedicated service within the transportation sector. These new approaches, however, suggest a different mind set, where ITS is not a closed dedicated system, but a part of an open system.

- **Flexible approach to ITS deployment**

The above point suggests a new and improved way to approach ITS deployment. The major approach to ITS so far has been an “all-out approach” so to say, creating a grand architecture that encompasses the whole spectrum of ITS, and implement parts of the architecture in a structured manner. The attitude was to consider ITS as a completely separate discipline from other social and technological system. This, however, has been shown to be not the only way to implement ITS. The cases above shows that there are other ways to implement ITS, in a more ad-hoc manner.

In terms of system architecture, these cases suggests another approach, a Step-by-step architecture, as opposed to the comprehensive architecture that is the norm today. The step-by-step architecture does not deny the comprehensive approach, but it allows countries and regions to adopt simply the parts of architecture that is required at the moment, based on the needs and the environment of that particular area.

## **6. Policy Recommendations for Innovative ITS Deployment in Countries with Developing and Transitional Economies**

The innovative application of ITS that we have described suggests several policy recommendations for developing and transitional economies that aim to introduce ITS, as well as developed economies that aim to achieve higher efficiency;

- **Provide Incentives for Private Sector ITS Development**

It has been proven over and over that the main thrust of innovation comes from the competition that is led by the market. Therefore, the private sector is the natural place for many kinds of innovative ITS applications to be developed, deployed, and operated. The private sector can often act much more quickly than government, which is very important

in a field that depends on rapidly changing IT. The private sector is usually willing to assume some level of risk in opening new markets and establishing new businesses. However, a very new industry like ITS may be more costly and more risky than many business find acceptable. This can have the effect of delaying the introduction of many kinds of ITS applications.

Therefore, it is sometimes appropriate for governments to help reduce the cost and the risk for private businesses to enter the ITS industry. This is especially true where private sector ITS applications can help achieve social goals (reduced pollution, reduced congestion, more mobile population). Some of the ways that government can do this are:

- Being an Early Adopter. For example, a government could acquire vehicle location and fleet management technology for its own vehicles to help get this market started.
- Subsidizing Consumer Purchases. For example, governments could help pay part of the cost of electronically collected tolls, to encourage use of the ETC system. This is already being done by some countries. Governments could similarly subsidize the cost of public transit fare cards.
- Providing Loan Guarantees or Low-cost Financing. Especially where the development of valuable private sector ITS applications is capital intensive, governments can help make loans less expensive to borrowers or less risky to lenders.
- Offering Tax Incentives. When a consumer buys a product that helps to reduce air pollution, a tax credit could be given. In countries with income taxes, the portion of a person's income spent for public transport would not be taxed.

By using one or a combination of these methods, governments can encourage ITS applications to be deployed and operated much more rapidly.

- Promote Joint Efforts between Various Areas

People from different disciplines can bring different ideas to the table, which is likely to lead to innovation. Especially in the case of ITS, the system itself is a hybrid of information technology and various traffic technology. Breakthroughs may occur by putting together different people to tackle an old issue. As mentioned before, the main innovation in the new ITS approach lies in thinking about ITS as an open area, rather than a closed dedicated discipline. Promising hybrids may include transport and computers, transport and communications. Also, the cooperation between the government, industry and academia may provide interesting breeding grounds for innovative ideas to come about.

- Encourage the Formation of an ITS Promotion Organization

Innovations are easier when there are enough sources of information to draw from, including studies at academia and cases in other countries. This may be achieved through the formation of ITS Promotion Organizations. The purpose of an ITS promotion organization is to provide opportunities for everyone interested in ITS to share ideas and information and work together to advance ITS.

- Encourage Organizational Cooperation

Innovation cannot see the light of day without proper implementation. Various kinds of organization cooperation are necessary for ITS implementation to succeed. People and agencies may agree in principle that cooperation is helpful. However, such cooperation often has immediate costs, but benefits that appear only later. In addition, good cooperation takes time. People need to get to know and trust the people they need to work



with. Therefore, consistent high-level direction can be very helpful, by encouraging (or requiring) cooperation at the appropriate levels. If agencies know that they will be evaluated on how well they work with other agencies, cooperation will come much faster.

- **Adopt Relevant ITS Standards**

Standards can also work in similar ways as architectures to promote innovation. Standardized technology can be expected to meet clear quality, reliability, and performance requirements. Standardized technology is likely to be available from more than one vendor, helping to keep prices low, and minimizing the risk of having a single vendor go out of business. Standardized technology makes it easier to create systems that are interoperable with adjoining systems, for example across political jurisdictions. In many cases, there are already well established standards that are developed collectively by many countries in existence, that many equipments and systems adhere to. Using such standards will also lead to better utilization of other existing technologies that may be used for providing a service, as we have seen in the above cases.

- **General Promotion of ITS**

Also, it is important to promote ITS itself to ensure an expanding market for the players to operate in. Social and organizational issues need to be addressed for this purpose. The need for constant system updates, maintenance and training needs to be stressed. The study also identifies the institutional arrangements that support the effective deployment of ITS, and summarises the findings into a toolkit that can assist the decision makers to identify the promising solutions and the issues that accompany them.

It should be noted that the toolkit included in the actual study provides a much more comprehensive description for each of the policy.

## **7. Conclusions**

ITS has great potential for improving surface transportation throughout the world and for delivering benefits to everyone who uses the transportation system. The recent advance in IT has made the innovative introduction of ITS much easier than it was before. The careful evaluation, selection, introduction, operation, and maintenance of ITS applications can be challenging, but it can be of great value at the national level, at regional and city levels, and at a personal level for travellers and for the people responsible for moving freight. Various innovations would help this trend, if applied properly. The issues pointed out in this study can help policy- and decision-makers in developing countries take advantage of the experience gained elsewhere in the world in introducing ITS, avoid pitfalls and risks, and move forward with ITS quickly and economically.

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