EVALUATING ITS IN THE NETWORK OPERATION CONTEXT

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ABSTRACT

ITS has long surpassed the stage of novelty in the field of network operations. However, it has been difficult to compare it with other tools of the trade, due to lack of evaluation. This paper attempts to summarize various evaluation methods as well as their results, based on representative cases around the world that were summarized as a part of the PIARC TC1.4 activity, focusing on the relationship between the purposes of various systems, the tools involved and the evaluation method/results.

Keywords: ITS, intelligent transport systems, evaluation,

1. Introduction: The Changing Environment of Network Operations

As pointed out in the PIARC C16: Network Operations Handbook, the environment surrounding network operators around the world are changing rapidly. Until recently, the major role of network operators was new road construction. The concept of "network operator" itself was a strange one, since there were virtually no "operators" that were separate from owners and/or builders of the road. A single road operator, who would be in charge of the whole road matters were the norm, and there use to be little point in highlighting the operator aspect.

This situation, however, is changing rapidly. In many of the developed country, significant part of the national road network has more or less been completed, or likely to become that way in the near future. Much of the remaining stretch of the network are very difficult to construct due to technical issues, land procurement, or financing. With increasing traffic and congestion, but without the capability to lay more roads, the focus for the road authorities have shifted toward operation of the existing infrastructure. This gave more sense to the concept of an independent "network operator." A related factor is the major shift in road procurement. Due to difficulty of publicly financing new road

construction, there has been significant rise in various BOT[1] schemes and private sector participation schemes. This has led to a clear separation between the road builders, road owners and the road operators. And while it is relatively easy to demonstrate the performance of road builders (measurable by the amount of concrete poured or length they procured), properly understanding the performance of an operator has become a big issue.

And then there is the technical environment. Until recently, once the infrastructure was in place, the tools that the operator can employ were very limited. The best that can be used were dynamic controls of traffic signals. But with the arrival of new communication technology and computer processing power, new control technology has opened a whole new area for network operations, to take advantage of the maximum capacity of the infrastructure as well as increase safety and lower various costs. This also gave rise to the question: what is the best way to achieve a certain goal?

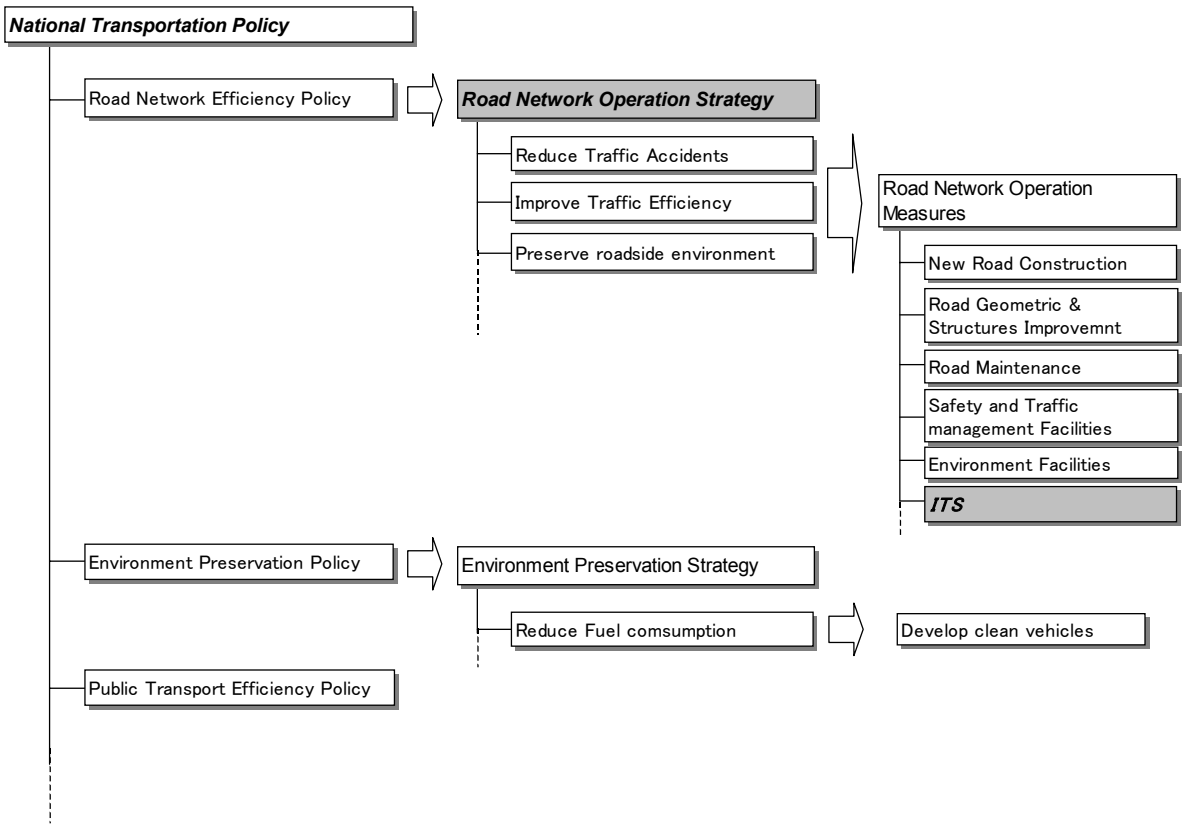

Figure 1: ITS as an Option within Network Operations

Intelligent Transport systems (ITS), obviously, is related to the second and third

[1] BOT: Build, Operate and Transfer

points above. It is related to the issue of how to evaluate the effectiveness of network operations. It is also related to the operation strategy of the network operators, i.e., how to implement their operations. Therefore, ITS is both the cause and the result of this change in the environment. And in terms of evaluation, it is both a tool for evaluation and a tool to be evaluated.

2. Objective of the Paper

Under this back ground, this paper attempts to clarify the whole scope of ITS evaluation. This seemed necessary for several reasons.

First is to understand the whole scope of evaluation in general. When evaluating, operators tend to focus on their narrow technical agenda, and often fail to address issues that are important to other stakeholders. In order to apply ITS services most effectively, it is important to understand their benefits and costs of these ITS services in a larger sense. The diverse array of ITS applications available can address a variety of transportation problems. Some applications provide more cost-effective benefits than others, and as technology evolves, the available choices change. The evaluation of ITS technology investments is of interest to road network operators, as well as other stakeholders.

It does not, however, attempt to be an encyclopedia or a manual. In order to respond to the road network operator's needs, this paper was produced to presents key elements of ITS evaluation and serve as a source of ideas and a checklist for evaluating ITS performance. Therefore, this paper does not take aim at giving answers to everything like manuals or guidelines. In order to obtain more substantial information, it may in many cases be necessary to seek the advice of experts.

There have been other studies concerning the evaluation of ITS. However, since evaluation was not a major issue in ITS until recently, they seemed more interested in individual methodology. There seems to be the impression that there aren't enough ITS evaluation in the world, and that it is important to simply increase evaluation efforts at all levels. They fail to address important questions like; how much evaluation is adequate? Since we have the technology, we could, in principle, collect enormous amount of data using all sorts of equipment if necessary. Thinking about the use of various evaluation results is gaining importance. This paper also attempts to provide the why and for whom of evaluation, so that evaluation can be done effectively,

3. Methodology

The paper attempts to get a framework of ITS evaluation by looking at the existing The paper drew examples cited in the following existing studies:

- PIARC C16 (2004) *ITS Handbook 2nd* , Arteckhouse, London
- FHWA Study
- IBEC Study

The total number of the cases amounted to about a 100. From the cases, the stated objectives and the actual evaluation results, the purpose of the evaluation, and the timing of the evaluation effort etc. were extracted. The description, however, were not always as detailed as we would have liked them to be. Certain amount of informed guess work was involved. In order to increase the accuracy of the study, it would be desirable to undertake a follow-up study of the cited cases.

Based on the extracted information, the major objectives of the ITS systems were extracted, and organized into a general framework. The evaluations were sporadic to say the best, and even when some results were presented, the purpose of undertaking that particular evaluation was usually not cited.

Since the objective was to provide an agreeable framework of the whole scope of evaluation, it does not attempt to make any statistical analysis of the existing efforts in evaluation. It merely ensures that all the existing efforts are included in the study, and that they are properly accounted for.

4. Characteristics of ITS evaluation: Major Objectives of Network Operations and ITS

Based on general consensus, the objectives for network operations can be classified as follows;

- Improving traffic efficiency
- Improving safety
- Improving the environmental impact

- Improving operational efficiency and economic gain

However, looking at the various cases of ITS, it seems that there are some additional objectives that ITS systems aim for. They can broadly be classified as;

- Improving organizational structure
- Better system integration
- Improve journey ambience
- Improve user acceptance

Granted, these may be subcategories of the earlier four objectives. For example, improving organizational structure (such as the introduction of Public Private Partnerships) can be seen as a way to improve operational efficiency and lower costs for the agencies and the society. Journey ambience may be a part of the overall safety. On the other hand, in many cases, they are treated as something different, either because they do not directly translate into the four major objectives, or even when they do, it is not clear enough.

It should also be noted that the objectives will be further subdivided into sub-objectives. Within the whole range of safety inducing strategies, traffic safety occupies only a small portion. Within that small portion, safety may mean deaths, or accidents in general, or any other measure. And then, there would be many ways to reduce accidents, such as reducing speed. This is the level where ITS becomes relevant as an option. However, the adoption of ITS will affect multiple levels of objectives, all the way up to the main objectives. When evaluating ITS, it is important to notice the level of the sub-objectives that is being discussed.

5. Characteristics of ITS evaluation: Stakeholders

The cases show a large variety of evaluations, not limited to those concerning the traffic conditions alone. This is because ITS applications usually have a much wider range of stakeholders than simple road infrastructure. Since evaluation is always based on someone's viewpoint, it is important to understand who the evaluation is intended for.

The main categories of stakeholders can be summarized as follows. As their points of interest may vary, the stakeholders needs need to be appropriately prioritized and a consensus among them should be sought.

- **Public authorities**

The part of the public administration authorized to issue directives, impose regulations and requirements, for the planning and financing of the transport infrastructure. They include national and local governments, government agencies and regional development agencies established for this purpose.

- **Road network operators**

The body (public or private) that provides the transport service, collects information on traffic and exercises control, within the framework of directives and regulations, and sets the targets for service procurement and safety.

- **Relevant public agencies**

They include police, operators of public transport, freight and emergency services.

- **Road users**

These constitute the basis for transport management and are the last link in the transport chain. They may be regarded collectively (traffic) or as single entities, for example individual drivers or passengers each with his/her need or needs.
Inter-modal travelers

- **Private sectors involved in ITS services**

Product providers include vehicle manufacturers and system integrators and consultants, construction businesses (as buyers of research products and technologies). Service providers could be related, for example, to the information infrastructure.

6. Characteristics of ITS evaluation: Timing and its Purpose

When would the evaluation take place? And for what reason? This is not necessarily clear from the case study. However, from experience and interviews with some colleagues, a hypothesis can be induced.

Like all projects, ITS projects will follow a Plan-Do-See cycle (Figure 2).

Figure 2: Plan-Do-See Cycle

In the early phases of ITS adoption, however, this cycle will have not begun, since in the beginning, there would be no existing system. Therefore, the role of pre-evaluation would be essential to persuade initial investment. After implementation, there would be opportunities for post-evaluation. The purpose of such post-evaluation, however, may not be clear. Many are done as an afterthought, when they are pressed by politicians or the press to demonstrate the effectiveness of the project. Unless they are truly disastrous, they would usually not be required to pull the plug, and hence, there will be little incentives for the operators to perform a rigorous post-evaluation. While there has been more pressure towards accountability and performance requirements in recent years, this situation still hasn't changed drastically.

The value of the post-evaluation, however, becomes apparent when preparing for the pre-evaluation of a similar project. Post evaluations will be indispensable. This is the main reason why there are more interest in evaluation. Also in the future, this will change. As with roads, ITS projects themselves will go through a change in phase, where improvements and integration, updates of existing systems will become dominant compared to implementation of new systems. In order to justify the incremental investment, evaluation will be crucial. Under this condition, the distinction between the pre-evaluation and post-evaluation will necessarily become blurry.

In the pre-evaluation, there would be adequate levels of evaluation also. One does not need to perform a rigorous socio-economic cost benefit analysis for installing a single speed camera. The level of evaluation would necessarily correspond with the competition for the particular project. At the basic level, the system may only need to demonstrate its effectiveness to lower speed, say, between a speed camera and a road

bump. As the project becomes larger, the competing projects will change, and the corresponding evaluation needs to change. Therefore, there is a corresponding relationship between the level of objectives, stakeholders, and the size of the system. This requires further study.

7. Conclusions and Recommendations: Hypothesis

As mentioned, this paper is based on the on-going study undertaken by PIARC TC1.4 WG3. It is still a work in progress, and any conclusions or recommendations are naturally tentative. It has, so far, managed to present an overall framework of evaluation, along with its importance in the activities of the network operator. This will be further pursued during the remaining period of activities of TC1.4 WG3. The study is expected to identify the performance indicators at various levels.

While the study is still in preliminary stage, assuming that the conclusion is on target, there are several recommendations that can be drawn from the cases so far;

- **Plan for evaluation during the planning process**

Since evaluation is important, it is important to plan for the evaluation before the project gets underway. Judging from the cases, it seems costly and less effective to implement evaluation as an afterthought. It is important to clarify the objective of the project (ex. improve safety/decrease accidents), what the immediate outcome should be (ex. reduce average driving speed). Implementing necessary sensors and systems during the construction phase is much cheaper and effective.

- **Set aside resources for evaluation.**

In various foreign aid project, where evaluation is essential for maintaining accountability, it is said that spending 3-5% of the total investment for information gathering purposes can be justified. Such amount may also be applicable for ITS, although this could be smaller.

- **Preparing a global database for performance benchmarking**

Problems in evaluation at the moment seems to be that there are no benchmarks. When installing a Variable Message Sign decreased accidents by 10 percent, is this significant? At the moment, it is rather hard to say. This seems to be another reason why evaluation is not as popular as we would like them to be. Organizations, possibly

PIARC, may try to form an initiative in preparing some benchmarks for expected effectiveness of various ITS implementations.

- **Further Study in Evaluation Methodology, Especially in Non-Technical Areas.**

Many cases state non-technical issues, such as organizational harmonization or system integration as the objective of ITS implementation. None, however managed to present any concrete evaluation for these objectives, other than gut feelings of the parties involved. Socio-economic benefit studies are slightly better, since Economic Internal Rate of Return and cost benefit analysis have been extensively utilized in various large-scale projects. This, however, also requires further study. Asian Development Bank demands 12% EIRR for providing a loan, but the reason behind this 12% is unclear. Much needs to be studied in the evaluation of non-technical nature, which is gaining importance.