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POLICY BRIEF

# Why evaluating Intelligent Transport Systems?

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## Providing an insight into needs of policy makers and the differences in evaluation culture across the globe.



Millions of dollars and euros are invested each year by transport authorities in making their countries' transport infrastructure more intelligent. New Traffic Control Centres are built, new sensors and communication technologies are deployed and traveller information services are rolled out.

Much of this deployment is driven by public authorities; the main drivers being the traditional policy goals of safety, security, sustainability and efficiency. Especially in the transport field, all investments need to show a positive impact on at least one of these goals, ideally more. Also cost efficiency needs to be ensured, especially in times of limited financial resources. In principle, all bigger investments need to be evaluated in this framework.

A solid framework to support decision-makers in well-founded choices is indispensable. For politicians, who are often the final decision-makers especially for large infrastructure investments, it is extremely important to have expert assessments to support the case. This should also be considered where ITS implementations are involved.

Often such huge investments in new infrastructure have a highly positive socio-economic impact. Smart measures that include ITS (Intelligent Transport System) often have an even higher benefit-cost-ratio. However, such smarter solutions are often not that visible to the general public. In this gap between high visibility and a good benefits-cost-ratio and low visibility and an even higher benefit-cost-ratio, decisions in favour or against ITS solutions are made at the highest authority level.

The underlying thesis of this policy brief is: "ITS evaluation contributes to better informed, evidence-based ITS decision-making". It is important to understand the general principles of ITS evaluation and the expected value by decision-makers. Secondly, this policy brief provides an analysis of the different decision-making and evaluation cultures around the globe. Finally, the findings of a global survey among ITS practitioners and decision-makers are presented.

## QUINTESSENCES

- At the policy level, evaluation is seen as an important tool for decision-makers, particularly in the public sector where public funds are involved, in order to plan and assess the cost effectiveness of ITS. Additionally, with the help of evaluation, the benefits of ITS implementation can be made visible to the public.
- ITS evaluation shows which ITS solutions work and where further improvements are needed. In this context evaluation provides a kind of "investment security" by helping decision-makers to invest money in the most efficient manner, preferably based on commonly agreed Key Performance Indicators (KPIs) underlining the impact of envisaged ITS deployments.
- An internationally harmonised evaluation methodology would contribute to improving access to knowledge of ITS implementations and projects, including positive as well as negative examples. It would furthermore enable the linking of similar ITS deployments in order to learn from each other, coordinate approaches and accomplish similar goals.
- There is a need for (open access) repositories, whether national or international, where ITS evaluation studies can be accessed. However, this would only be helpful if the studies contain the information that is most sought after, namely costs, benefits and in particular safety related benefits.
- The issue of differing expectations, cultures and context needs to be reflected or made explicit when ITS evaluation results are presented at international ITS conferences or published in reports.
- The data most used in ITS decision-making are cost data, lessons learnt and international best practice or success stories. Even though this information is highly requested however, a lack of cost-benefit information, a lack of impartial information and legal obstacles as well as a lack of political acceptance or awareness are seen as the main barriers to the use of ITS evaluation evidence.
- Translating ITS evaluation evidence into a language that is understood by decision-makers and geared towards their motives is the key to raising the awareness of the potential contribution of ITS to today's transport challenges.

### EVALUATION

In general evaluation can be defined as 'systematic acquisition and assessment of information to provide useful feedback about some object' [1]. In particular 'the term "evaluation of ITS" is an assessment of the extent to which an ITS scheme has met its objectives' and 'provides lessons on improving performance in future' [2].

## THE IMPORTANCE OF EVALUATION FOR ITS DEPLOYMENT

The overall goals that authorities and operators aim to achieve with the deployment of ITS are the improvement of safety, increased efficiency of road infrastructure and reduced environmental impacts of road traffic. To verify and quantify those benefits and to support decision-makers in the justification of investments in ITS systems and applications, it is of utmost importance to use comprehensive evaluation methods.

As most of the deployment of ITS solutions is driven by the public sector and hence funded through tax revenues, accountability is always one of the highest priorities. In order to justify the spending of scarce public funds, evaluation provides a convenient tool for assessing the cost-effectiveness and the documentation of already existing systems. It creates the basis for future implementations and supports the creation of a better understanding and acceptance of ITS measures within the general public.

However, it must be noted that the impact evaluation of ITS projects in comparison to conventional road projects is different as stated by Newman-Askins et al. [3]. Evaluation activities of ITS comprise various additional factors like customer satisfaction, driver behavioural response or increased comfort. These factors are difficult to measure or value and they necessitate qualitative assessment methods rather than being measured through quantitative methods.

Evaluation needs the commitment and the cooperation of many actors in order to enable a comparison of ITS implementations. Therefore certain standards for evaluation need to be created, starting with commonly agreed Key Performance Indicators (KPIs) followed by standardised evaluation methodologies, ultimately resulting in comparable evaluation results.

## FROM R&D TO ITS DEPLOYMENT

The path from research and development (R&D) to deployment can be a long and difficult one, particularly in the case of ITS. Often ITS technologies remain in the research stage or get stuck in the transfer process to deployment because of gaps in the knowledge about the real abilities of the ITS services. Furthermore, the implementation process can take too long, not keeping pace with technology life-cycles with technology becoming obsolete before the implementation of the ITS system has been finalised.

In Europe, the European ITS Action Plan [4] and the European ITS Directive [5] were created to accelerate and foster harmonised ITS deployment across Europe. While several research projects have demonstrated the positive impact of ITS systems and services, real-world deployment has sometimes gotten stuck. The ITS Action Plan was established in 2008 to ensure a European approach towards reaching the goals of greening transport, improving transport efficiency and improving road safety and security and in this context showing the European added value of ITS deployment. In 2010, the European Commission (EC) published the ITS Directive followed by delegated acts with the goal of fostering and accelerating wide-scale, coordinated implementations of ITS across Europe.

The high importance of ITS evaluation is recognised by the United States (US), where the Joint Programme Office (JPO) of the US Department of Transport (DoT) provides guidance for ITS evaluation [6]. Similar approaches can be found in Canada, where the Canadian Victoria Transport Policy Institute has published many documents on evaluation in the transport sector [7]. On a global level, three initiatives need to be mentioned: the World Bank provides an ITS Toolkit for urban ITS implementation [8] which includes case studies; the International Benefits Evaluation Society for ITS (IBEC) provides training materials for ITS evaluations [9]; and the World Road Association (PIARC), which is also concerned with the subject of ITS evaluation and has published some supporting guidance documents [2] on its website. A project from the OECD's International Transport Forum (ITF) on "Decarbonising Transport" was also initiated in order to help decision-makers establish pathways to carbon-neutral mobility [10] with the support of a new tool.

Complementary to guidance on how to perform evaluation, the facilitation of harmonised evaluation methods could help the comparability and reliability of evaluation results, supporting the leap from R&D to ITS implementation. A thorough understanding about investing in ITS needs to be developed, and evaluation is the most appropriate tool to achieve this target by showing the benefit-cost-ratio for single implementation projects. Evaluation creates a better understanding of the potential of ITS by both ITS experts and decision-makers.

While discussing the positive effect of harmonised evaluation methods, it needs to be noticed that even the commonly areed KPIs for ITS evaluations do not exist globally. In 2015, a study, funded by the European Commission (EC), was carried out by AECOM on 'Key Performance Indicators for Intelligent Transport Systems', induced by the need for common European KPIs for ITS. The goal was to provide KPIs that 'deliver a minimum standard' for ITS deployment and to 'support future investment and deployment' [11]. A shortlist of eleven KPIs resulted from this study. The EC expects evaluation results provided by the single Member States on these KPIs. This can be seen as a starting point for the harmonisation of evaluation KPIs in Europe.

## EVALUATION POLICY AND HOW IT INFLUENCES ITS EVALUATION

Evaluation has been seen differently in various policy traditions, research traditions as well as from a more general conception of the sociology of knowledge. This interview is intended to stimulate some reflective thoughts and to raise awareness of potential risks from implicitly assuming that we are all looking at the same phenomenon.

A perspective on ITS Evaluation provided by Dr. Walter Aigner.

*What is ITS Evaluation in your point of view and what is expected from an evaluation report?*

From some government agency officials we have heard the clear cut expectation: "I would expect rather unbiased clear answers, guided by objectivity." This assumes that it is entirely clear what ITS evaluation is and that a dominant culture as well as dominant professional standards have developed. The implicit assumption that ITS evaluation results are relevant for the local transport administration when they consider rolling-out an ITS-service seems to prevail in several ITS-deployment-related discussions. This implicitness seems to hinder many of us in reflecting or speculating on cultural or other contextual differences. In explicit terms: It is perhaps rather rare to find ITS evaluation reports that really are targeted towards potential buyers or interested transport authorities and deployment experts.

*How is ITS evaluation conducted in other parts of the world compared to Europe? Are there any differences?*

People from the US and more generally from outside Europe take it for granted that ITS evaluation is done by independent professionals and these experts are fully committed to serving a governmental agency or transport authority. At least for Europe we have seen a variety of different ITS evaluation contexts and sub-cultures. Most often in Europe evaluation is done within joint-industry-university ITS research and development consortia. With many local ITS programmes it has become a key expectation to develop local ITS knowledge as well as knowledge-intensive jobs by involving local (research and educational) institutions in ITS evaluation projects. However there have been several initiatives studying alternative options or triggering something like self-regulatory processes by means of publishing ITS evaluation results in easy to use data bases.

From voices mainly in the US there have been hints towards standard evaluation being part of an outdated policy or management paradigm. In blunt terms the claim is made that the new key is that decision-makers are not in control or they better admit that they act on the basis of non-knowledge as referred by Ross and Malik in the literature. [12][13]

*What are the challenges or risks for evaluators evaluating ITS?*

The evaluation methodology design team may find itself forced into rough guesses about what will be tested due to many loose ends and unspecified elements into what the "box" actually will deliver. As a consequence, the evaluation is framed independently from the flagship projects' evolving vision and project roadmap: Additionally, it is either the core of an academic thesis or similar academic exercise. Or it is one of a series of scientific publications that have to be done in order to qualify for the next two-year contract or the ITS evaluation exercise has to be done for funding reasons but actually steals away precious time from other academic research activities.

*Are there any risks for the contracting entity, e.g. decision-makers or public bodies?*

For some regions in Europe we have learned to think in terms of different ITS evaluation traditions. One of these schools tends to identify with engineering conceptions of real-world ITS phenomena. A second school builds its identity on social science methodology. However a significant number of researchers in this group

seems to have an ITS policy agenda of their own and are not guided by openness towards the consequences of an ITS innovation or a yet emerging future. Evaluation communities (outside ITS) have demonstrated significant hesitation to cooperate with state power. It is considered inappropriate to work on an evaluation focus or research question set by somebody who is not the researcher themself. At least in several (European) evaluation traditions, supporting the decision-makers or governments and operators has been challenged. This strong self-selection and self-confirmation mechanism certainly hinders ITS evaluation from gaining momentum.

A reader of an ITS evaluation report most probably will see the written report as a valid representation of the underlying phenomenon, research result or ITS innovation project outcome. Many evaluation teams are unaware of differences in report writing benchmarks, skills and training traditions as well as their own poor practice.

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Walter Aigner has worked as a full faculty member for fourteen years at Vienna University of Economics and Business Administration. He holds a PhD in Innovation Management and has focussed on the role of key individuals in ITS projects and ITS programme success.

## SURVEYING THE USE OF ITS EVALUATION EVIDENCE

Being aware of the different policy frameworks and the current change in the evaluation culture, an online survey designed by the International ITS Benefits and Evaluation Society (IBEC) and Global Road Links, with support from AustriaTech, was carried out over August and September 2015.

Caroline Visser explains the results of this online survey.

*What was the aim of the survey and whom did you want to address?*

The aim of the survey was to better understand the currently implemented decision-making practice concerning deployments of and investment in ITS in different parts of the world. The focus of the survey was on the characteristics and quality of data and information that are needed for and used to support these processes.

Although the survey was aimed at a global audience of ITS experts and responses from all over the globe were received, the vast majority of the 42 respondents that completed the survey were from Europe.

Table 1: Breakdown of survey respondents' affiliation

| Respondent's affiliation | % of total respondents |
|---|---|
| 1. Trans-national governmental policy maker / decision-maker (e.g. EU/World Bank/UN Agencies) | 1.5 % |
| 2. National governmental policy maker / decision-maker (incl. federal level) | 12.3 % |
| 3. Regional governmental policy maker / decision-maker (incl. state level) | 10.8 % |
| 4. Local governmental policy maker / decision-maker (incl. city level) | 1.5 % |
| 5. Coordinator or leadership within a transnational organisation supporting transport policy development and implementation | 3.1 |
| 6. Coordinator or leadership within a national organisation supporting transport policy development and implementation | 10.8 % |
| 7. Provider of transport solutions (for example transport supplier, operator, consultancy) | 32.3 % |
| 8. Academic, research or capacity building | 23.1 % |
| 9. Others | 4.6 % |

Table 1 illustrates what organisations the survey respondents work at. To draw some conclusions as to parallels or differences between public and private sector responses, the responses coming from organisations in categories 1 to 4 are considered public sector respondents (26.1 %). Respondents coming from organisations in categories 5 to 7 are considered private sector respondents (46.2 %).

*How does a decision-making process work in an ITS environment?*

Decision-making processes within organisations vary, due to structure, culture and other factors such as vision and mission, complexity of the issue to be resolved, data availability and estimated impacts of alternative solutions.

According to 68% of the survey respondents, decisions about ITS investment are made in a wider context of infrastructure investments, such as the construction of new infrastructure or renovation of existing infrastructure. 16% of the respondents indicated that the decision is stand-alone and another 16% said that it depended on the circumstances. A number of respondents indicated that ITS was often applied at a later stage to existing (road) infrastructure, e.g. measures to improve traffic safety.

In terms of fitting in with vision and mission, ITS decisions seem to be rather strongly embedded in higher-level strategies of the organisations. This was indicated by 78% of the respondents. Typical higher-level strategies include innovation strategies, business strategies, national ITS strategies, congestion relief policies, national/federal ITS architectures, mobility policies and strategic long-term transport plans.

According to the survey respondents, ITS decision-making can be characterised as very to moderately structured, neither predominantly top-down nor bottom up, often to very often involving multiple actors, mostly based on practical experience, and both problem- and solution driven.

Figure 1 depicts the phases of the decision-making process and the degree to which they were acknowledged by the survey respondents. The figure also indicates to what extent ITS evidence was used for each phase.

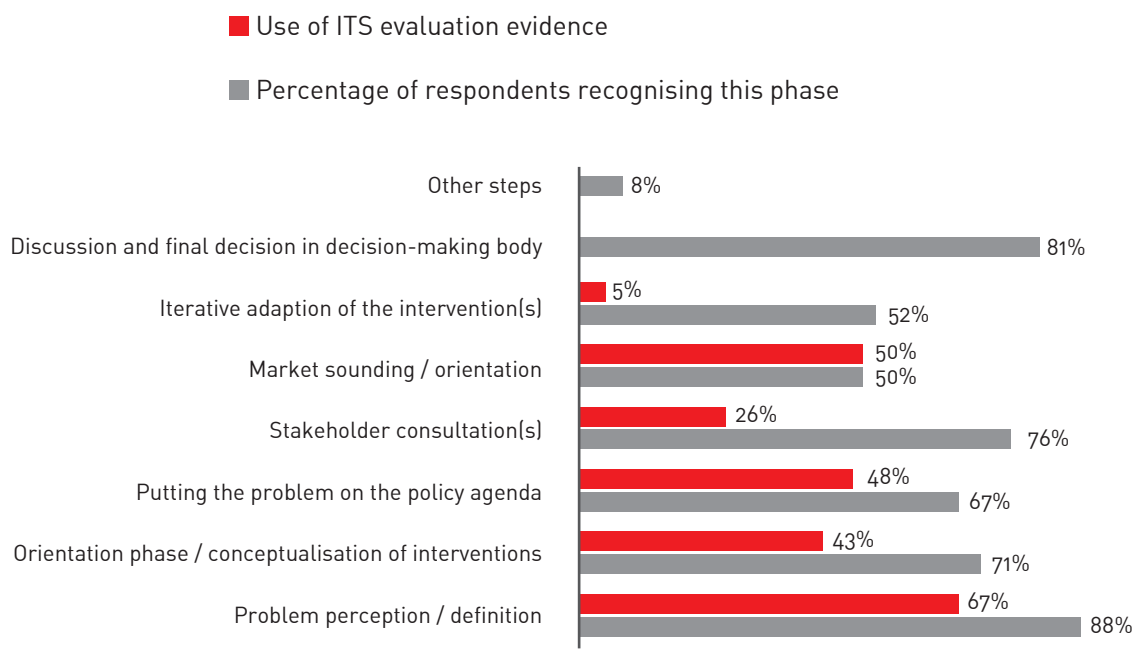


Figure 1: Recognised phases in the decision-making process and the use of ITS evaluation evidence (% of respondents)

*What data are needed to decide on an ITS investment?*

From the survey it appeared that the three most important factors taken into account when assessing ITS investment options are 1) efficiency of the solution; 2) cost and expenditures and 3) traffic safety related factors. Other factors, such as social, environmental and security related aspects were deemed of lesser importance.

When looking at the difference between public sector and private sector respondents, the percentages are generally higher for public sector respondents on all factors than the percentages for private sector respondents. This could be explained by the multi-objective orientation that drives public sector operators in their decision-making, whereas private sector decision-making is generally motivated by continuity and profit.

The implications for data needs derived from this would be that data on costs, efficiency and in particular traffic safety effects are of particular interest to ITS investment decision-making.

Interestingly, according to the survey response, security issues didn't appear to be a prominent factor. However it is estimated that, over time, this will be deemed a more important factor due to its specific role in transport automation initiatives.

*Which data are actually used by ITS decision-makers and what are the sources of ITS evaluation evidence?*

The actual data use indicated by the respondents show that the most used is cost data, which is in line with the identified data needs, followed by data on lessons learned (including unsuccessful deployment or failed implementation) and international best practice/success stories.

Figure 2 depicts the sources where data are obtained.

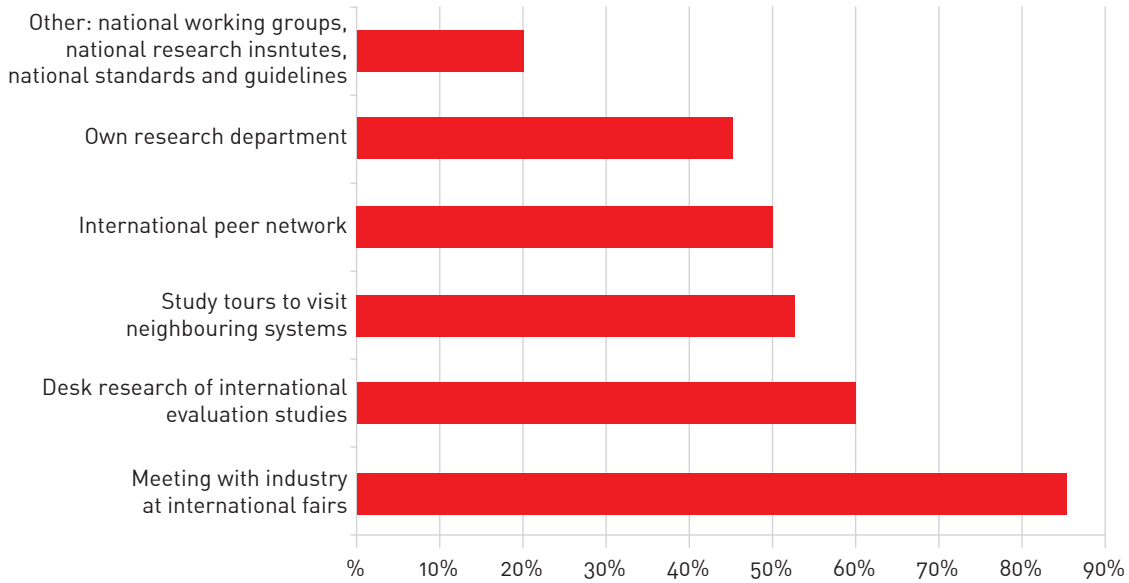


Figure 2: Sources of ITS evaluation evidence - Where the data are obtained from.

A number of online resources on ITS evaluation evidence are available to the public. Of these, the International Benefits Evaluation Society for ITS (IBEC), the EasyWay Evaluation Expert Group and the Transport Research & Innovation Portal were best known and/or consulted by the respondents.

*Are there any barriers to evidence-based decision-making?*

When asked about the obstacles to evidence-based ITS investment decision-making, remarkably there was not a single respondent that indicated that he/she did not see any obstacle. This seems to indicate that obtaining useful evidence for solid decisions is perceived to be rather difficult. The most important barriers that were identified by the respondents included: lack of cost-benefit information, lack of impartial information and legal obstacles or lack of political acceptance or awareness. In particular it was perceived that objective information about benefits was difficult to obtain. Cost data is easier to get or easier to estimate with a certain level of accuracy.

An interesting comment was made by one of the respondents who addressed the communication gap between ITS practitioners and decision-makers. The respondent referred to the ability (or lack thereof) of ITS practitioners to demonstrate the business case to relative "technology-agnostic" decision-makers. In a similar way, one respondent recommended a shift for ITS practitioners from a supply mind-set, offering a technically sound solution, to a buyer's mind-set that is oriented towards providing a solution that meets costs, reliability and sustainability requirements.

Caroline Visser runs Global Road Links, an independent transport consultancy focusing on knowledge and innovation to build modern road infrastructure networks. Her client portfolio includes Cardno Emerging Markets (UK) Ltd., Via-Group Ltd Switzerland and the European Commission's Innovation and Networks Executive Agency, among others. Caroline Visser has worked for the Dutch and French national road administrations. She graduated from Twente University, the Netherlands, in 1999 and holds a Master's degree in public policy and public administration, with a specialisation in infrastructure networks.

## CONCLUSION

The policy framework concerning evaluation based ITS decision-making is fragmented across the globe. While especially in the US we are currently entering an era where public administrations are reducing their linking with external ITS experts, we see in Europe a close linking in the field of decision driven evaluation, with experts that are fully committed to serving a governmental agency or transport authority resulting in sugar-coated evaluation results. Independent evaluation results provided by experts are only scarcely available. By taking these policy framework conditions into consideration however, evaluation is highly relevant for achieving policy decisions and needs to be considered on a policy level right from the beginning.

ITS evidence plays an important role in the early stages of the decision-making process and in particular during the problem definition stage. A big problem identified in the evaluation practice is the lack of a consistent, harmonised set of KPIs for measuring ITS benefits. As it is extremely difficult to generate evidence by comparing pears and apples, administrations have started to work towards harmonised KPIs. In the US and Canada, many documents on evaluation in the transport sector have been published. In Europe the European Commission has started with the definition of commonly agreed KPIs to be used to monitor ITS deployment across Europe.

But KPIs are certainly not enough. Currently there is no internationally harmonised evaluation methodology for ITS evaluation. Such a harmonised evaluation methodology would contribute to generating evidence on ITS solutions including the improved access to knowledge of ITS implementation and projects. Additionally, the commitment from all involved parties to use KPIs and a harmonised method needs to be created. Further in this respect it is important to state that such evaluation evidence needs to include both positive as well as negative examples. Unfortunately however, the failure of a project is not an option. Therefore, most evaluation results are presented in a positive manner.

That was also recognised by the survey respondents; a clear result showed that obtaining objective information about benefits in the field of ITS is exceedingly difficult. It is much easier to collect cost data or it is at least easy to estimate with a certain level of accuracy. However, for deployment decisions often only the information on investment costs is available. Much more difficult is the collection of the operation and maintenance costs.

The conclusion would emphasise the need stated in the introduction to continue investing in (open access) repositories, whether national or international, where ITS evaluation studies can be accessed. However, this would only be helpful if the evaluation studies contain information that is most sought after, namely costs, benefits and in particular safety related benefits. The transferability and impartiality of results and outcomes of evaluation studies is a concern. Standardised evaluation study methodologies and formats would help address this issue.

Last but not least, translating ITS evaluation evidence into a language that is understood by decision-makers and geared towards their motives is key to raising the awareness of the potential contribution of ITS to today's transport challenges e.g. assessing $CO_2$ emissions and in this context the impact on the environment, energy effectiveness or safety related issues.

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## IMPRINT

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