Think ITS early - the risks if you don't

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Abstract:

Limited budgets and resources are increasingly challenging the ability of governments to effectively respond to traffic congestion. Solutions focused only on increasing physical capacity have been met with limited success. ITS is becoming increasingly relevant in long term planning to meet transport policy goals seeking to support the efficient movement of people and freight.

Intelligent Transportation Systems (ITS) is the application of computer and communications technology to improve efficiency and safety of the multimodal transportation network. ITS solutions are cost effective compared to alternative solutions, flexible, upgradable, expandable and in general environmentally friendly.

Because ITS in New Zealand is an emerging field for transport engineers and planners – they still lack experience and awareness of ITS compared with other transport improvements. ITS is often seen as an operational detail to be worked out after planning is complete. Such an approach risks losing the potential benefits of ITS which may change the decisions made during early infrastructure planning, or even the overall approach to solutions.

Considering ITS at a later stage of a project can affect areas beyond project designation and across organisational boundaries. This potentially requires additional consents, redesigns and duplication of activities. An even higher risk is - if ITS is not considered until the design or worse the construction is completed. This risks expensive re-designs, additional construction activity on recently completed sites, negative public responses, political issues.

Problem Definition

Limited budgets and resources are increasingly challenging the ability of governments to effectively respond to traffic congestion. Solutions focused only on increasing physical capacity have been met with limited success. ITS is becoming increasingly relevant in long term planning to meet transport policy goals seeking to support the efficient movement of people and freight.

What is "ITS" and what it can give us / why bother?

Definition: Intelligent Transport Systems (ITS) is the application of computer and communications technology to improve efficiency and safety of the multimodal transport network.

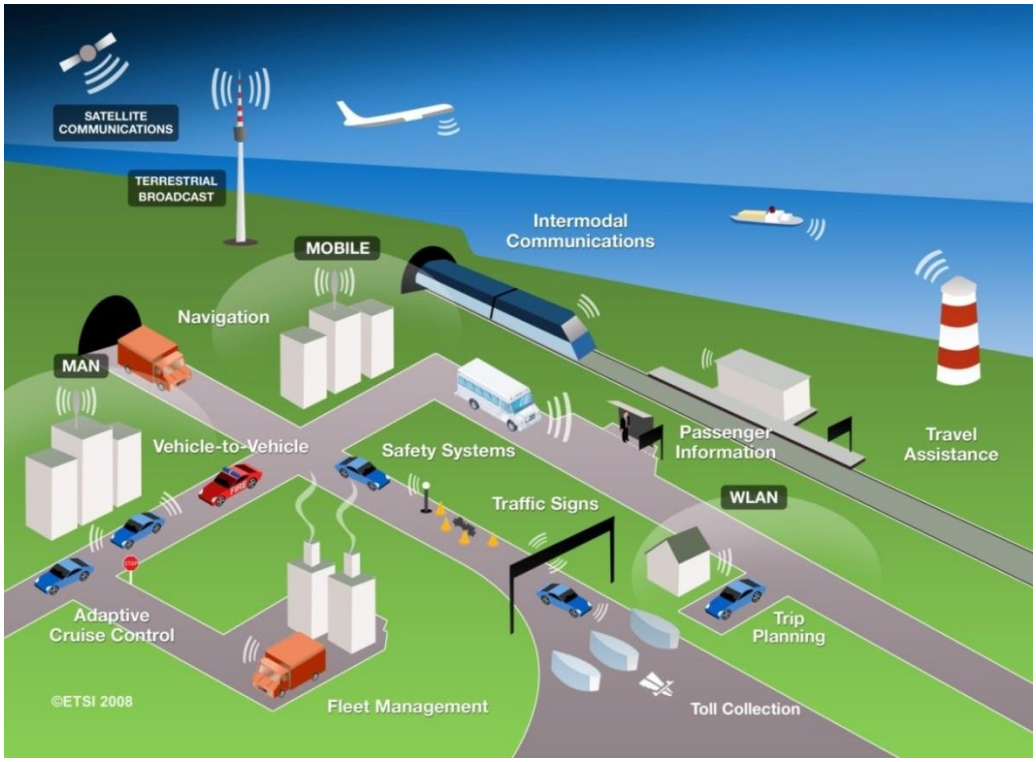

Figure 1. ITS Cooperative Mobility (Kompfner, 2009)

ITS applications can be grouped into user services as seen in the Table 1 below:

Traveller Information	**Traffic management**
Pre Route Traveller Information En-Route Driver Information Route Guidance and Navigation Ride Matching and Reservations Traveller Services and Reservations	Traffic Control Incident Management Travel Demand Management Emission Testing and Mitigation Highway-Rail Intersection
Public Transportation Management	**Electronic payment**
Public Transport Management En-Route Transit Information Personalised Public Transit Public Travel Security	Electronic Payment Services
Commercial vehicle operations	**Emergency management**
Commercial Vehicles Electronic Clearance Automated Roadside Safety Inspections On-board Safety and Security Monitoring	Emergency Notification and Personal Security Emergency Vehicle Management

Commercial Vehicles Administrative Processes Hazardous Material Security and Incident Response Freight Mobility	Disaster Response and Evacuation
Advanced vehicle controls and safety systems	**Information Management**
Longitudinal Collision Avoidance Lateral Collision Avoidance Intersection Collision Avoidance Vision Enhancement for Crash Avoidance Safety Readiness Pre-Crash Restraint Deployment Automated Vehicle Operation	Archived Data Function
Maintenance and Construction Management	
Maintenance and Construction Operations	

Table 1. ITS User Services (Key Concepts of the National ITS Architecture, Dec 2014)

ITS solutions are:
- very cost effective, when compared to alternative solutions (reported Benefit-to-Cost Ratios of some ITS solutions are in the range of 5:1 to 40:1 according to the US Department of Transportation);
- flexible because it can be amended to meet specific requirements;
- upgradable, which avoids replacement when seeking the most advanced resources;
- expandable with minimal redundancy, allowing users to buy basic packages and expand later; and
- environmentally friendly, with most solutions unobtrusive or not visible at all.

There are evaluation methodologies to evaluate quantitative projected ITS costs and benefits. These costs and benefits need to be assessed in conjunction with various conventional improvements before public sector investment decisions are made.

ITS as a part of Transport Planning Activities

To achieve the safe, reliable and secure operation of the transport network and fully realise ITS benefits, it requires comprehensive collaboration and thorough coordination across traditional jurisdictional and organisational boundaries. In other words – institutional integration is required. Integration is a "bridge" between the various components of the surface transport system, and involves information sharing and combining resources to achieve seamless operations.

In addition to institutional integration, the transport network also requires other types of integration:
- Operational (for example, emergency plans are developed jointly in advance by all affected organisations to manage traffic during emergencies or special events).
- Technical - enabling different agencies and their Traffic Control Centres to exchange information.
- Procedural - synchronizing planning and programming processes that address the transport network as a whole and take into consideration all possible improvements in a consistent manner.

Procedural integration is the one requiring serious attention. In order to fully incorporate ITS into the transport system, ITS must be "embedded" into the overall transport planning and project development processes. The significance of "embedding" ITS in terms of business processes, funding, and management cannot be overstated.

To accomplish this "embedding" the development and deployment of ITS actions must be advanced through the existing transport planning process. The goal of transport planning "is to make quality, informed decisions pertaining to the investment of public funds for transport systems and services" (Regional ITS Architecture Guidance, 2006).

Very close coordination between ITS planning and operations is essential. ITS projects included in Transport Plans have to satisfy the purpose and needs which were identified during planning activities, be operationally viable, and be maintainable through the project's life cycle. Taking into account each of these aspects early in project development requires the combined expertise from many areas, including planning, operations, and maintenance.

In transport planning a structural approach shall take place among stakeholders to gain consensus on the planning of ITS. ITS architecture or framework is an answer and it has a big impact on institutional integration. It clearly sets roles and responsibilities for each stakeholder involved to realize the benefits of ITS.

So it is obvious that "Go or No Go" analysis of ITS use shall be considered early in the system development – when all project needs are assessed. The needs assessment is done to ensure that the system meets the most important needs of the project's stakeholders. The goal here - is to ensure that stakeholders' needs are clear and well understood before moving into further development of the ITS system functionality.

Because ITS in New Zealand is an emerging field for transport engineers and planners – they still lack experience and awareness of ITS compared with other transport improvements. This leads to ITS being seen as an operational detail to be worked out after planning is complete. Such an approach risks losing the potential benefits of ITS which may change the decisions made during early infrastructure planning, or even the overall approach to solutions.

Considering ITS at a later stage of a project can affect areas beyond project designation and across organisational boundaries. This potentially requires additional consents, redesigns and duplication of activities.

The risk is even higher if ITS is not considered until the detailed design has been completed or the construction finished. All this leads to expensive re-designs, additional construction activity on recently completed sites, negative public reaction, political issues.

ITS at different project lifecycle stages

Table 2 below illustrates the level of impact to various phases of a project if ITS is not considered early:

Project Lifecycle Stage	**Additional costs if ITS considered first at this stage**	**Impact on total project delivery**	**Negative public reaction**
Initiation/ Scoping	No	No	No
Scheme Design	No	Low	No
Concept Design	Low	Low	No
Detailed Design	Medium	Medium	No
Before Construction	High	High	No
During Construction	High	High	High (project delayed)
Post Construction	High	High	Very High (public to expect delays again)

Table 2. Levels of impact during project stages if ITS missed out

To further illustrate this level of impact, below are examples of projects showing when ITS was considered and what was achieved or issues faced.

Example 1: (ITS is an integral part of transport planning)
This is an example from the Seattle 2020 North Corridor case study.

The tables below summarise the impact of using ITS as an option in comparison with the alternatives (Do-Nothing, High Occupancy Vehicle/Busway, Single Occupancy Vehicle Enhancement). They show that using ITS the average traveller delay is reduced by 15-20 percent, the corridor throughput is increased by 4-10 percent, and the trip travel time variability is reduced by 17- 30 percent.

Measure per Average AM Peak Period	**Comparison of the "Do Nothing plus ITS" scenario with "Do Nothing", Percentage Change**
Delay Per Vehicle	-15%
Corridor Throughput	+4.6%
Trip Travel Time Variation	-30%

Measure per Average AM Peak Period	**Comparison of the "HOV/Busway Plus ITS" scenario with "HOV/Busway", Percentage Change**
Delay Per Vehicle	- 20%
Corridor Throughput	+4%
Trip Travel Time Variation	-17%

Measure per Average AM Peak Period	**Comparison of the "SOV Capacity Enhancement Plus ITS" scenario with "SOV Capacity Enhancement", Percentage Change**
Delay Per Vehicle	-16%
Corridor Throughput	+10%
Trip Travel Time Variation	-30%

Table 3. Impact of ITS, Do-Nothing Alternative (Seattle 2020 North Corridor Case Study)

Example 2: (late addition of ITS – before construction)
This is an example from a New Zealand State Highway upgrade project where a new on-ramp was built.

Issues:
- ITS was only considered just before the construction.
- ITS was not included in the scope of works during the tender process. ITS was added as a variation to the scope of works following award of the tender just before construction process;

Outcomes:
- Client had cost overruns – in tens of thousands of $. The costs were in addition to typical ITS installation costs (if ITS was the integral part of the main contract): additional traffic management costs, Road Opening Notices, crew re-establishing on site, extra temporary works, etc.;
- ITS full capabilities were not achieved when physical construction was completed and the road was ready for use;
- Conflicts between main Contractor and ITS Sub-contractor to complete their work on time;
- ITS Sub-contractor affected significantly – ITS activities were not considered as a part of the main construction activities in project plan. Additions to project plan were not easily achieved.

Example 3: (late addition of ITS – during construction)
This is an example from a New Zealand State Highway project where an extension to the existing highway was constructed.

Issues:
- ITS was only considered during the construction.
- ITS was not included in the main contractor's scope of works. ITS was added as a variation to the scope of works following award of the tender in the middle of the construction process. A deadline to complete ITS variation was not clearly set;

Outcomes:

- Client had costs overrun – $1M+. The costs were in addition to typical ITS installation costs (if ITS was the integral part of the main contract): additional traffic management costs, Road Opening Notices, crew re-establishing on site, extra temporary works, etc.;
- ITS full capabilities were not achieved when physical construction was completed and road was ready for use;
- Tensions between the main Contractor and ITS Sub-contractor to complete their work on time;
- Negative Client feedback.

Conclusions and Recommendations

ITS should be considered early in the initiation and scoping of project objectives, planning and concept designs – when all project needs are assessed. Examples above illustrated that there are significant benefits if ITS is considered at early stage of the project and large disbenefits if it is not. The risks of not "thinking ITS early" could lead to cost overruns, late project delivery and negative public reaction.

ITS planning shall become a part of an integrated transport planning process which assesses project needs and therefore shall review how those needs might be met by ITS. ITS architecture or framework enhances transport planning and helps to set roles and responsibilities for each stakeholder involved to realize the benefits of ITS.

The above will help to accelerate ITS deployment, operation, systems management, intermodal integration, and interoperability of the ITS program and ITS-enabled operational strategies and therefore will:

- effectively measure and improve the performance of the transport systems;
- reduce traffic congestion and the economic and environmental impacts of traffic congestion;
- significantly increase safety aspect - minimize fatalities and injuries;
- enhance mobility of people and goods;
- boost the economy by improving traveller information and services;
- optimize existing roadway capacity;
- optimize use of (saving/delaying/redirecting) transport funds.

If ITS benefits are truly to be recognised for many of our infrastructure projects, the following should be considered:

- "Mainstream" ITS planning into transport planning processes;
- Continuous cooperation between transport planning and operations departments is a must – current procedures are to be reviewed;
- ITS Architecture / Framework "standardising" rules of engagement of all stakeholders including transport planning has to be developed and thoroughly followed;
- Include ITS in the list of options/"treatments" to be assessed in the NZTA Scheme Assessment Report (Z/6) and Specimen Design Report.

References

Internet

Key Concepts of the National ITS Architecture. *National ITS Architecture.* Read Dec 2104. http://www.iteris.com/itsarch/documents/keyconcepts/keyconcepts.pdf

Kompfner P. *1st ETSI TC ITS Workshop, 4 February 2009, Sophia Antipolis* http://docbox.etsi.org//Workshop/2009/200902_ITSWORKSHOP/ERTICO_KOMPFNER_cooperativeMobility_NewTransportParadigmsofthe21stCentury.pdf

Regional ITS Architecture Guidance, 2006, Version 2. *US Department of Transportation.* http://ops.fhwa.dot.gov/publications/regitsarchguide/raguide.pdf

Seattle 2020 Case Study. Incorporating ITS into Planning Analysis. *Report of US Department of Transportation 2002.* http://ntl.bts.gov/lib/jpodocs/repts_te/13605/13605.pdf