





# Pre-study on the effects of ITS

## **Pre-study on the effects of ITS**

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## **Nordic co-operation**

Nordic co-operation, one of the oldest and most wide-ranging regional partnerships in the world, involves Denmark, Finland, Iceland, Norway, Sweden, the Faroe Islands, Greenland and Åland. Co-operation reinforces the sense of Nordic community while respecting national differences and similarities, makes it possible to uphold Nordic interests in the world at large and promotes positive relations between neighbouring peoples.

Co-operation was formalised in 1952 when *the Nordic Council* was set up as a forum for parliamentarians and governments. The Helsinki Treaty of 1962 has formed the framework for Nordic partnership ever since. The *Nordic Council of Ministers* was set up in 1971 as the formal forum for co-operation between the governments of the Nordic countries and the political leadership of the autonomous areas, i.e. the Faroe Islands, Greenland and Åland.

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## Forord

Denne rapport er utarbeidet for Nordisk ministerråd våren 2005.

Rapporten er utarbeidet av en uavhengig konsulent som ble valgt på bakgrunn av anbefaling fra NETs (Nordisk embetsmannskomiteé for transports) temagruppe for ITS(Intelligente transportsystemer og tjenester).

På grunn av rapporten har NETs temagruppe for ITS anbefalt:

- Det anbefales at det etableres nasjonale multimodale nettverk for evaluering av ITS (Intelligente transportsystemer og tjenester)
- Det anbefales at NMR ved hjelp av NETs temagruppe for ITS på et overordnet nivå får foretatt belysning av effektene av ITS.
- Det anbefales samarbeid med VIKING om deres database for alle transportmåter.
- Det anbefales undersøkt om de nasjonale ITS -organisasjonene kan bli sentrale i spredning av informasjon om effekter av ITS (Intelligente transportsystemer og tjenester)

NETs temagruppe for ITS

*ved leder Runar Guðjónsson*

## Background and objectives

The deployment of ITS (Intelligent Transport Systems) has been slower than expected, partly because decision makers do not have sufficient access to information about the effects of ITS. This is partly due to the fact that up to now relatively few research results exist, but possibly also to a considerable degree because the existing results are not easily accessible.

The ITS Working Group of the Nordic Council of Ministers (NMT/NÄT-ITS) initiated this pre-study with the objective to map on a general level the available knowledge in the Nordic countries and to make a proposal on how the knowledge could be easily accessible as well for planners as for decision makers.

After implementation of the proposals made the total knowledge in the Nordic countries could easier be used in each country. Furthermore the results of this study can as such assist in coordinating and directing the future research work on the Nordic level.

This pre-study presents an inventory on a general level of knowledge about studies made in the Nordic countries about the effects of ITS.

Traficon

*ved Tomi Ristola og Kristian Appel*

## Working method

The work has been carried out by a consultant, Traficon Ab, Esbo, Finland. The project manager was Mr Tomi Ristola, while Mr Kristian Appel was in charge of quality control.

A letter was sent out to National ITS associations in Denmark, Finland, Norway and Sweden as well as to NVF (Nordiska Vägtekniska Förbundet) Technical Committee 53 (Road Transport Informatics) chairmen and secretaries in Denmark, Finland, Iceland, Norway and Sweden.

The following questions were asked:

- Are there complete lists available on the surveys on the effects of ITS, prepared in each country?
- Have summaries of the effects of various ITS systems/services been prepared?
- Are these reports or summaries openly available e.g. over internet?

This report is based on the replies of the aforementioned survey together with information from other reports and public web sites.

## General state of knowledge

In various replies it was stated that the use of ITS is still very limited and research on evaluation is nearly absent. However, after collecting all the replies, it can be summarised that the first steps in a systematic approach to ITS evaluation have been taken especially in Sweden but to some extent also in Finland. Numerous isolated research results are available.

## Evaluation results by ITS services

In order to have an overall view to the status of knowledge this study reviewed the evaluation results using the same classification of ITS services as presented in the Road Transport Informatics Terminology <http://www.nvf53.org/terminology/>.

In the following list **bold text type** is used for those ITS services where evaluation results are available to the extent that in many cases relatively reliable estimates can be made about the effects of a planned system/service in the Nordic countries.

Traffic monitoring and control:

- variable message signing
- **warning systems**
- incident management
- **speed control**

- motorway traffic control
- tunnel traffic control
- **intersection signal control**
- **traffic signal priority**
- parking management

Traffic and travel information:

- pre-trip information
- **on-trip information**
- **road weather information**
- **public transport information**

Booking and payment:

- electronic booking
- **electronic fee collection** (results are mainly based on modelling)

Freight and fleet management

- freight management
- fleet management

Public transport management

- public transport operations management
- **systems for demand responsive public transport**

Driver assistance and vehicle control

- driver monitoring
- vehicle monitoring
- vision enhancement
- collision avoidance
- **intelligent speed management**
- emergency call
- route guidance

Using a more detailed classification, evaluation results from the Nordic countries are available especially for the following ITS services:

- road weather warning; control and information systems (especially in Finland)
- automatic speed enforcement (Sweden, Finland)
- weather related variable speed limits (Finland)
- traffic signal control
- public transport priorities in traffic signals
- real time travel information
- public transport journey planner
- information network for maritime cargo network
- intelligent speed adaptation, ISA (Sweden)

## Dissemination and exploitation of the results

Some attempts have already been made to summarise survey results and to present them as a supporting tool for ITS decision makers and professionals.

In Sweden a reference document “Impacts from ITS investments” (Effektsamband) has been produced to provide support in the planning and implementation of ITS applications. It was compiled in 2000 and updated in 2003. Expert knowledge in combination with a literature survey has been used to compile knowledge of impacts of 20 different ITS applications.

Most of the surveys that have been performed in Finland in recent years have been a part of a national R&D programme (TETRA, FITS, and now AINO). These survey reports are available on the programme’s web site and also on the CD-ROMs that have been produced after the end of the programmes.

Based on Finnish survey results supported by survey results from abroad the Ministry of Transport and Communications, Finland has produced a leaflet presenting 20 ITS applications and their general effects on the transport policy objectives. This leaflet is mainly targeted at the decision makers.

The Ministry of Transport and Communications, Finland has also produced a survey report where a number of ITS applications, their impacts, benefits and costs were evaluated in the Finnish context. The study concentrated on applications with which there was little or no previous experience in Finland (and thus naturally the survey results were not from Finland).

In the VIKING-project<sup>1</sup> a report has been prepared to provide an overview of ITS evaluations in the VIKING area (i.e. Finland, Sweden, Norway, Denmark and Northern Germany). The report contains both evaluations conducted within the VIKING project and evaluations conducted outside the project. The evaluations cover not only the VIKING network, but the entire VIKING area, in order to give an overall idea of the nature of the results and how they depend upon local characteristics. An updated version of this report is scheduled to be published in April 2005.

The European Commission launched the TEMPO programme (for Trans-European intelligent transport systems Projects) in 2001. Its aim is to stimulate a harmonised and synchronised deployment of intelligent transport systems and services on the Trans-European Road Network. The TEMPO programme has also produced guidelines for project evaluation and for reporting them.

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<sup>1</sup> VIKING, An action for Co-Ordinated Road Traffic Management Implementation in Northern Europe, is a EURO-Regional Project supported by the Commission of the European Union, DG Energy and Transport.

In the VIKING-project together with the other Euro-Regional projects there have been plans to set up an evaluation database based on the library of reports including Meta analysis of ITS applications. So far this idea has not been realised.

The SNRA (Vägverket) in Sweden has produced a PLUTO – ITS evaluation Planning Handbook to provide support in the planning and implementation of evaluation in connection with ITS implementations. According to the handbook ten per cent of the investment costs of an ITS implementation should be allocated for evaluation.

In Sweden there is also a Manual for the Pre-Assessment of the effects of ITS implementation.

In Finland the Ministry of Transport and Communications has also produced guidelines for the evaluation of ITS projects. The implementation projects that receive funding from the Ministry are obliged to follow these guidelines.

The SNRA has emphasized the importance of evaluation in its ITS implementation programme. A Strategy consists of four main components:

1. The evaluation handbook PLUTO
2. A special framework project to improve knowledge about the effects of ITS
3. Development of a national, independent evaluation centre within the ITS sector
4. Knowledge dissemination

In recent years there have been various shortcomings in ITS evaluations. Therefore the SNRA undertook the initiative to establish an independent forum for the co-ordination and consolidation of ITS evaluations. The working name for this national expert group is UFO (Utvärderingsforum ITS)

On an international level an IBEC (International Benefits, Evaluation and Costs) working group was established in 2002. Its main activity has been to organise training and technical sessions in connection with ITS World Congresses.

Since December of 1994, the United States Department of Transportation's Intelligent Transportation Systems Joint Program Office has been actively collecting information regarding the benefits and costs of ITS. Information collected on the impact of ITS projects on the operation of the surface transportation network is available in the ITS Benefits Database.

## Conclusions and proposals for further work

There are already a relatively high number of evaluation reports prepared in the Nordic countries. However, **the level of knowledge about the effects of ITS is far from adequate in most applications**. In many cases it is very difficult to make any general conclusions based on the survey results of an ITS installation. Generally ITS services are developed like a process rather than a project. It is usually very difficult to isolate the effects of the ITS service or system from external factors.

The **results are not easily accessible** or at least it is not generally known how to access the results. There is no single portal to help the information seeker to find out what information is available.

**The web sites of the National ITS associations have little if any information related to the effects of ITS applications.**

Road (passenger car) traffic seems to be studied much more than other modes of transport.

There are already many actors involved in the evaluation work. It is hardly practical for NMR/NÄT ITS to take an independent role in the dissemination of evaluation results. However **NMR in co-operation with the national ministries should promote the establishment of national evaluation expert fora in all countries (similar to UFO in Sweden) and their Nordic co-operation**. The main task of an evaluation expert forum would be to collect evaluation results and collate them especially for decision makers. This task is well suited for international (Nordic) co-operation.

**NMR/NÄT ITS should on a general level monitor evaluation work** carried out in the Nordic countries **and co-ordinate it** through national ministries so that resources are allocated to all fields that could have a positive impact on the achievement of the transport policy goals.

It is not evident if there is a real need to establish a separate Nordic database for evaluation results. Instead of that **NMR/NÄT ITS should co-operate with VIKING with their database initiative** so that all transport modes and all transport environments will be present.

The main shortcoming is the poor dissemination of evaluation results. It seems to be a general trend that the national ITS associations will become the main portals to information related to ITS. **It should be examined how the national ITS associations could be developed to be major and co-operating actors in the dissemination of the effects of ITS all over the Nordic countries**. It can be assumed that the national ITS associations are well prepared to disseminate information using their web sites, arranging seminars etc. However, they do not have the resources to collate the results.

## Action points

### NMR/NÄT ITS

- monitor and co-ordinate evaluation work
- promote co-operation between evaluation fora in the Nordic countries
- support VIKING evaluation database initiative

### Ministries

- carry out / finance research on the effects of ITS
- set up evaluation fora

### National ITS associations

- present information about the effects of ITS on web sites
- arrange seminars to disseminate information
- co-operate on the Nordic level in dissemination

## Reference list

ITS Effektsamband. Uppdatering av Effektsamband 2000 med avseende på ITS. Vägverket Publikation 2003:193

Euro-Regional Project VIKING – MIP

VIKING Status and overview of evaluations, version 0.95 – April 2004

Impact evaluation studies of Finnish telematic systems and services, FITS-programme  
<http://www.vtt.fi/rte/projects/fits/impacts/index.htm>

U.S.Department of Transportation, ITS Benefits and Costs Database  
<http://www.benefitcost.its.dot.gov>

ITS Denmark <http://www.itsdanmark.dk/>

ITS Finland <http://www.its-finland.fi/>

ITS Norway <http://www.its-norway.no/>

ITS Sweden <http://www.its-sweden.com/>

## Appendix list

1. US DOT summary. Benefits By Program Area and Benefits By Measure
2. VIKING Evaluation documents

| Benefits By Program Area       |                       |                                                                                                                                                           |
|--------------------------------|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Program Area / Benefit Measure | Summary               | Appendix 1                                                                                                                                                |
| Arterial Management Systems    | Safety Improvements   | Automated enforcement of traffic signals has reduced red-light violations 20-75%.                                                                         |
|                                | Delay Savings         | Field studies in several cities have shown that adaptive signal control systems can reduce peak period travel times 5-11%.                                |
|                                | Throughput            |                                                                                                                                                           |
|                                | Customer Satisfaction | In Michigan, 72% of drivers surveyed felt "better off" after signal control improvements.                                                                 |
|                                | Cost Savings          | Transit signal priority on a Toronto transit line allowed same level-of-service with less rolling stock.                                                  |
| Freeway Management Systems     | Environmental         | Model estimates showed advanced traffic signal control systems can reduce fuel consumption 2-13%.                                                         |
|                                | Safety Improvements   | Studies of traffic management centers using ramp meters show freeway management systems reduce accidents 15-50%.                                          |
|                                | Delay Savings         | Advanced Traffic Management Systems (ATMS) in the Astrodome area reduced street congestion delay by 46%.                                                  |
|                                | Throughput            | After ramp meters were experimentally turned off in the Twin Cities, MN, freeway volume declined 9% and peak period throughput decreased 14%.             |
|                                | Customer Satisfaction | After the Twin Cities ramp meter shutdown test, public support for a complete shutdown fell from 21% to 14%.                                              |
| Transit Management Systems     | Cost Savings          | Variable speed limits with lane controls on the German Autobahn reduced injury accidents 20-28% saving approximately \$4 million/year.                    |
|                                | Environmental         | In Denver, dynamic message signs (DMSs) that displayed real-time vehicle emission levels motivated most motorists surveyed to consider repairs.           |
|                                | Safety Improvements   |                                                                                                                                                           |
|                                | Delay Savings         | Computer Aided Dispatch (CAD) and Automatic Vehicle Location (AVL) technologies improved on-time bus performance 9-23%.                                   |
|                                | Throughput            | In Portland, OR, models of transit data showed AVL/CAD may allow same level-of-service to more travelers using the same rolling stock.                    |
| Incident Management Systems    | Customer Satisfaction | In Denver, installation of a AVL/CAD system contributed to improved schedule adherence. Customer complaints decreased 26% per 100K boardings.             |
|                                | Cost Savings          | In San Jose, CA, a paratransit scheduling and routing system increased shared rides 45% and reduced operating costs \$500K the first year.                |
|                                | Environmental         |                                                                                                                                                           |
|                                | Safety Improvements   | In Pennsylvania, Traffic and Incident Management Systems (TIMS) decreased secondary incidents on highways 40% between 1993 and 1997.                      |
|                                | Delay Savings         | The I-95 Traffic and Incident Management System (TIMS) in Pennsylvania cut highway incident closure time 55%.                                             |
| Emergency Management Systems   | Throughput            |                                                                                                                                                           |
|                                | Customer Satisfaction | The Virginia DOT has received hundreds of "thank you" letters from customers satisfied with service patrols.                                              |
|                                | Cost Savings          | In Minnesota, a \$600K/yr Highway Helper Program reduced the average duration of stall incidents by 8 minutes, saving \$1.4 million/yr in delay costs.    |
|                                | Environmental         | Based on calculations of incident delay reduction, models of the Maryland CHART system showed a fuel savings of 4.1 million gallons/year in 2000.         |
|                                | Safety Improvements   | In Erie, NY, dispatch center notification time was about 1 min. for vehicles equipped with automated collision notification, and 3 to 46 minutes without. |
| Electronic Payment Systems     | Delay Savings         |                                                                                                                                                           |
|                                | Throughput            |                                                                                                                                                           |
|                                | Customer Satisfaction | In Puget Sound, WA, 95% of drivers equipped with Mayday voice communications felt more secure. 70% with text messaging felt more secure.                  |
|                                | Cost Savings          | In New Mexico, a private ambulance company used CAD/AVL to guide ambulances to exact locations. The company increased efficiency 10-15%.                  |
|                                | Environmental         |                                                                                                                                                           |
| Traveler Information Systems   | Safety Improvements   | In Florida, driver uncertainty about toll plaza configuration and traffic speeds contributed to a 48% increase in accidents at E-PASS toll stations.*     |
|                                | Delay Savings         | The New Jersey Turnpike Authority (NJTA) E-Zpass system reduced overall toll station traffic delay by 85%.                                                |
|                                | Throughput            | Tappan Zee Bridge, New York, NY: Manual lane 400-450 vehicles/hour (vph), ETC lane 1000 vph.                                                              |
|                                | Customer Satisfaction | 20% of surveyed travelers on two bridges in Lee County, FL adjusted their departure times as a result of value pricing at electronic tolls.               |
|                                | Cost Savings          | In New Jersey, automated fare collection increased revenues 12%, and saved an estimated \$2.7 million from the reduced cost of handling fare media.       |
| Information Management Systems | Environmental         | NJTA models indicate E-Zpass saves: 1.2 mil gallons of fuel/year, 0.35 tons of VOC/day, and 0.056 tons NOx/day.                                           |
|                                | Safety Improvements   | IDAS models of ARTIS in Cincinnati and Northern Kentucky estimated traveler information reduced fatalities 3.2%.                                          |
|                                | Delay Savings         | In the DC metro area, a simulation model estimated that commuters who used traveler information improve their on-time reliability 5-16%.                  |
|                                | Throughput            | A simulated traffic network of Seattle estimated that supplementing freeway ATIS with arterial ATIS will not significantly improve throughput.*           |
|                                | Customer Satisfaction | In Philadelphia, 86% of surveyed commuters changed their departure time, and 86% changed their route after receiving traveler information.                |
| Crash Prevention & Safety      | Cost Savings          | In the DC area, models showed pre-trip departure notification can reduce early/late arrivals and save 40% of users \$60 or more each year in lost time.   |
|                                | Environmental         | Models of vehicle emissions in Boston showed users of Smart Traveler generated 1.5% less NOx, and 25% less VOCs.                                          |
|                                | Safety Improvements   |                                                                                                                                                           |
|                                | Delay Savings         |                                                                                                                                                           |
|                                | Throughput            |                                                                                                                                                           |
| Operations & Maintenance       | Customer Satisfaction |                                                                                                                                                           |
|                                | Cost Savings          |                                                                                                                                                           |
|                                | Environmental         |                                                                                                                                                           |
|                                | Safety Improvements   | In Colorado, a downhill speed warning system on interstate I-70 decreased truck accidents 13%, and reduced runaway ramp usage 24% in 2 years.             |
|                                | Delay Savings         | Models of increased traffic flow at a San Antonio rail crossing showed dynamic message signs with delay information can reduce system delay 6.7%.         |
| Road Weather Management        | Throughput            |                                                                                                                                                           |
|                                | Customer Satisfaction | 70% of truck drivers and 85% of car drivers surveyed in California felt curve speed warning systems were useful.                                          |
|                                | Cost Savings          |                                                                                                                                                           |
|                                | Environmental         | An automated horn warning system in Ames, Iowa, reduced elevated noise impact areas 97% adjacent to a highway rail intersection.                          |
|                                | Safety Improvements   | In Iowa, 55% of truckers surveyed said the automated work zone CB-radio warning system first alerted them of painting crews on I-35.                      |
| Commercial Vehicle Operations  | Delay Savings         | Work zone surveillance and incident response at the "Big-I" interchange in Albuquerque, NM, reduced average clearance time 44% the first year.            |
|                                | Throughput            |                                                                                                                                                           |
|                                | Customer Satisfaction | Most people surveyed about the Minnesota Guidestar program said Smart Work Zone warning signs were accurate and useful.                                   |
|                                | Cost Savings          | In MT, WIM scales installed in travel lanes on major truck routes can improve pavement fatigue estimates and save \$4.1 M/year in construction costs.     |
|                                | Environmental         |                                                                                                                                                           |
| Intermodal Freight             | Safety Improvements   | In Idaho, weather-related warnings on freeway dynamic message signs decreased vehicle speeds 35% compared to a 9% decrease without the signs.             |
|                                | Delay Savings         |                                                                                                                                                           |
|                                | Throughput            |                                                                                                                                                           |
|                                | Customer Satisfaction | 30% of highway maintenance staff surveyed in IA, MO, WI used an Internet based weather information network to prepare for winter storms.                  |
|                                | Cost Savings          | In WI, a snow forecasting model (with ice detection) improved DOT work schedules and reduced labor costs 4 hrs/person during significant storms.          |
| Intelligent Vehicles           | Environmental         |                                                                                                                                                           |
|                                | Safety Improvements   | Infrared brake screening tested in 4 states improved inspection selection for trucks, increasing the percentage placed out-of-service by 250%.            |
|                                | Delay Savings         | Carriers commissioned new vehicles 60% faster by printing their own electronic credential paperwork and not waiting for conventional mail delivery.       |
|                                | Throughput            |                                                                                                                                                           |
|                                | Customer Satisfaction | A survey of truckers showed operators who carried hazardous materials were very much in favor of hazardous materials incident response programs.          |
| Intelligent Vehicles           | Cost Savings          | Motor carriers surveyed indicated CVISN electronic credentialing reduced paperwork and saved them 60-75% on credentialing costs.                          |
|                                | Environmental         |                                                                                                                                                           |
|                                | Safety Improvements   |                                                                                                                                                           |
|                                | Delay Savings         | Biometric/smart-card authorization vs. manual duplication/photocopying of paperwork at transfer stations saved carriers about 8 min. per shipment.        |
|                                | Throughput            |                                                                                                                                                           |
| Intelligent Vehicles           | Customer Satisfaction | Carriers surveyed indicated they were very satisfied with the ability of electronic supply chain manifest systems to duplicate paper-based systems.       |
|                                | Cost Savings          |                                                                                                                                                           |
|                                | Environmental         |                                                                                                                                                           |
|                                | Safety Improvements   | After a transport company installed radar sensors on trucks to warn operators of obstacles in blind spots, at-fault accidents decreased 34% in 1 year.    |
|                                | Delay Savings         | In Turin, Italy, cars equipped with in-vehicle navigation systems experienced a travel time savings of more than 10% during the CLEOPATRA project.        |
| Intelligent Vehicles           | Throughput            | Models show intelligent cruise control vehicles (ICC) that use TMC detector data to optimize speeds and match signal timing increase capacity 3-5%.       |
|                                | Customer Satisfaction | Participants overwhelmingly ranked intelligent cruise control over manual or conventional cruise control for convenience, comfort, and enjoyment.         |
|                                | Cost Savings          | A company's operating costs declined 10% after they installed GPS/AVL systems to eliminate miscommunication between drivers and dispatch.                 |
|                                | Environmental         | Field data shows introducing an ICC vehicle into traffic with manually controlled cars can smooth traffic flow and reduce fuel consumption 0.4-3.6%.      |

## Benefits By Measure

## Appendix 1

| Benefit Measure/<br>Program Area |                           | Summary                                                                                                                                                   |
|----------------------------------|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Safety Improvements              | Arterial Management       | Automated enforcement of traffic signals has reduced red-light violations 20-75%.                                                                         |
|                                  | Freeway Management        | Studies of traffic management centers using ramp meters show freeway management systems reduce accidents 15-50%.                                          |
|                                  | Transit Management        |                                                                                                                                                           |
|                                  | Incident Management       | In Pennsylvania, Traffic and Incident Management Systems (TIMS) decreased secondary incidents on highways 40% between 1993 and 1997.                      |
|                                  | Emergency Management      | In Erie, NY, dispatch center notification time was about 1 min. for vehicles equipped with automated collision notification, and 3 to 46 minutes without. |
|                                  | Electronic Payment        | In Florida, driver uncertainty about toll plaza configuration and traffic speeds contributed to a 48% increase in accidents at E-PASS toll stations.*     |
|                                  | Traveler Information      | IDAS models of ARTIMIS in Cincinnati and Northern Kentucky estimated traveler information reduced fatalities 3.2%.                                        |
|                                  | Information Management    |                                                                                                                                                           |
|                                  | Crash Prevention & Safety | In Colorado, a downhill speed warning system on interstate I-70 decreased truck accidents 13%, and reduced runaway ramp usage 24% in 2 years.             |
|                                  | Operations & Maintenance  | In Iowa, 55% of truckers surveyed said the automated work zone CB-radio warning system first alerted them of painting crews on I-35.                      |
| Delay Savings                    | Roadway Weather Mgmt      | In Idaho, weather-related warnings on freeway dynamic message signs decreased vehicle speeds 35% compared to a 9% decrease without the signs.             |
|                                  | Commercial Vehicle Ops.   | Infrared brake screening tested in 4 states improved inspection selection for trucks, increasing the percentage placed out-of-service by 250%.            |
|                                  | Intermodal Freight        |                                                                                                                                                           |
|                                  | Intelligent Vehicles      | After a transport company installed radar sensors on trucks to warn operators of obstacles in blind spots, at-fault accidents decreased 34% in 1 year.    |
|                                  | Arterial Management       | Field studies in several cities have shown that adaptive signal control systems can reduce peak period travel times 5-11%.                                |
|                                  | Freeway Management        | Advanced Traffic Management Systems (ATMS) in the Astrodome area reduced street congestion delay by 46%.                                                  |
|                                  | Transit Management        | Computer Aided Dispatch (CAD) and Automatic Vehicle Location (AVL) technologies improved on-time bus performance 9-23%.                                   |
|                                  | Incident Management       | The I-95 Traffic and Incident Management System (TIMS) in Pennsylvania cut highway incident closure time 55%.                                             |
|                                  | Emergency Management      |                                                                                                                                                           |
|                                  | Electronic Payment        | The New Jersey Turnpike Authority (NJTA) E-Zpass system reduced overall toll station traffic delay by 85%.                                                |
| Throughput                       | Traveler Information      | In the DC metro area, a simulation model estimated that commuters who used traveler information improve their on-time reliability 5-16%.                  |
|                                  | Information Management    |                                                                                                                                                           |
|                                  | Crash Prevention & Safety | Models of increased traffic flow at a San Antonio rail crossing showed dynamic message signs with delay information can reduce system delay 6.7%.         |
|                                  | Operations & Maintenance  | Work zone surveillance and incident response at the "Big-I" interchange in Albuquerque, NM, reduced average clearance time 44% the first year.            |
|                                  | Roadway Weather Mgmt      |                                                                                                                                                           |
|                                  | Commercial Vehicle Ops.   | Carriers commissioned new vehicles 60% faster by printing their own electronic credential paperwork and not waiting for conventional mail delivery.       |
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|                                  | Arterial Management       |                                                                                                                                                           |
|                                  | Freeway Management        | After ramp meters were experimentally turned off in the Twin Cities, MN, freeway volume declined 9% and peak period throughput decreased 14%.             |
| Customer Satisfaction            | Transit Management        | In Portland, OR, models of transit data showed AVL/CAD may allow same level-of-service to more travelers using the same rolling stock.                    |
|                                  | Incident Management       |                                                                                                                                                           |
|                                  | Emergency Management      |                                                                                                                                                           |
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|                                  | Traveler Information      | A simulated traffic network of Seattle estimated that supplementing freeway ATIS with arterial ATIS will not significantly improve throughput.*           |
|                                  | Information Management    |                                                                                                                                                           |
|                                  | Crash Prevention & Safety |                                                                                                                                                           |
|                                  | Operations & Maintenance  |                                                                                                                                                           |
|                                  | Roadway Weather Mgmt      |                                                                                                                                                           |
|                                  | Commercial Vehicle Ops.   |                                                                                                                                                           |
| Cost Savings                     | Intermodal Freight        |                                                                                                                                                           |
|                                  | Intelligent Vehicles      | Models show intelligent cruise control vehicles (ICC) that use TMC detector data to optimize speeds and match signal timing increase capacity 3-6%.       |
|                                  | Arterial Management       | In Michigan, 72% of drivers surveyed felt "better off" after signal control improvements.                                                                 |
|                                  | Freeway Management        | After the Twin Cities ramp meter shutdown test, public support for a complete shutdown fell from 21% to 14%.                                              |
|                                  | Transit Management        | In Denver, installation of a AVL/CAD system contributed to improved schedule adherence. Customer complaints decreased 26% per 100K boardings.             |
|                                  | Incident Management       | The Virginia DOT has received hundreds of "thank you" letters from customers satisfied with service patrols.                                              |
|                                  | Emergency Management      | In Puget Sound, WA, 95% of drivers equipped with Mayday voice communications felt more secure. 70% with text messaging felt more secure.                  |
|                                  | Electronic Payment        | 20% of surveyed travelers on two bridges in Lee County, FL adjusted their departure times as a result of value pricing at electronic tolls.               |
|                                  | Traveler Information      | In Philadelphia, 68% of surveyed commuters changed their departure time, and 66% changed their route after receiving traveler information.                |
|                                  | Information Management    |                                                                                                                                                           |
| Environmental                    | Crash Prevention & Safety | 70% of truck drivers and 85% of car drivers surveyed in California felt curve speed warning systems were useful.                                          |
|                                  | Operations & Maintenance  | Most people surveyed about the Minnesota Guidestar program said Smart Work Zone warning signs were accurate and useful.                                   |
|                                  | Roadway Weather Mgmt      | 30% of highway maintenance staff surveyed in IA, MO, WI used an Internet based weather information network to prepare for winter storms.                  |
|                                  | Commercial Vehicle Ops.   | A survey of truckers showed operators who carried hazardous materials were very much in favor of hazardous materials incident response programs.          |
|                                  | Intermodal Freight        | Carriers surveyed indicated they were very satisfied with the ability of electronic supply chain manifest systems to duplicate paper-based systems.       |
|                                  | Intelligent Vehicles      | Participants overwhelmingly ranked intelligent cruise control over manual or conventional cruise control for convenience, comfort, and enjoyment.         |
|                                  | Arterial Management       | Transit signal priority on a Toronto transit line allowed same level-of-service with less rolling stock.                                                  |
|                                  | Freeway Management        | Variable speed limits with lane controls on the German Autobahn reduced injury accidents 20-29% saving approximately \$4 million/year.                    |
|                                  | Transit Management        | In San Jose, CA, a paratransit scheduling and routing system increased shared rides 45% and reduced operating costs \$500K the first year.                |
|                                  | Incident Management       | In Minnesota, a \$800K/yr Highway Helper Program reduced the average duration of stall incidents by 8 minutes, saving \$1.4 million/yr in delay costs.    |
| Environmental                    | Emergency Management      | In New Mexico, a private ambulance company used CAD/AVL to guide ambulances to exact locations. The company increased efficiency 10-15%.                  |
|                                  | Electronic Payment        | In New Jersey, automated fare collection increased revenues 12%, and saved an estimated \$2.7 million from the reduced cost of handling fare media.       |
|                                  | Traveler Information      | In the DC area, models showed pre-trip departure notification can reduce early/late arrivals and save 40% of users \$60 or more each year in lost time.   |
|                                  | Information Management    |                                                                                                                                                           |
|                                  | Crash Prevention & Safety |                                                                                                                                                           |
|                                  | Operations & Maintenance  | In MT, WIM scales installed in travel lanes on major truck routes can improve pavement fatigue estimates and save \$4.1 M/year in construction costs.     |
|                                  | Roadway Weather Mgmt      | In WI, a snow forecasting model (with ice detection) improved DOT work schedules and reduced labor costs 4 hrs/person during significant storms.          |
|                                  | Commercial Vehicle Ops.   | Motor carriers surveyed indicated CVISN electronic credentialing reduced paperwork and saved them 60-75% on credentialing costs.                          |
|                                  | Intermodal Freight        |                                                                                                                                                           |
|                                  | Intelligent Vehicles      | A company's operating costs declined 10% after they installed GPS/AVL systems to eliminate miscommunication between drivers and dispatch.                 |
| Environmental                    | Arterial Management       | Model estimates showed advanced traffic signal control systems can reduce fuel consumption 2-13%.                                                         |
|                                  | Freeway Management        | In Denver, dynamic message signs (DMSs) that displayed real-time vehicle emission levels motivated most motorists surveyed to consider repairs.           |
|                                  | Transit Management        |                                                                                                                                                           |
|                                  | Incident Management       | Based on calculations of incident delay reduction, models of the Maryland CHART system showed a fuel savings of 4.1 million gallons/year in 2000.         |
|                                  | Emergency Management      |                                                                                                                                                           |
|                                  | Electronic Payment        | NJTA models indicate E-Zpass saves: 1.2 mil gallons of fuel/year, 0.35 tons of VOC/day, and 0.056 tons NOx/day.                                           |
|                                  | Traveler Information      | Models of vehicle emissions in Boston showed users of Smart Traveler generated 1.5% less NOx, and 25% less VOCs.                                          |
|                                  | Information Management    |                                                                                                                                                           |
|                                  | Crash Prevention & Safety | An automated horn warning system in Ames, Iowa, reduced elevated noise impact areas 97% adjacent to a highway rail intersection.                          |
|                                  | Operations & Maintenance  |                                                                                                                                                           |
| Environmental                    | Roadway Weather Mgmt      |                                                                                                                                                           |
|                                  | Commercial Vehicle Ops.   |                                                                                                                                                           |
|                                  | Intermodal Freight        |                                                                                                                                                           |
|                                  | Intelligent Vehicles      | Field data shows introducing an ICC vehicle into traffic with manually controlled cars can smooth traffic flow and reduce fuel consumption 0.4-3.6%.      |

## Appendix 2

Search result for the word (phrase) **Evaluation**: showing 25 documents

### VIKING Documents in Phase MIP

|                                                                                                                            |                                    |
|----------------------------------------------------------------------------------------------------------------------------|------------------------------------|
| 📎 Guidelines for the evaluation of ITS projects                                                                            | <i>The file size is: 803.5 Kb</i>  |
| 📎 Mobile Phones as probes in travel time monitoring                                                                        | <i>The file size is: 1 Mb</i>      |
| 📎 Recommendations for preparation of guidelines concerning use of traffic management at road works                         | <i>The file size is: 549 Kb</i>    |
| 📎 RpF, Travel Time measurement on Frederikssundsvej - Trailoperations, technical evaluation                                | <i>The file size is: 141.4 Kb</i>  |
| 📎 Evaluation and monitoring plan for the TRIM Light pilot project                                                          | <i>The file size is: 59.6 Kb</i>   |
| 📎 Planning Report for Tests of Selected Mobile Dynamic Traffic Management in Small and Medium sized Work Zones             | <i>The file size is: 343.1 Kb</i>  |
| 📎 Safety Effects of Variable Speed Limit Systems                                                                           | <i>The file size is: 828.8 Kb</i>  |
| 📎 TRIM LIGHT - PILOT PROJECT                                                                                               | <i>The file size is: 396.3 Kb</i>  |
| 📎 Economic feasibility of road and public transport ITS applications in Finnish conditions                                 | <i>The file size is: 1.7 Mb</i>    |
| 📎 GPS PILOT PROJECT – EVALUATION PLAN                                                                                      | <i>The file size is: 67.5 Kb</i>   |
| 📎 VIKING Status and overview of evaluations                                                                                | <i>The file size is: 244.9 Kb</i>  |
| 📎 Traffic capacity at road and bridge works                                                                                | <i>The file size is: 93 Kb</i>     |
| 📎 Domain 4 report based on minutes of SACC meetings                                                                        | <i>The file size is: 1004.6 Kb</i> |
| 📎 Accompanying the launch of two pilots of Public Mobility Stations (PMS) and first steps of evaluation of the field trial | <i>The file size is: 274.2 Kb</i>  |
| 📎 Development of a pilot application of the Northern German Traffic Information Portal - Vol. 1 of the final report        | <i>The file size is: 1 Mb</i>      |
| 📎 Evaluation: TRIM Light Travel Time pilot project                                                                         | <i>The file size is: 588.4 Kb</i>  |
| 📎 Evaluation: TRIM Light Travel Time pilot project                                                                         | <i>The file size is: 1.1 Mb</i>    |
| 📎 Improved Traffic Information: Study and Specification of a Structure and the Services.                                   | <i>The file size is: 241.9 Kb</i>  |
| 📎 Improved Traffic Information: Study and Specification of a Structure and the Services.                                   | <i>The file size is: 636.3 Kb</i>  |
| 📎 Evaluation plan for traffic management on the Motorring 3, E45/E55                                                       | <i>The file can't be found!!</i>   |
| 📎 Evaluation framework for the assessment of ITS services and their pilots                                                 | <i>The file can't be found!!</i>   |
| 📎 ITS helps, 20 solutions to transport problems                                                                            | <i>The file can't be found!!</i>   |
| 📎 The realisation of a multimodal travel information web portal in Finland, a preliminary study                            | <i>The file can't be found!!</i>   |
| 📎 Traffic controlled variable speed limits on a main roads' intersection                                                   | <i>The file can't be found!!</i>   |
| 📎 Intelligent Speed Adaptation (ISA)                                                                                       | <i>The file size is: 4.9 Mb</i>    |

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