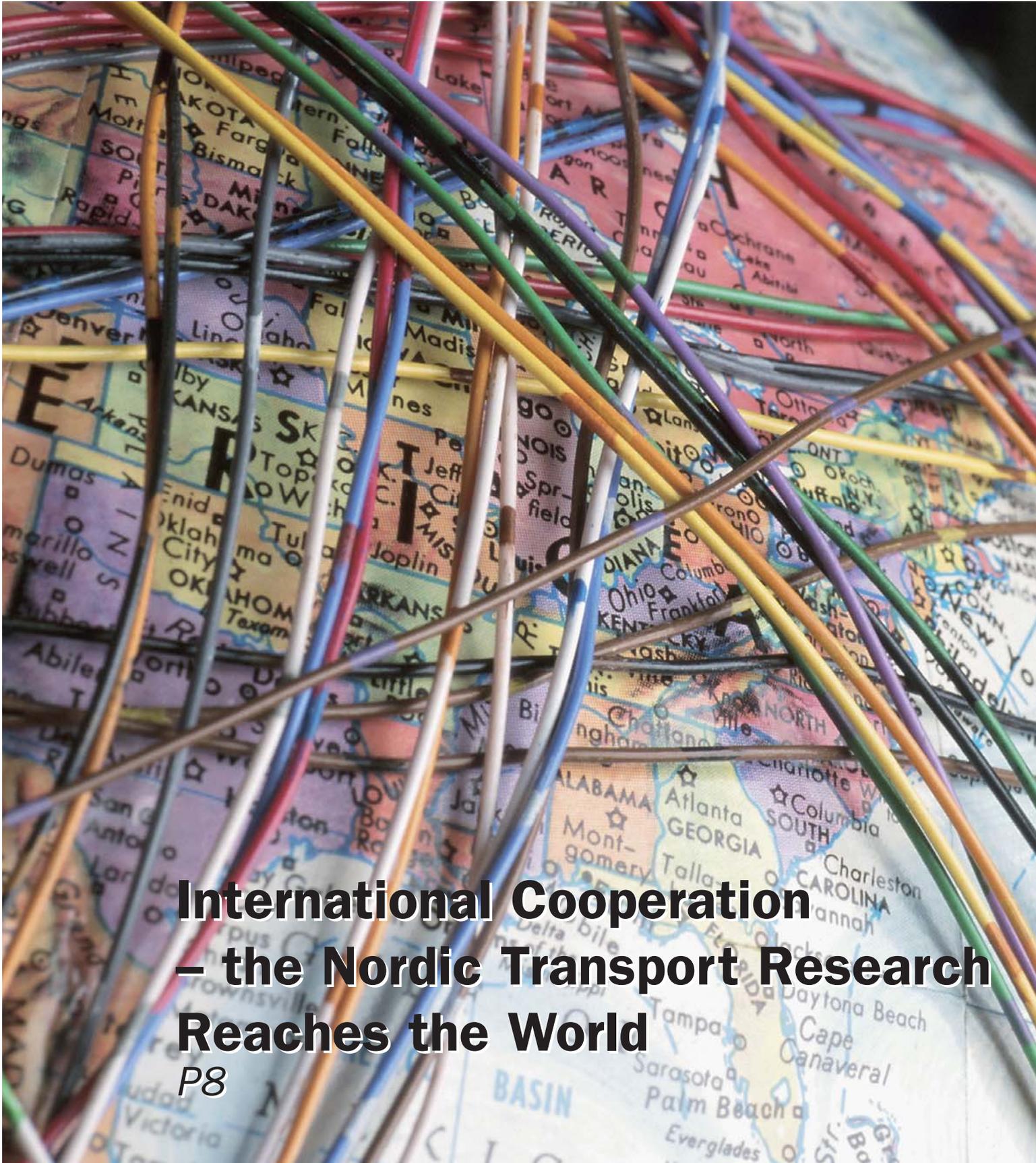


# NORDIC

ROAD AND TRANSPORT RESEARCH | NO.1 | 2008



**International Cooperation  
– the Nordic Transport Research  
Reaches the World**

*P8*

# News from

## **Swedish National Road and Transport Research Institute (VTI)**

VTI is an independent, internationally established research institute which is engaged in the transport sector. Our work covers all modes, and our core competence is in the fields of safety, economy, environment, traffic and transport analysis, public transport, behaviour and the man-vehicle-transport system interaction, and in road design, operation and maintenance. VTI is a world leader in several areas, for instance in simulator technology.

## **Danish Road Directorate (DRD) Danish Road Institute (DRI)**

The Road Directorate, which is a part of The Ministry of Transport & Energy, Denmark, is responsible for development and management of the national highways and for servicing and facilitating traffic on the network. As part of this responsibility, the Directorate conducts R&D, the aim of which is to contribute to efficient road management and to the safe use of the network. The materials research component is carried out by the Danish Road Institute.

## **Technical Research Centre of Finland (VTT)**

VTT Technical Research Centre of Finland is a contract research organisation with a staff of 2,800. In this joint publication, the VTT expertise areas cover research and development of transportation, logistics and road structures. The work is carried out in five research groups employing a staff of 60.

## **Icelandic Road Administration (ICERA)**

The ICERA's mission is to provide the Icelandic society with a road system in accordance with its needs and to provide a service with the aim of smooth and safe traffic. The number of employees is about 340. Applied research and development and to some extent also basic research concerning road construction, maintenance, traffic and safety is performed or directed by the ICERA. Development division is responsible for road research in Iceland.

## **Norwegian Public Roads Administration (NPRA)**

The Norwegian Public Roads Administration is one of the administrative agencies under the Ministry of Transport and Communications in Norway. The NPRA is responsible for the development and management of public roads and road traffic, as well as the Vehicle Department. This responsibility includes research and development of all areas related to road transport and the implementation of R&D results.

## **Institute of Transport Economics (TØI), Norway**

The Institute of Transport Economics is the national institution for transport research and development in Norway. The main objectives of the Institute are to carry out applied research and promote the application and use of results through consultative assistance to public authorities, the transport industry and others. The Institute is an independent research foundation employing about one hundred persons.

## Editorial notes

Nordic Road & Transport Research is a joint publication of six public road and transport research organisations in the Nordic countries, Denmark, Finland, Iceland, Norway, and Sweden. The main objective of the publication is to disseminate research results and news from the institutions, especially to researchers and decision makers. Each institution is responsible for the selection and presentation of the material from its own scope of activities.

Nordic Road & Transport Research is published three times a year. It is regularly sent out, free of charge, to recipients selected by the six joint publishers. Free sample copies are also sent out on special request.

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PHOTO: PHOTOS.COM

## Deepest Road Tunnel in the World

In February 2008 the Norwegian Minister of Transport, Liv Signe Navarsete, opened the so called Eiksund Connection. The Eiksund Connection is situated in the western part of Norway, and forms a fixed link between the Norwegian mainland and the island municipalities of Hareid, Ulstein, Sande and Herøy. The Eiksund Connection is also intended to improve the transport services for the inhabitants of the mainland municipalities of Ørsta and Volda.

A part of the Eiksund Connection is the 7.765 metres long Eiksund Tunnel, which is one of the longest sub sea tunnels in Norway. The tunnel's deepest point is 287 metres below sea level, which makes it the deepest road tunnel in the world.

The Eiksund Connection has, like many other strait crossing projects, a long history. Twenty five years after founding the company Eiksund Connection Ltd, the ground was first broken in Eiksund exactly five years ago.

Norwegian Public Roads Administration has been the builder of the connection. During the construction period 16 contractors with their subcontractors and suppliers have been working on the project. The initial cost estimate was 126.5 million euro

converted into 2008 value, while the final cost turned out to be 123.3 million euro. This results in a saving of 3.2 million euro. Approximately 660.000 man-hours were used over the five year long construction period.

The official opening of the tunnel was celebrated with a wide range of activities. Among other things a cycle race was organized through the tunnel. This was intended to be registered in the Guinness Book of Records as the "deepest" non-professional cycle race in the world. ■



PHOTO: WIGGO KANCK, NPRA

*The Eiksund Connection improves the transportation between islands and mainland.*



PHOTO: NPRA

*From the bottom of the Eiksund Sub Sea Tunnel.*

## New Director General for VTI

The Government has appointed Jonas Bjelfvenstam as the new Director General of VTI. He comes from a post as special inspector for the Ministry of Enterprise, Energy and Communications where he also had the post of Secretary of State and Head of Department. He took up his post as Director General of VTI in December 2007, and the appointment extends until 31 July 2009. ■

**Contact:** [jonas.bjelfvenstam@vti.se](mailto:jonas.bjelfvenstam@vti.se)

*Jonas Bjelfvenstam is looking forward to being in charge of VTI. He has followed the institute for many years.*



## The City as a Laboratory

The Norwegian Public Roads Administration, the Technology Department in Trondheim (Tek-T), uses the city itself as a laboratory. In connection with a visit in January 2008 by the Standing Committee on Transport Affairs of the Norwegian Parliament, the committee was informed about the transportation problems concerning large cities.

– It is all about the future, the head of Section for ITS and Traffic Technology at Tek-T, Even Myhre told. The constant development of international technology can solve the environment and transportation problems in the city.

Even Myhre also told the committee that Tek-T uses Trondheim as its “research laboratory”. For instance, in a project named “ITS towards 2020”, the main objective is to establish a test site encompassing main streets in the city centre, local roads and highways. It will be possible to perform tests both in a simulated road environment in a driving simulator and in a real road network environment, fully equipped with data communication.

– The interface between the academic and theoretical research situation on one side and the real traffic in Trondheim on the other, gives us a unique possibility, stated Even Myhre, who also told the politicians that most other professionals are making research in closed and controlled sites instead of full scale tests in real cities.

The chairman of the Standing Committee on Transport Affairs expressed his enthusiasm over the research work made by the Norwegian Public Roads Administration in Trondheim. Some time ago the committee visited the Japanese city of Toyota so the committee had a chance to compare the activities of the research actors in Trondheim and in Toyota respectively. ■

More general information and contact information about “ITS towards 2020” on: [www.vegvesen.no](http://www.vegvesen.no) (Choose *English flag*, then *Professional*.)

## New Director General of NPRA

On November 13<sup>th</sup> 2007 Terje Moe Gustavsen started up as new Director General of Norwegian Public Roads Administration. Terje Moe Gustavsen, who was Minister of Transportation and Communication in the first Government of Prime Minister Jens Stoltenberg, is 53 years old. He comes from an executive position as senior adviser in the Government Employers' Association “Spekter”. He has a wide-ranging background from public and private sectors, and has, to mention a few, worked as a leader of Norwegian Confederation of Trade Unions (State Department), Director of Strategy at the telecom company Telenor, Director of NAVO (Government Employers' Association) and Director of Personnel in the airline company SAS Braathens. ■

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Director general of NPRA, Terje Moe Gustavsen.

## IN BRIEF

# Temporary Bridges - Collaboration between Road and Rail



PHOTOS: NPRA

*Practical experience in use of reserve bridges.*

The Norwegian Public Roads Administration (NPRA) has a special responsibility when a road connection is broken. To cope with future emergencies a new type of temporary bridge material has been obtained. In cooperation with the Norwegian Railway Authority, NPRA has invested in the heavy panel bridge system Mabey Universal. This is a dual-purpose bridge system that allows the equipment to be used on both railways and roads. The system consists of panel-girders and transoms, while the decking is built with special components. The railway bridge decking consists of special stringers and slippers, while the road bridge decking is made with an additional anti-skid surface. This heavy panel system can be used for a free single-span construction up to 49.5 metres for railway and 81.0 metres for roadway with loading class 13/65.

A part of the agreement between NPRA and the Norwegian Railway Authority involves close cooperation with training, erection and storage, as well as profiting from the experience of each other.

In January-February 2006 a flood destroyed the Mo Bridge in Salsnes in Mid Norway and a temporary 48 metre single lane reserve bridge was erected by NPRA. After the new bridge was completed, professionals from the Railway Authority were invited to participate in the disassembling. This cooperation between NPRA and the Railway Authority provided a unique on-the-job training to help to improve the use of temporary bridge equipment in Norway.

**Contact:** Gunnar Magnus Haugen, NPRA.  
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## A VTI Publication in Japanese!

Encouraged and supported by the wide Japanese interest in the VTI research within winter road management and maintenance, and especially in the Swedish Winter Model developed by VTI, the institute has published a translation into Japanese of VTI papers presented at the PIARC Winter Road Congress in Torino, Italy, 2006, concerning the Winter Model.

Dr Motoki Asano of Civil Engineering Research Institute, CERI, Sapporo, Japan, has been the promoter of the translation.

The papers have earlier been published in English and French as VTI notat 19A-2006. The serial number of the Japanese translation is 19D-2006 and it can be found at the web site [www.vti.se/english](http://www.vti.se/english). ■

## Transportforum Celebrated 25 Years

Sweden's largest meeting place for the transport sector, Transportforum, was arranged by VTI for the 25<sup>th</sup> year in succession in January. Transportforum 2008 was attended by about 1 600 delegates, about 400 of whom presented papers, and by more than thirty exhibitors. The programme was extensive, with 49 sessions which, in different ways, dealt with traffic and transport. Over the years, the conference has developed into the largest annual conference for the transport sector in the Nordic countries, where researchers and the many players of the transport sector meet to share experiences and make contacts.

Jonas Bjellfvenstam, the newly appointed Director General of VTI, said in his speech that the first conference attracted 350 delegates and 70 papers. A lot has thus happened over the years, both with the arrangement and in the transport sector, something that was highlighted in different ways during the introduction. As an anniversary feature, a narrative in words and pictures was presented on roads, transport and societal development over the past 25 years. The ceremony was also attended by Åsa Torstensson, the Swedish Minister of Enterprise, Energy and Communications.

[www.vti.se/transportforum](http://www.vti.se/transportforum)

## VTI Sums up 2007

In January, VTI submitted its annual report for 2007 to the Ministry of Enterprise, Energy and Communications. A summary will be found in the brochure "VTI in words and figures" which can be downloaded from the web site [www.vti.se/english](http://www.vti.se/english). The brochure describes the work of VTI in the past year, and presents the institute's accounts. ■

# Preventing Pedestrian Accidents

The risk of pedestrian accidents is about ten times greater than the risk for motorized road users. Safety measures are effective in reducing the risk for pedestrian and cyclist accidents when one or more risk factors are reduced, e.g. vehicle speed or lack of visibility of pedestrians and cyclists in the traffic environment, according to a new report from Institute of Transport Economics in Norway.

This report describes the risk of accidents and injuries for pedestrians and cyclists, factors affecting the risk of these accidents, and measures to reduce the probability and severity of these accidents.

Increasing the amount of walking and cycling may increase the total number of pedestrian and cyclist accidents, but would decrease accident risk and would lead to a more fair distribution of injury rates between non-motorized and motorized road users.

Institutional measures can improve pedestrian and cyclist safety indirectly by

supporting the implementation of effective safety measures. Organisation of planning and implementation processes so that safety for pedestrians and cyclists can be focused are important. They will also constitute important premises for measures that can increase pedestrian and cyclist volumes and safe behaviour of pedestrians and cyclists.

Examples are specific goals for pedestrian and cyclist safety and plans designed to achieve these goals, task groups that represent the interests of pedestrians and cyclists, and that contribute to decisions and planning processes that are relevant for pedestrians and cyclists, safety audits for pedestrian and cyclist facilities, incentives for car dealers and consumers to sell and buy cars that offer good pedestrian protection.

**Report:** Making Vision Zero real: Preventing pedestrian accidents and making them less severe. TØI report 889/2007 Authors: Alena Erke, Rune Elvik, Language: English.



*Institutional measures can improve pedestrian and cyclist safety indirectly by supporting the implementation of effective safety measures.*

# Competitive Tendering Strengthens Urban Areas



*The analyses show that competitive tendering is associated with rising administrative costs for the local government.*

During the last 5–10 years, public transport service levels in Norway have increased more in urban areas than in rural ones, and seemingly more so in areas relying on competitive tendering.

Previous studies have shown that competitive tendering is associated with cost reduction for the procuring authority. This report from Institute of Transport Economics analyses its effects on service level in rural areas and on administrative costs.

Rising service levels in cities are mostly due to political subsidy priorities in favour of urban areas during the last ten years, agreed on both local and national level.

The analyses also show that competitive tendering is associated with rising administrative costs for the local government.

The cost increase is, however, closely connected to the shift from net cost to gross cost contracts, and to the authority's take-over of planning and design responsibilities.

**Report:** Competitive tendering in local bus services. Effects on rural service levels and on administrative costs. TØI report 927/2007. Language: Norwegian

# VTI's International Cooperation

*VTI has a well developed and active partnership in global networks. The national and international networks and alliances are a guarantee that the knowledge VTI produces has a broad, deep and interdisciplinary basis. VTI and Sweden are global leaders in several fields, such as simulator technology and road safety.*



Magdalena Green,  
VTI, Sweden

**T**he mission of VTI is to contribute to improved transport sector knowledge. The institute takes part in European research projects, takes international consultancy commissions, is engaged in organisational networks, and participates in scientific committees and international standardisation work as well as in bilateral cooperation. VTI also organises educational courses, seminars and conferences in the field of transport.

## VTI's participation in EU projects

Work by the EU to stimulate research and development is mainly carried out through Framework Programmes which lay down the guidelines for research financed by the Commission. Framework Programmes extend over several years, and they determine what scientific goals are to be achieved and which research areas will be accorded priority.

VTI has successfully participated in research projects in previous Framework Programmes, and intends to increase its engagement in EU projects. In the Sixth



Jonas Bjelvenstam, Director General of VTI.

Framework Programme, VTI is participating in over 20 research projects.

Three of the projects in the Sixth Framework programme are coordinated by VTI. The first is Heavy Route, the aim of which is to develop an advanced guidance system for heavy goods vehicles as a means of selecting the safest and most cost effective routes in Europe. The system will take account of the needs of road users, vehicle costs and the costs of road management authorities. The second project coordinated by VTI, CATRIN, will generate new knowledge regarding the allocation of infrastructure costs to all modes. The third programme is INTRO, Intelligent Roads, the aim of which is to enhance road safety and capacity on existing and future road networks through integrating cost effective ITS technology and new sensor technology.

In 2007, VTI was a partner in almost thirty applications for various research projects in the EU. Seven of the applications have so far been accepted for funding by the EU, for two of which VTI has the role of coordinator.

The applications within the seventh framework programme primarily focused on the research themes "Transport" and "Information and Communication Tech-

PHOTO: VTI/HELDIOSA BILDER

nology", and also on research programmes concerned with environment, energy, materials technology, and safety/security in the transport system. The applications encompass most of the areas of expertise of VTI, such as transport planning and transport economics, road and rail engineering, and road safety and environment. Several of the projects focus on IT based support systems for increased road safety, in which respect the VTI driving simulator is an important resource.

Two projects in the Seventh Framework Programme started in the autumn of 2007. The first is FESTA, Field Operational Test Support Action, in which a methodology is to be developed for the study of normal driving, or, alternatively for the study of the long term effects of various in-vehicle IT systems. The second is eVALUE, Testing and Evaluation Methods for Integrated Safety Systems, which concerns the evaluation and development of systems for active safety in vehicles.

A major project within the framework of the European research network ERA-NET has also commenced. This is the project Keep Moving – Improving the mobility of the elderly. VTI is the coordinator for this consortium that conducts research on travelling and mobility in conjunction with various transitional periods in the later phases of life. Participants in this project come from Sweden, the Netherlands and Austria.

For the other approved projects, contract negotiations are in progress. These projects concern, inter alia, methods for recycling materials for road construction, and the development of IT based driver support systems in vehicles.

### **Commissions and cooperation concerning road safety**

VTI undertakes international consultancy commissions, mainly in the field of road safety. For example, in Abu Dhabi VTI has investigated road safety and speeding, and in Romania VTI has examined bypasses for cities and villages. VTI has worked on the design of a national system for driving licences in Ghana, and has worked in Morocco, Lebanon and Jordan with the overall objective to assist the authorities in formulating and implementing projects for technical cooperation in road safety.

In the autumn of 2007, VTI participated in a "stakeholder participation" project in Namibia. This was the first time that Swedish stakeholders consisting of authorities and private organisations visited Namibia with the aim of elucidating the interest in starting cooperation in the field of road safety.

VTI has taken part in several international conferences and seminars in order to communicate knowledge of Swedish road safety development and, in particular, the Vision Zero. During the UN Road Safety Week in the spring of 2007, a VTI employee participated as keynote speaker in Singapore and Brunei.

### **Sharing of research experience with Japan**

Sweden and Japan have shared road transport research experience for many years. This collaboration began in 2000 at official level, with the Swedish Road Administration and VTI as Swedish partners. Since then, five seminars have been arranged, two in Japan and three in Sweden. The most recent seminar was held in Sweden in September 2007, with management, bridges, ITS, road safety and winter road management as the subjects. At this occasion Japanese researchers also visited VTI in Linköping in order to receive information concerning work on road safety, ITS and winter traffic.

### **Global conferences on road safety**

In November 2007, VTI arranged the international conference "Road Safety on Four Continents" in Bangkok, Thailand. This was the fourteenth successive international road safety conference that VTI has arranged since 1987. The conference programme, with papers and presentations by researchers and other road safety experts, attracted about 250 delegates from about 50

countries. The principal theme of the conference was the sharing of new findings concerning road safety, transfer of knowledge on road safety, the sharing of good experiences of road safety measures, and road safety as a work environment problem.

"Road Safety on Four Continents" is unique since its focus is on the sharing of experiences between countries with a high standard of road safety and countries where work on increased road safety has only just begun, especially the developing countries in Africa and Asia.

### **International study visits and courses**

VTI often receives international guests for study visits or as participants in courses and conferences.

During 2007, VTI was visited by the Taiwanese Minister for Communications and Transport who wishes to share experiences and improve relations between the countries, by a delegation from Research Institute of Highways in China with the aim to study the VTI driving simulators and the experimental set-ups for studies in these, by a delegation from Japan in order to study the Swedish programme for calculating the effects of road improvement measures, and economic estimates regarding road safety, and by visitors from the Ministry of the Interior in Bahrain who attended a six-day course on Swedish road safety. During the year, VTI, in partnership with the Swedish Road Administration, also arranged an international workshop on "Monitoring of Road Surface Condition". Delegates from nine countries took part in discussions on issues such as the need for data, the choice of indicators and evaluation models, methods of measurement and quality assurance for road surface measurements.

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Examples of VTI partnership in international networks:

- ECTRI** – European Conference of Transport Research Institutes
- ETSC** – European Transport Safety Council
- FEHRL** – Forum of European National Highway Research Laboratories
- FERSI** – Forum of European Road Safety Research Institutes
- GRSP** – Global Road Safety Partnership

VTI also participates in the **JTRC** (the Joint OECD-ECMT Transport Research Centre).

# VTT's International Cooperation

*VTT Technical Research Centre of Finland aims at developing new technologies and creating new innovations and value, thus increasing the competitiveness of its customers. We are becoming increasingly global by exploiting international cooperation networks, participating in and coordinating international projects, and serving international private and public sector customers. During the past few years VTT has opened new offices in USA, China and Korea, increasing its presence in markets serving both Finnish and international enterprises right on the spot. The initial results of this strategy are already apparent.*



Heikki Kanner,  
VTT, Finland

**V**TT has participated in a number of projects related to intelligent transport systems or ITS. In the eIMPACT and PreVAL projects, we assessed the behavioural and safety impacts of intelligent vehicle safety systems. VTT also identified topics of future research in winter services within COST353, explored human technology interaction issues in HUMANIST — especially for children and the elderly as pedestrians and cyclists — and developed ambient intelligence services for elderly and disabled travellers in ASK-IT. Sensor development has also been an important activity; the APOLLO and FRICTION projects focused on the development of an intelligent tyre, and determination of on-line friction for vehicle control systems. Another sensor development deals with driver monitoring such as the SENSATION project, in which VTT developed a seat sensor to monitor driver activity. In the AIDE project, together with Volvo Technology, VTT developed a cockpit-monitoring

model to measure driver-scanning activity while driving. The focus of the PEPPER, FAIR and ASSET is new enforcement technologies and traffic control. Cooperative driving is being studied in the SAFESPOT, ASSET and INTERSAFE II projects where our role has been to focus on infrastructure sensors. VTT has also been actively involved in PREVENT, and is now starting the TeleFOT project on the impacts of nomadic and aftermarket devices.

In the field of road safety VTT has coordinated the ESCAPE and PEPPER projects concerning enforcement, and participated the SUPREME project dealing with best practice road safety measures. We are also taking part in the 2-BE-SAFE consortium aiming at developing 2-wheeler BEHAVIOUR and SAFETY. Regarding rail transport, VTT has participated in the EURNEX network of excellence and the SELCAT project aiming to improve safety at road-railway level crossings.

In the EU intermodal projects EUTP, ITIP and PROMIT, VTT has analysed best practices, benchmarks and strategies of intermodal choices. VTT Logistics has good experience with IT architectures, e-

documents and RFID technologies. The newest areas of logistics research are extensions to short sea shipping and ICT solutions for transport to Russia. Changes in European rail legislation, progress of implementation, barriers, impacts, expectations, acceptance etc. have been studied in the REORIENT project.

Since the 1980s, the VTT transport system analysis team has actively taken part in EU research programs for sustainable development. This covers both urban and rural areas and passenger and freight transport, and ranges from network performance assessment through policy analysis and evaluation to environmental, emission and equity impact assessment. Development of evaluation, validation and assessment methodologies and indicators for policy assessment has been the main objective of the SAMI, MAESTRO, CANTIQUE, INTERNAT, COMMUTE and TRANSFORUM projects, and is also the subject of the new FP7 project METRONOME coordinated by VTT. The CODE-TEN and EVAMONTENT projects have been for TEN assessment and development. The OPTIMA, FATIMA, PROSPECTS and SPECTRUM projects,



PHOTO:PHOTOS.COM

based on common EU transport policy objectives, have used modelling techniques and practical experience to give recommendations for optimal policies and policy packaging, as well as guidelines for decision-making. VTT has also participated in COST Action 355 relating to sustainable mobility, especially in working groups for harmonising national transport surveys and the surveying and modelling of car ownership and use.

Regarding energy use in the transport sector and promotion of alternative fuels, VTT has participated in various EU projects such as UTOPIA, FUREORE, CLEANER DRIVE and PREMIA. The role of hydrogen as an energy carrier in road vehicles has also been a topic of the HySOCiETY and HyWAYS projects, and we are currently involved in the co-Nordic Scandinavian Hydrogen Highway Project (SHHP) in trying to engage Finnish partners in this initiative.

#### **Cooperation with the USA**

VTT has conducted several joint research projects with the University of Michigan Transportation Research Institute (UMTRI). The most recent studies have focused on major opportunities for road safety in the US, characteristics and availability of road-crash databases worldwide, and safety effects of stop lamps. Cooperation with the Great Lakes Maritime Research Institute is under development.

#### **Other international activities**

VTT has actively cooperated with CEDR (Conference of European Directors of Roads) and national road authorities in the development and deployment of ITS. We have chaired the development of the road map for intelligent vehicle and infrastructure systems in CEDR, led the European monitoring expert group, and participated actively in the European evaluation expert group producing tools and guidance for ITS evaluation activities. VTT has been closely involved in the VIKING and EASYWAY actions, developing and deploying harmonised traffic management on European roads.

VTT and Helsinki are the Finnish partners in the COST Action 358 Pedestrian Quality Needs. The main objective is to provide knowledge of pedestrians' quality needs and how those needs relate to structural and functional interventions, policy making and regulation to support walking conditions across the EU and other involved countries.

Apart from VTI, VTT cooperates with many Swedish universities, e.g. Lund University, Umeå University and Luleå University of Technology (LTU). Dr Lars Leden has a guest professorship at LTU with focus on traffic safety for children and the elderly.

The development and take-up of intelligent vehicle safety systems has been fostered

by the eSafety Forum in cooperation between the European Commission, industry, authorities and other stakeholders. VTT has supported the work by co-chairing the Implementation Road Maps Working Group, building up the eSafety effects database, and contributing to other working groups, especially the Research and Technology Development Working Group.

VTT has led a vast research project, EVASERVE, that has developed an evaluation tool spanning the entire lifespan and service network of information services especially for transport and logistics. Novel know-how on viable business models and pre-evaluation of business cases will help service providers, equipment suppliers and evaluation experts in both the domestic and international markets.

**Contact:** Heikki Kanner, heikki.kanner@vtt.fi

#### **Examples of VTT partnership in international networks:**

ECTRI – European Conference of Transport Research Institutes  
FERSI – Forum of European Road Safety Research Institutes  
EARPA – European Automotive Research Partners Association  
ERTICO - ITS Europe  
IBEC - International Benefits, Evaluation and Costs

# The Danish Road Directorate's Participation in International Research and Development

*Cooperation and exchange of know-how across borders is essential for innovation and in the final instance for implementation of new materials and methods in the Danish road sector. This article presents some of the international networks in which the Danish Road Institute is active in the field of research and development.*



Hans Jørgen Ertman Larsen and Flemming Berg

The Danish Road Directorate (DRD) has an obligation towards the road sector. The sector responsibilities of the DRD have the purpose of creating a qualified knowledge base which the road administrations can use to achieve a more effective road administration. International relations are established through the Nordic Road Federation, the Conference of European Directors of Roads (CEDR) and the Forum of European National Highway Research Laboratories (FEHRL).

It is necessary that new methods, systems and work processes are developed all the time so that the planning, construction and running of the road network become cheaper. Such a process can only succeed by obtaining new knowledge, which is based on international research and development cooperation. An important starting point for this cooperation is national projects.

The research, development and demonstration strategy of the DRD focuses on a number of areas which in the coming years

should contribute to the creation of an effective, sustainable and safe road transport system:

- traffic flow quality
- road safety
- noise
- environmental protection – recycling and clean technologies
- specific service needs of people and business
- road construction techniques and technological improvements
- contracting strategies; public-private cooperation.

In the following, some examples of international research and development cooperations are considered which live up to the research strategy and are of benefit for the Danish road sector.

## **NordFoU**

The Nordic road directorates in Finland, Iceland, Norway, Sweden and Denmark established in 2004 a joint research cooperation in the road and traffic area – NordFoU. The purpose of the initiative is to strengthen the existing cooperation across borders by common agreement and financing of the research requirements. By doing this, advantages of large scale opera-

tions are obtained and Nordic research gets better possibilities to specialise and develop.

The NordFoU cooperation requires that projects, where at least two countries agree on a problem, go together financially to solve the problem. The projects are solved by common financing from those countries which participate and the projects are carried out with the expert know-how which is considered necessary to achieve the best results. The cooperation therefore makes the means of obtaining new knowledge more effective by using existing knowledge in the individual countries.

The following completed or on-going projects can be mentioned with Danish participation:

*Nord2000 – the Nordic noise calculation model:* The development of the last part of the new Nordic noise calculation model Nord2000Road has been carried out under Danish leadership and with participation from Norway, Sweden, Finland and Iceland.

*Deterioration models for flexible pavements:* The project should contribute so that existing models in Pavement Management Systems can be improved and extended by means of a better description of the deve-

lopment of the condition of road pavements as a function of time, traffic and climate. This means that road administrations get an improved planning tool which must be expected to lead to savings for the road administrations and the road users. Norway is in charge of this project and has the responsibility of carrying out this project. Norway and Denmark, Sweden and Iceland take part in this project.



### CEDR

The road directors in West European countries recognise the importance of extending cooperation in the road and transport area in order to be able to carry out their road sector responsibilities. Thus an agreement was reached in 2003 to cooperate on the exchange of experience and know-how within all traffic related subjects, especially infrastructure management, traffic and transport, financing, legal questions, safety, environment and above all research in all of these areas. Initially eighteen countries participated, now a further six countries have joined CEDR.

CEDR has developed a strategic plan for cooperation for the period 2005–2009. In this connection twenty five research and development themes have been identified and prioritised and work is being carried out in these fields. Under Danish leadership, one group has the responsibility to prepare a handbook with advice on how to include a reduction of road traffic noise in road maintenance and also give a survey of the methods of road noise reductions.



### FEHRL

FEHRL has existed for 15 years and has 30 European member institutes. The Danish Road Directorate, Danish Road Institute has participated in FEHRL work from the

very beginning. The 5-year plan of FEHRL for 2003-2008 includes activities, which can be classified in the following four classes:

- Environment, energy and resources
- Safety
- Mobility, transport and infrastructure
- Design and construction

One of the purposes of FEHRL work is to coordinate research and development within the participating national road laboratories. Each country has a Research Coordinator, who represents the country's interests in the FEHRL Research Coordinator Group. The Danish Road Institute has the chairmanship of this group. One of the group's responsibilities is to coordinate applications for the EU Framework Programmes. For one of the framework programmes "Sustainable Surface Transport" FEHRL made a total of twelve applications for FP7, 1<sup>st</sup> call, and the Danish Road Institute participated in seven of these applications.



### ERA-NET ROAD

ERA-NET ROAD (ENR) is a three-year programme running from June 2005–May 2008 that focuses on better cooperation of road research and transnational coordination. It is funded by the European Commission within the Sixth Framework Programme (2002–2006). The primary objective is that by May 2008, ENR will have achieved transnational programmes which are strategically planned, transnationally funded and will have led to the mutual opening of national research programmes.

The main objectives are:

- to encourage exchange of information and best practice
- to identify and analyse potential complementary research themes
- to implement common activities by identifying possibilities of coordinating already planned or on-going research projects
- to develop strategies and programmes for transnational research projects with

common financing and tendering

- to develop multinational possibilities to ensure that rules and administrative procedures among the partners does not prevent transnational cooperation
- to communicate results to project leaders, research strategists and users in Europe.

There are eleven national road authorities as partners and the research has been developed through two branches: collaboration on existing programmes (Project Opportunities) and the implementation of new research activities (Strategic Research Opportunities).

ENR held a series of workshops in 2007 to discuss and define themes for such activities. Five Project Opportunities and seven Strategic Research Opportunities were found to manage in this important phase of this project. There was significant enthusiasm from participants to address their mutual research needs in a collaborative way. This is encouraging, and the ENR team will endeavour to further these collaborations.

As a first outcome from ENR, a joint call for proposals concerning "Road Owners Getting to Grips with Climate Change" is about to be developed and a call for proposals has been launched.

### Further research efforts

Over and above the mentioned examples, the Danish Road Directorate also participates in other working organisations such as European Road Transport Research Advisory Council (ERTRAC), Transport Research Arena (TRA), World Road Association (PIARC), Organisation for Economic Co-operations and Development (OECD) and Transportation Research Board (TRB).

Information concerning ongoing research can be found at <http://www.vd.dk> – English – Road Research – Projects.

Links:

NordFou: [http://www.vejdirektoratet.dk/nordisk/om\\_nordfou.asp](http://www.vejdirektoratet.dk/nordisk/om_nordfou.asp)  
 CEDR: <http://www.cedr.fr>  
 FEHRL: <http://www.fehrl.org>  
 ERA-NET ROAD: <http://www.road-era.net/>

Institute of Transport Economics (TØI):

# Applied Research on a National and International Level

*Road safety, international logistics, freight transport, and accessibility of public transport are some research topics in which the Institute of Transport Economics (TØI) is involved.*



Harald Aas, TØI, Norway

**T**he Institute of Transport Economics is a non-profit research foundation with a mission to develop and disseminate transportation knowledge with scientific quality and practical application.

The institute has a multidisciplinary, 70-strong research staff consisting of economists, engineers, sociologists, geographers, psychologists, and political scientists.

TØI specialises in the societal aspects of transport. The sphere of activity includes most of the current issues in road, rail, sea and air transport, as well as urban mobility, environmental sustainability, and road safety.

The majority of TØI studies are commissioned. Important clients are the Norwegian Ministry of Transport and Communications, the Norwegian Public Roads Administration, the Research Council of Norway, and the European Commission. Having participated in a large number of projects under the Framework Programmes of the European Union, TØI emphasises the importance of international research cooperation in the transport area.

### **The Handbook of Road Safety Measures**

The Institute has a particularly strong tradition within road safety analysis. Researchers at TØI have authored *The Handbook of Road Safety Measures*, a comprehensive, meta-analytical survey of the international, scientific road safety literature, now available in English, Spanish, Russian, Finnish, and Norwegian. In the Handbook more than 1,700 road safety evaluation studies made all over the world are summarised. The effects of approximately 130 road safety measures have been evaluated and quantified, measures ranging from highway engineering and traffic control, through vehicle design, driver training, public information campaigns and police enforcement. The English edition is published by Elsevier.

### **CIENS**

Having relocated recently to its new premises near the main campus of the University of Oslo, TØI is now one of the leading partners of the Oslo Centre for Interdisciplinary Environmental and Social Research (CIENS), a strategic research collaboration between independent research institutes and the University of Oslo. With a total staff of around 500, integrating the natural and social sciences, technology, and economics, the centre will build capa-

city to face the complex challenges arising in the interface between environment and society.

### **ECTRI**

The Institute is also among the founding members of the European Conference of Transport Research Institutes (ECTRI) which was established in 2002. ECTRI aims to promote research contributing to an efficient, safe, secure, and sustainable intermodal transport system in Europe.

### **EU projects**

In recent years the Institute has been engaged in more than 60 research projects under the Fourth, Fifth, Sixth and Seventh Framework Programmes of the European Union. The projects cover a wide thematic field, including road safety measures, methodology of cost-benefit analysis, public transport, walking and cycling, statistics and data collection for travelling and freight, optimal transport policy in urban areas, the potential for reducing tyre noise, transport pricing, and methodologies for policy and project evaluation. In addition, several projects in the area of international logistics have contributed to making rail freight transport more competitive.



PHOTO: PHOTOS.COM

### **Development aid**

The Institute also has a long tradition in activities aimed at international development cooperation. There is a particular focus on Africa, but projects have also been carried out in Asia and Eastern Europe. The activities have recently included evaluations of various road sector programmes in Tanzania and Zambia, road safety in Benin, classification of the road network in Mozambique, and an overall evaluation of the transport sector support provided by the Nordic Development Fund. Most activities have concerned the road sector, focusing on institutional reform, evaluations, and road safety.

### **International representation**

The Institute is represented in several international transport organisations and expert committees, including:

- European Conference of Transport Research Institutes (ECTRI)
- Forum of European Road Safety Research Institutes (FERSI)
- OECD/ITF Joint Transport Research Committee (JTRC)
- Transportation Research Board (TRB): Transportation Economic Committee, Transportation and Development Committee, Committee of Safety Data Analysis and Evaluation
- Association for European Transport

(AET): Programme Committee for Local Public Transport

- European Transport Safety Council (ETSC)
- European Co-operation in the Field of Scientific and Technical Research (COST): Technical Committee on Transport
- Network on European Communications and Transport Activity Research (NECTAR)
- International Association and Scientific Experts in Tourism (AIEST).



# INTERNATIONAL COOPERATION

## **EU-projects in which TØI are involved (2008):**

### **Road safety:**

#### **IN-SAFETY** (Infrastructure and Safety)

Road safety engineering measures may reduce casualties by 6.5 percent. IN-SAFETY project aims to use intelligent, intuitive and cost-efficient combinations of new technologies and traditional infrastructure best practice applications, in order to enhance the forgiving and self-explanatory nature of roads.

**RIPCORD** (Road Infrastructure Safety Protection – Core-Research and Development for Road Safety in Europe)

The objective is to develop and manage a safe road infrastructure in a cost effective way. Tools will be established to assess the cost efficiency of different safety measures. The determination of what makes a road self-explaining will be elaborated, road accident black spots will be focused and safety of road networks will be analysed.

#### **Safety Net**

The objective of the project is to build the framework of a European Road Safety Observatory, which will be the primary focus for road safety data and knowledge. The project will make new proposals for common European approaches in several areas including exposure data and Safety Performance Indicators.

**CAST** (Campaigns and Awareness-raising Strategies in Traffic Safety)

CAST is set up to meet the European Commission's needs for enhancing traffic safety by means of effective road safety campaigns. The project aims at developing and assessing an evaluation tool for road safety campaigns. These handbooks will enable the EC to design and to implement future campaigns and to evaluate their effect.

**PEPPER** (Police Enforcement Policy

and Programmes on European Roads)

The PEPPER project aims to enhance the effectiveness and efficiency of the police enforcement of road traffic. This by describing and analysing the way traffic law enforcement functions and how it contributes to national road safety work.

**HUMANIST** is a Network of Excellence. Its goal is to create a European Virtual Centre of Excellence on Human Centred Design for Information Society Technologies Applied to Road Transport ( In-Vehicle Information System and Advanced Driver Assistance Systems), with joint programmes of activities, gathering research, and integrating and spreading activities.

### **Freight Transport**

**PROMIT** (Promoting Innovative Intermodal Freight Transport)

The main objective is to contribute to a faster improvement and implementation of intermodal freight transport technologies and procedures, and to help promoting innovative intermodal freight Transport and modal shift by creating awareness on innovations, best practices and intermodal transport opportunities.

**REORIENT** focuses on freight transport in a Trans-European railway corridor to investigate the status of interoperability between the countries. The project has identified different barriers which prevent intermodal railway freight transport to succeed. The knowhow will be used to develop means to solve the problems.

**RETRACK** is applying an innovative rail freight service concept to the movement of rail freight across Europe. This is being achieved through the design, development and implementation of a commercial Trans-European rail freight service along the rail corridor between Rotterdam (the Netherlands) and Constanza (Romania) on the

Black Sea. The project aims to secure a significant modal shift of cargo from road to rail.

### **Other programmes**

#### **ENACT**

The aim of the project is to assess the extent to which the introduction of social marginal cost pricing obligations may hinder or not the further development of Public-Private Partnerships (PPP) schemes in the transport sector and, to devise ways to incorporate such obligations in PPP schemes while, at the same time, taking advantage of the positive aspects that such partnerships can have.

**TOOLQIT** (A toolkit for measuring quality of service in transport)

The objective is to develop and validate a framework for the assessment of levels and quality of service across different transport market segments as well as to propose indicators for quality, measurement tools and methods to assess the impacts of policy.

#### **EURO ACCESS**

The objective is to contribute to the development of EU policy on the accessibility of the transport systems in the 27 member states, and two EFTA countries, in order to promote the social integration and active participation in society of people with disabilities.

**CONCERTOUR** (Concerted innovative Approaches, Strategies, Solutions and Services Improving Mobility and European Tourism)

The project seeks to improve tourism-related transport as a means of boosting economic growth in Europe. Better connections with different transport modes, improved information on sustainable transport modes and enhanced ticketing systems are some of the research areas.

# A Norwegian Delegation to Chile – Cooperation in Projects and Seminars



Ferry connection near Conchi, east of Chiloé.



Thorbjørn Chr. Risan,  
NPRA, Norway

The main reason for the cooperation between the two countries is the fact that Southern Chile, Region 10–12, in many ways is “a Norway in south”. We have the same sort of topography, climate, vegetation, industry and also partly the same insufficient infrastructure. Chile and Norway therefore often share the need for the same sort of solutions for new roads, tunnels, bridges and ferries as well as maintenance and traffic safety work.

This official visit in January 2008 had three main intentions:

1. Conduct four seminars on the infrastructure on 24 and 25 of January as a part of the official visit of the Norwegian Crown Prince Haakon Magnus.
2. Follow-up existing contracts.
3. Discuss new possible projects in Chile and Norway where support from the other country can be necessary.

## Seminars

Altogether four seminars were conducted at the Grand Hyatt Hotel with participants from the highest official level. Totally about 280 delegates took part in the two days of semi-

*At the end of January 2008 an official delegation led by the Norwegian Crown Prince Haakon Magnus visited Chile. The Crown Prince was accompanied by a large delegation of more than 100 managers and professionals from the energy, fish, trading and transportation sector in Norway. From Norwegian Public Roads Administration (NPRA) seven participants took part in the visit to continue the work drafted in the updated agreement in the area of transportation for the 2006–2010 period.*

*The trace for the bridge to Achao east of Chiloé.*

nars. During the two days the participants were given information about existing projects in which the two countries already cooperate. In addition, ideas about implementation of some new projects of interest for the cooperation were discussed, of which national tourist routes and traffic safety were the two most interesting subject areas.

## Following up existing projects

Since 2000 Chile and Norway have had a cooperation both for the private and public sectors. Within the transportation sector the activity has been centered on the following three major projects:

- New ferry terminals for Chacao Channel.
- Planning of the Austral Route Project – “the missing link” for a road between Region 10 and 11, east and south/east of Puerto Montt.
- The Otta Seal Project – a Norwegian pavement material for local district roads. Introduced to Chile by NPRA and now used in six regions in Chile.

Through information and discussions a review of status and a further follow-up on these projects were conducted.

## Possible new projects

On January 29, a meeting was held to make efforts to map possible new areas of coop-

eration. In the process many exciting suggestions for cooperation projects were given, including the following:

- Bridge to Achao
- Bridge in Valdivia
- Bridge in the Austral Route Project
- The BRUTUS Program – a computing program for bridge maintenance
- Ferry connection over a fjord in Valdivia city
- Ferry connection from Chiloé to Isla Lemuy (near Chonchi)
- Chilean-Norwegian partnership for operating a ferry connection over the Chacao channel
- New tunnel through the Andes
- Sub sea tunnels in Chile
- Rebuilding tunnels.

The result of the process shows the multitude of challenges in the future and the potential for the Chilean–Norwegian cooperation in the area of transportation.

Altogether the visit to Chile must be considered as successful with a view to develop and strengthen the cooperation between the two countries through exciting and comprehensive common projects in the future.

Contact: Arild O. Eggen, arild.eggen@vegvesen.no

# International Activity of the NPRA

*NPRA, Norwegian Public Roads Administration, is represented in over 200 working groups and committees in a wide range of international organisations, and has assisted developing countries for more than 30 years.*



Carl Chr. Gabrielsen

**T**he vision of NPRA is to be “on the road for a better society”. In striving towards this vision we find ourselves increasingly connected internationally. The content, extent and duration of our international engagements vary from short term research projects to ongoing work of political nature. We deal with subjects ranging from state-of-the-art ITS to “maintenance on a shoestring” in the developing world, from traffic safety in the Nordic countries to the use of Kalahari sand in low-trafficked road seals. The overlying objective for all our international work is the same: to enhance NPRA’s capacity to carry out the tasks with which we are entrusted.

### **Nordic Cooperation**

Approximately 40 per cent of NPRA’s international work occurs within a Nordic framework, mainly within the Nordic Road

Association (NVF). NVF is a coalition of national road administrations, private sector companies and research institutions, with the objective of furthering road transport efficiency.

### **Europe**

Cooperative agreements have been signed with the Baltic countries of Estonia, Lithuania and Latvia as well as with Poland. EU/EEA related cooperation is conducted through several organizations, including the Western European Road Directors (CEDR) and the European Committee for Standardization (CEN). On an international level NPRA channels most of its efforts through PIARC (World Road Association). Additionally, NPRA participates in a large number of organizations dedicated to purely technical aspects of roads and traffic.

### **Africa – 30 Years of Cooperation**

NPRA has been cooperating with developing countries since Botswana became a Norwegian partner country in the early

1970s. Since then, the paved road network of Botswana has increased from 160 km (1971) to 6 400 km (2007), and the use of the cost effective Norwegian Otta seals have provided savings equivalent to the cost of constructing the entire 600 km Trans-Kalahari Highway. Botswana has gone from being one of the ten poorest countries in the world to being middle income country, and today finances cooperation with NPRA largely with its own means.

In Zambia, NPRA cooperates with the Roads Development Agency on legal, administrative and technological aspects of axle-load control. The aim of the project is to increase traffic safety by reducing overload. In Tanzania, NPRA cooperates on a wider range of issues, focusing on organisational development.

### **Chile**

A completely different form for cooperation is found in NPRA’s bilateral cooperation agreement with Chile. Similar in both



*Kjell Solberg from NPRA together with Afghan colleagues. NPRA has an agreement on cooperation with Afghanistan and has contributed to winter maintenance training of the Salang tunnel, which is a part of the main road into Kabul.*

PHOTO: NPRA

demography and topography, Norway and Chile face many of the same challenges and have a mutual interest in developing cooperative solutions. Our activities in 2008 include: use of the Otta seal, developing ferry terminals for the Chacao Channel, preliminary studies for bridges and tunnels, and installing NPRA developed Brutus software for bridge maintenance. Furthermore both countries have committed to information exchange by sending and receiving delegations, with a series of seminars set up for 2008. This is a recent example of our international engagement.

#### **Cost Efficiency**

The extent of international activity in

NPRA is in part due to funding by partner countries and institutions such as the World Bank and Norwegian Agency for Development Cooperation (Norad). At the same time, we keep costs down by cutting travel time, using video-conferencing and electronic communication channels whenever possible. When taking into regard only time spent on travel and work abroad, the workload invested by NPRA staff corresponds to only that of eight full-time positions. Taking into consideration the extent of our international activity, we believe this is quite cost-efficient.

#### **Challenges**

In a globalized and competitive world, NPRA is dependant upon international

engagement for three highly interlocking reasons. The first is to attract, develop and retain key personnel, who are much in demand by the private sector. The second is to function as a facilitator for Norwegian consulting companies, and the third is to be updated on contemporary developments within a set of disciplines ranging from environmental protection to intelligent traffic systems and heavy infrastructure construction. One of our largest challenges ahead lies in distributing the output of our international activity, which only seems to increase. International activity and information management have indeed become integral parts of roads administration.

# Tromsø 2018 – Compact Winter Games: What about the Roads?



*The city of Tromsø is a potential applicant to host the Winter Olympic Games in 2018. During this year, the Norwegian Government will decide whether or not to guarantee for the required 1,9–2,5 billion EUR. The International Olympic Committee will take the final decision in 2011. Larger cities as Pyeongchang in South Korea and München in Germany are also applicant cities.*



Nils Arne Johnsen

**T**he main competitive strategies of Tromsø are: Emphasis on the arctic dimension, the spectacular dimension – snow-white alpine mountain ranges and deep blue fjords – and, not at least, the most compact games ever held the last 30 years.

All the arenas are located less than 45 kilometres from downtown Tromsø, several of these are in fact located on the Tromsø Island, an island 10 kilometres long at the most. For the first time since the Squaw Valley games in 1960 there will be only one participants' village. As a major element, several of the arenas will be in walking distance from downtown. Another important element is housing of visitors on ships along the docks by the Tromsø sound.

## **Will such compact games create a need for new road investments?**

The municipality of Tromsø has 65 000 inhabitants, most of them living in a rather

small area on the Tromsø Island and around the Tromsø sound and Sandnes sound. The airport is located on the island, a 10 minute drive from the city centre. The main road is E8 and it is connected to E6 at 70 kilometres to the south. The municipality is one of the few in Northern Norway that have experienced growth continually the past 40 years. It is the largest city in Northern Norway.

During the 1990s the main roads on the island where constructed. The most important is the 4-lane sub sea tunnel connecting the island to the mainland. The capacity of this road network is beginning to reach its maximum in peak hours.

A recent strategic plan for the road system in Tromsø – Tromsø Transportation Plan – suggests new projects for approximately 126 to 380 million EUR. The E8 on the mainland and the main road on the island connecting the airport to the E8, are the most important projects. In addition, a new E8 through Ramfjorden south of the city is considered necessary. This project alone will need 89 million EUR in funding.

During the proposed Tromsø Games in

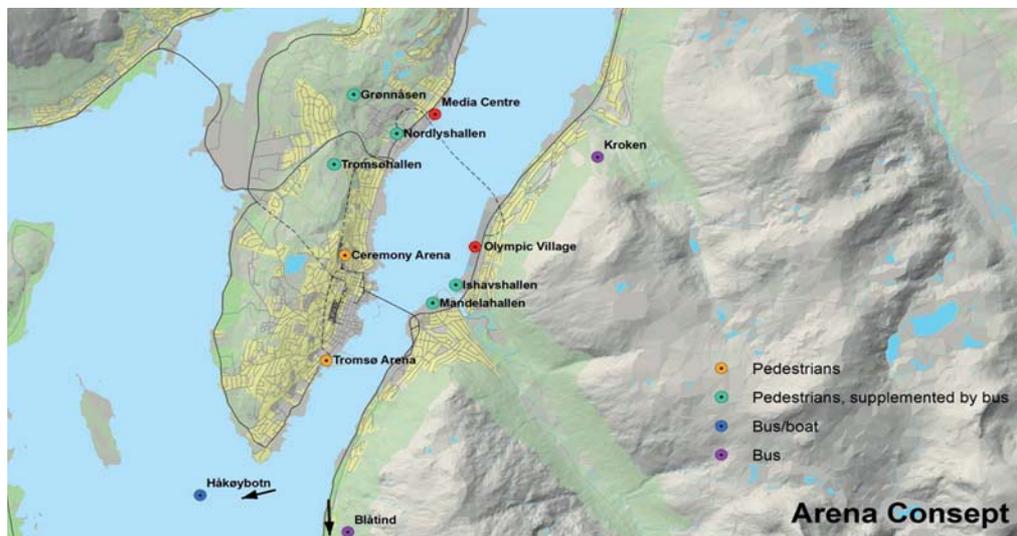
2018, ordinary civil road traffic will be prohibited most of the day. Even though, there will be need for increased capacity in the main road network to take care of the traffic during the Games. The most important projects are:

- new 4-lane road, E8/Fv 53 Hungeren–Kroken, mainland, 99 million EUR
- new 2-lane road, Fv 53 Kroken–Movika, mainland, 32 million EUR
- new 2-lane road, E8 Ramfjorden, 89 million EUR.

## **The need of new infrastructure exists even without the Games**

All together the Norwegian Public Roads Administration is estimating a 316,5 million EUR budget for new roads to be built before the Olympic Winter Games in Tromsø. Neither of these projects has been listed in the newly proposed National Transportation Plan 2010–2019.

The next 12–18 months, the Norwegian Government will scrutinize the strategies of Tromsø Transportation Plan to decide the extent of further planning. This is regardless of the Tromsø Games' need for trans-

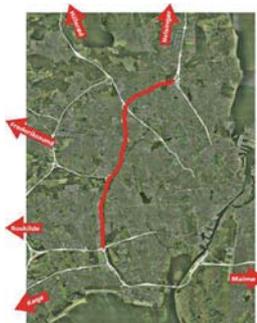


portation. During the same period, the city of Tromsø will establish an official plan for the potential Tromsø Games. This plan will specify where the arenas and the participants' village are to be located and what kind of transportation system that has to be established. It will also map out where to construct bus roads, bus terminals, pedestrian zones, extension of the airport terminal and parking areas on the outskirts of the city.

The need for construction of roads according to the proposed Tromsø Games is very much identical to the need for new roads in Tromsø without the Games. Therefore, there is not much criticism connected to these elements of the effect of the Olympic Games on the Tromsø community.

**More information at:** [www.tromso2018.no](http://www.tromso2018.no) (not yet translated into English)

# Use of ITS on the Motorring 3 in Copenhagen



*Intelligent Transport Systems (ITS) are becoming still more popular with The Danish Road Directorate (DRD) when it comes to traffic management during major motorway construction works. In this article, the impacts of the various ITS applications on the M3 motorring are presented. Applications were implemented due to the widening of the motorring from four to six lanes.*



Charlotte Vithen,  
Danish Road Institute

Jens Toft Wendelboe, COWI

The overall M3 traffic management system consists of the following key applications:

- Traffic detector system
- Variable speed limits via variable message signs (VMS)
- Lane management
- Real time traffic information provided by VMS
- Video surveillance
- Web applications
- Voice-response telephone services.

The applications are to help the DRD to fulfil the motorway construction success criteria which include: preventing increases in the numbers of incidents, keeping as much traffic on the M3 as possible, keeping the traffic flowing smoothly, keeping the motorists informed of queues, acci-

dents, travel times etc. as well as keeping the motorists as happy as can be while the construction is taking place.

Following the implementation of the ITS applications a number of assessment activities have been carried out.

## Assessment results

The overall assessment results are described in the following:

### Reallocation of traffic

Prior to the construction works, major reallocation of traffic from the M3 to the surrounding road network was expected. Traffic reductions on the M3 were expected to be 25–30 per cent. Although the traffic load on the M3 has decreased, and the traffic loads on the surrounding road network have increased, the reallocation of traffic has been less than expected.

### Traffic safety

The construction works do not seem to have led to an increase in the number of traffic accidents taking place on the M3. Although the comparison only includes data from one year before and one year

after the beginning of the construction works, it is generally found to be satisfactory that the number of accidents has not gone significantly up. Overall it is estimated that status quo is maintained.

### Driving speeds

Investigations regarding travelling speeds have shown that the variable message signs have led to a slight decrease in travelling speeds, the magnitude of which depends on what is shown on the variable message signs (both speed limits and others) and the traffic conditions at hand.

### Traffic flows

Prior to implementation, the traffic management system was expected to lead to increases in traffic flows. Such increases have not been identified.

### Gaps between vehicles

The traffic management system in general causes the drivers to drive more closely to each other at speeds between 80 km in an hour and 100 km in an hour. Outside of this speed interval the time gaps have generally increased.



### Travel time and route choice

It has been analysed whether travel times displayed at a selected observation point have caused motorists to change route as a consequence of the travel times displayed. However, the analysis was inconclusive.

### User acceptance

As part of the assessment activities the DRD also decided to carry out a user survey with a focus on motorists' perception of the various traffic management applications. The survey was carried out as a post card survey:

(Uncertainties of the obtained results are within a few (less than five) percentage points.)

- Motorists' understanding of VMS: Most of the respondents understand the VMS as intended. Signs showing variable speed limits are correctly understood by 82 per cent of the respondents. When it comes to lane closures combined with variable speed limits, 96 per cent of the

respondents understand the VMS as intended. However, 42 per cent do not understand at which point the lane closure takes effect.

Information regarding queues is perceived as intended by 88 per cent of the respondents. In case queue information is supplemented by information regarding the distance to the rear end of the queue ahead, 61 per cent understand the information as intended whereas the rest of the respondents do not.

- Motorists' attitude towards VMS and signals: The survey has shown that the motorists generally appreciate the VMS. 84 per cent of the respondents have a generally positive attitude towards the variable speed limits. When it comes to queue information, 86 per cent of the respondents have a positive attitude towards the VMS.
- Use of traffic information services: The survey included a question regarding motorists' use of traffic information ser-

vices besides the VMS (web site and telephone service). However, only very few of the respondents use the services: 9 per cent use the website, 2 per cent use the telephone service and 2 per cent use both services.

### Conclusions

In conclusion, the ITS applications at M3 have helped the DRD to fulfil a number of their project success criteria. The number of traffic accidents has not gone up and the reallocation of traffic to the secondary road network has been less than expected. Furthermore, motorists generally understand how to use the various applications and (by far) most of the respondents are happy with the traffic management system.

**Contact:** Charlotte Vithen, Head of Office for Traffic Management and ITS. cv@vd.dk and Jens Toft Wendelboe, previously Office for Traffic Management and ITS, now COWI, e-mail address: jtwe@cowi.dk

# Tools for Analyzing Infrastructure Decisions

*The transport system contributes to welfare in Sweden and is a requisite for national and regional growth. At the same time, transport investments cost large sums of money, which suggest the need for relevant and purposeful analyses before decisions are made regarding planned infrastructure investments. In the VTI project, Tools for Analyzing Infrastructure Decisions, tools are developed for the analysis and illustration of potential consequences of a number of options.*



Sandra Johansson,  
Sweden

**W**ithin the framework of this comprehensive commission, the issues dealt with are expansion of regional labour markets, the location choices of households, the lengths of commuting trips, the environmental problems of traffic, and the gender aspects of infrastructure decisions. The project is headed by Gunnar Isacson. He says that the project is mainly based on a large sample of the Swedish population and on all work places in Sweden. The sample is drawn from administrative registers and it includes, inter alia, information on sex, age, income, place of residence and place of work. It is, furthermore, combined with information on travel distances and travel times. Although the data entails information from various administrative registers, it is not possible to identify the individuals in the database.

## **Salary and commuting distance are decisive factors for job changes**

In one part of the project, Gunnar Isacson is working with Jan-Erik Swärd who is a postgraduate student at VTI. Together, they are investigating how much commu-

ting time means for the likelihood that a person changes job. According to their results, there is a statistical relationship between commuting time and the duration of an employment. Short employments often coincide with long commuting distances. If, on the other hand, the commuting distance is short, people tend to stay at the same work place for a longer time. High wages, on the other hand, tend to reduce the likelihood of people changing jobs.

From these results it is possible to estimate the so-called value of travel time savings, which is one of the most important user benefits in cost-benefit analyses of investments in the transport infrastructure. The interest in the value of travel time savings is, thus, related to the transport policy objective that the measures taken in the transport system should be economically efficient.

There are also a number of other targets for transport policy that can, to some extent, be motivated from the standpoint of distributional policies and are therefore not taken into account in the traditional cost-benefit analyses; for example, objectives regarding an equitable transport system and a good environment. Such complementary targets indicate the relevance of analyzing likely results of different invest-

ment packages and how they may affect these other targets.

## **Maps illustrate the expansion of regional labour markets**

Another target of Swedish transport policy is to promote favourable regional development. It is often said that expansion of regional labour markets is strategically important as a means to promote regional development. Regional expansion means that two or more regions combine and begin to regard themselves as one and the same region with a common labour market.

– Expansion of regional labour markets may be seen as an expression of the fact that individuals have received more opportunities in terms of where to live and where to work, says Gunnar Isacson.

A well functioning transport system is an essential ingredient for the expansion of regional labour markets. Today, however, there are only blunt instruments available for measuring labour market expansion in conjunction with changes in the infrastructure. Gunnar Isacson works together with Johan Håkansson, who is a human geographer at the university in Dalarna (Högskolan Dalarna), in studying the possibility of using GIS, geographic informa-



PHOTO: VTI/HEJDLÖSA BILDER

tion system, for illustrating, analyzing and measuring regional expansion. GIS is a tool for illustrating, inter alia, spatially fixed information. Gunnar Isacson is convinced that it is a good tool for illustrating how planned infrastructure investments would affect the expansion of regional labour markets. Information that is otherwise set out in tables and calculations can be shown in the form of maps, a medium that most people have no difficulty in relating to.

– The pictures we are developing resemble three-dimensional navigation maps. The peaks represent areas that are reachable by many individuals, says Gunnar Isacson (see example above).

He shows how a railway line can increa-

se people's commuting area, and another "peak" appears on the map.

On the basis of the information shown in the maps, it is then possible to analyse the potential consequences of various infrastructure investments for individuals, households, companies and regions.

#### Quantitative studies

Empirical research on transport economics is almost exclusively based on quantitative data, i.e. "soft" data such as opinions, subjective experiences and people's motives for different behaviour are often, but not always, ignored.

– For an economist, there will be a lot of number crunching. The advantage of the database we are working with is that it

represents a large sample of the population, says Gunnar Isacson.

He believes that access to this type of register, based on large samples is quite unique to Sweden and the other Nordic countries.

– Even if access is naturally restricted – for instance I cannot search for data regarding specific persons – it is quite fantastic that this type of database is available for research.

**Contact:** Gunnar Isacson,  
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# Long and Heavy Lorries Are Profitable for Sweden



PHOTO: VTI/HEJDLÖSA BILDER

*In Sweden and Finland, longer and heavier lorries are allowed than in the rest of EU. A large proportion of freight transport in Sweden is carried out by vehicles which exceed the EU standard. In an investigation for the Government regarding the effect of lorries on the transport system, VTI finds that a change to shorter and lighter lorries in Sweden would cause a socioeconomic loss that would primarily have to be borne by the business sector.*



Magdalena Green,  
VTI, Sweden

**M**ost freight in Sweden is carried by long and heavy vehicles. These heavy vehicles are used for both general cargo and bulk. In Sweden and Finland, lorry traffic with vehicles up to 25.25 metres long and a total gross weight of max 60 tons is allowed. In the rest of EU the standard is 18.75 metres and 40 tons. Statistics show that about 64 per cent of tonnage and about 74 per cent of ton km are carried by vehicles that exceed the EU standard.

## Government commission

By commission of the Government, VTI has investigated what effects the long lorries have on the transport system in Sweden. The commission was divided into two – a socioeconomic assessment of existing vehicle regulations in Sweden, and an examination of competition between road and rail transport. According to VTI's interpretation, the effects of heavy lorries were also to be described. The consequen-

ces with regard to transport costs, road wear, air and noise emissions, road safety and congestion were analysed. The investigation is as far as possible based on official statistics, and different models have been used to calculate the effect on transport volumes, transport costs and external effects (road wear, emissions, safety and congestion). The final report was submitted to the Government in December 2007.

## A change in regulations would be unfavourable

The conclusion is that a change in regulations in Sweden, i.e. that the same quantity of freight should be carried with shorter and lighter lorries, would lead to a socioeconomic loss (up to SEK 9 billion per year). A loss that would primarily have to be borne by the business sector. The transport costs per vehicle would decrease, but the number of vehicles needed would increase. It is estimated that the cost per lorry would decrease by 5–12 per cent over the various commodity groups, and the number of lorries would increase by 35–50 per cent. On average, 1.37 lorries of max-

imum EU size are assumed to be required to replace a lorry of maximum Swedish size. It is estimated that the lorry transport costs increase by 24 per cent.

The largest negative effect of changed vehicle standards in Sweden would thus be due to changes in transport costs. According to the calculations about 80 per cent of the socioeconomic loss is due to the increase in transport costs. But a change to the EU standard would also entail changes for the worse for society as regards noise, exhaust emissions and traffic safety. Delays to passenger car traffic are also counted on the minus side.

The European Commission has recently purchased an international consortium headed by "Transport and Mobility" in Belgium to perform an investigation on European level, similar to that made by VTI on European level.

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**For more information:** VTI publication: The effects of long and heavy trucks on the transport system, R605A

# OECD Working Group on "Improving Reliability" – Request for Nordic Studies and Experiences

*Better mobility is not just a question of reducing travelling times. For many users of the transport system "arriving on time" can be of crucial importance – and in some cases of greater importance than the total time of the journey.*



Flemming Clausen,  
fcl@vd.dk

**W**ho hasn't experienced the frustration of arriving too late for an important meeting or appointment because of unexpected delays on the roadway or a train connection that has been cancelled or is running behind schedule. Likewise unexpected disruptions in the freight transport chain can be costly for shippers and freight carriers and have negative effects for business efficiency, especially where just-in-time production is in play. Unpredictability of travelling times can force transport users to build in costly time buffers to ensure arrival/delivery on time.

There is an increasing understanding that mobility policy in future must focus more on how to provide society with reliable transport systems and that transport policies should include goals and strategies for improving the reliability of travelling times.

The Joint Transport Research Centre of the OECD and the International Transport Forum established a working group "Surface Transport Networks: Improving Reliability and Levels of Service" in the spring of 2007, which is looking more close-



PHOTO: PHOTOS.COM

ly at the concept of transport reliability and its importance for transport users and society. One of the aims of the working group is to gather information, research and cases from different countries regarding:

- how reliability is understood and measured
- the costs of unreliability for users and businesses
- how reliability is modelled and included in benefit-cost analysis
- instruments for improving reliability.

The working group would appreciate any information or contributions from the Nordic countries, which could add value to the ongoing work. Questions, contributions or other information can be sent to Jari Kauppila in the OECD secretariat ([jari.kauppila@oecd.org](mailto:jari.kauppila@oecd.org)) or to working group member Flemming Clausen in the Danish Road Directorate ([fcl@vd.dk](mailto:fcl@vd.dk)).

# A Sub-sea Tunnel in Iceland: Roadwork Makes a Big Change in Life



*In this research, the local socio-economic impact of Hvalfjörður Tunnel, a sub-sea tunnel on the southwest coast of Iceland, was investigated in the region of West Iceland. The impact was detected in all major markets: the asset and labour markets, as well as the market for goods and services. Reduced travel costs and commodity prices and increased home values were the largest effects following the opening of the Hvalfjörður Tunnel.*



Vífill Karlsson

Even though most of the overall impact was positive, the most pronounced negative effects were a reduced number of chandleries and increased crime rate. The effects were not demographically and geographically equally distributed within the region of West Iceland. Men seemed to obtain more benefit from the tunnel than women, younger inhabitants more than older ones, and the citizens of areas closer to the tunnel more than those farther away. These differences were due largely to different levels of mobility in the groups.

An extensive research study on the local impact of Hvalfjörður Tunnel on the region of West Iceland was implemented in the period 2002–2004. The main purpose of the study was to investigate the size and effect of this large-scale transportation improvement's impact on one region.

## Hvalfjörður Tunnel

Hvalfjörður Tunnel, located on the southwest coast of Iceland, was completed and opened in 1998. It reduced the travel dis-

tance between Reykjavík, the capital city of Iceland, and other localities in the west, north and, to some extent, the east coast of Iceland by 42 kilometres, with the exception of Akranes, the tunnel's closest locality, where the travel distance to Reykjavík declined by 60 kilometres. Another large-scale investment project near Akranes at the same time was the construction of a new aluminium factory.

## West Iceland

West Iceland can be divided into four areas. Ordered by proximity to the Hvalfjörður Tunnel, they are Akranes and Hvalfjörður, Borgarfjörður, Snæfellsnes, and Dalir. Borgarfjörður and Dalir are historically known as agricultural areas, and fisheries have been the main industry in the other two coastal areas. The industry in Akranes has been rapidly developing for the last decades and is now divided among fisheries, energy-intensive industry and small industries, along with a large part of the region's public services, such as the regional hospital and the high school. A similar development has occurred in Borgarfjörður along with the introduction of two successful universities. The other two,

Snæfellsnes and Dalir, have more or less kept their traditional industrial patterns.

## General impact

The impact of the Hvalfjörður Tunnel was, to some extent, unexpectedly miscellaneous, but it can be divided into four general areas: impact on the local market of goods and services, impact on the labour market, impact on the asset market, and other impact. Reduced commodity prices, increased home values, and reduced travel costs were the most valuable of the single effects following opening of the Hvalfjörður Tunnel, but reduced commodity prices and an increased variety of goods and services were also observed in the goods and services market. Furthermore, the asset and the labour markets became more efficient in West Iceland, and both the prices and marketability of homes increased. Employment opportunities and security also increased because of better access to the capital area and the labour market of West Iceland; better access to the capital area meant that the labour market became more dynamic and heterogeneous for the inhabitants of West Iceland, a highly significant development for the modern labour

market, which has gradually become more specialised because of higher levels of education.

In addition, the variety of other effects included increased traffic, better access to culture and public services, generally less likelihood of emigration, a reduced number of chandleries and increased crime rate.

### Areas

Impacts of any kind, both positive and negative, grew with proximity to the Hvalfjörður Tunnel. Thus, the impact was largest in the area of Akranes and Hvalfjörður, followed by Borgarfjörður, and was much less in the two areas farthest from the tunnel. There were some exceptions to these general findings; for example, no positive impact on the local labour market in Snæfellsnes and Dalir was detected, and a negative impact on the market of specialised services in the area closest to the tunnel was found, while the impact had been positive in the other three areas. The number of companies and the total turnover in specialised services became lower in Akranes and Hvalfjörður, which was most likely due to increased competition in the capital area. The turnover in this industry increased in the more distant areas, most likely because of a lower level of competition from enterprises in the capital area and increased tourism following the opening of the tunnel.

### Gender

Men seemed more likely than women to benefit from Hvalfjörður Tunnel, especially when the impact through the labour market was examined, since there were more women than men employed in chandleries and other specialised services, which was the only industry in West Iceland which experienced significant loss following the opening of the tunnel. Furthermore, women seemed to be less likely than men to take advantage of new employment opportunities in the capital area in part because commuting seems to be less attractive to women, which makes them less mobile and less likely to benefit from reduced travel time. Thus, the male



population saw more benefits from increased new employment opportunities and reduced travel time than females following the opening of the tunnel. The Hvalfjörður Tunnel also seemed to reduce the likelihood of men's emigrating more than it did for women.

### Age groups

Younger inhabitants in West Iceland seemed more likely than older inhabitants to benefit from the Hvalfjörður Tunnel. Greater unemployment and mobility meant that younger people could benefit more from the higher wages and increased employment opportunities brought by the tunnel. The tunnel did, however, reduce the likelihood of older inhabitants' emigrating more than it reduced the emigration of younger people, so the results between age groups is not as clear as that between genders.

### Methods of the study

Both qualitative and quantitative methods were implemented in order to enlarge the scope of the study and to improve the reliability of the results. Several types of analyses were used to meet the purpose of the study, including descriptive analysis, regression, and cost-benefit analysis based on published statistics, survey data, and interviews. It was our intention to track the differences in impact both by capturing the dimension of all the different effects in the local economy and by examining the differences in the effects among several groups, primarily population areas, genders, and age groups.

A full version of the research is available on the internet but only in Icelandic ([http://nepal.vefurinn.is/Nepal\\_Skrar/Skra\\_0006226.PDF](http://nepal.vefurinn.is/Nepal_Skrar/Skra_0006226.PDF)).

# Improving the Accessibility of Public Transport



*Improving the accessibility of public transport systems is crucial for reducing social exclusion of people with disabilities through reducing physical barriers to employment, education and independent living.*



Aud Tennøy

Institute of Transport Economics (TØI) in Norway has recently completed a report describing policies, legal frameworks and other means for improving accessibility of public transport systems in EU, Iceland and Norway. The report is part of the 6<sup>th</sup> EU Framework Project Euro Access.

## Euro Access

Eurostat (2003) has estimated that more than 45 million persons of working age, living in EU countries, have a long-term disability or medical condition. These numbers are expected to grow. Employment rates for people with disabilities are lower than the average, which also contributes to the fact that people with disabilities in average are less well off than the population as a whole.

The objective of the Euro Access project is to promote social inclusion and active participation in society of people with disabilities through contribution to the development of EU policy on the accessibility of public transport systems. The project has a

strong focus on the link between accessibility of public transport and employment, and on transferability of best practices between countries.

*The Euro Access work is organised in four main work packages (Euro Access 2007)*



Accessible public transport systems are here understood to be systems which integrate all people – including those with mobility, sensory and cognitive impairments, mental health problems, environmental sensitivities and allergies – when delivering public transport services. This includes the whole journey; to be able to understand how the public transport system works, get to and from terminals or

stops, move around and find one's way in terminals, get on and off vehicles, buy a ticket and travel with confidence. All surface public transport is covered, local as well as long distance and international transport.

## Policies, legal frameworks etc.

The TØI report briefly describes the many documents containing current policies, action plans and strategies, legal frameworks (laws, acts, provisions, regulations, guidelines etc.), and other means (concessionary fares, economic incentives, budget requirements, special transport services, strategic plans, training etc.) in the EU countries, Iceland and Norway (Tennøy and Leiren 2008). The about 350 references are organi-

sed as an inventory, listed by topic and country, and may be useful for others dealing with accessibility of public transport systems.

The main data source has been an extensive questionnaire to ministries responsible for public transport. Other sources have been used for background information and for cross-check and completion of data.

Policies, strategies and action plans

demonstrate countries' will to change the status quo. Most of the countries in the survey have, or are in progress of making, policies aimed specifically at improving accessibility of public transport systems, as well as action plans to support and implement the policies. All of the main policy documents (except one) are dated 2003 or later. There is a lot going on in this field.

Translating a will to change into a legal framework is an important means of achieving real improvements. Most of the countries have general regulatory texts on accessibility, as well as planning and building acts that incorporate the needs of people with disabilities to access and move around in terminals etc. Half the countries have a transport or a public transport act that recognizes accessibility for people with disabilities. Half of them also have regulations on accessibility of vehicles based on EU directive 2001/85/EC. Guidelines and handbooks

Table 1: What would you say is the status of your work, regarding policies and legal frameworks for ensuring accessible public transport? The information is provided by the respondents.

Alternatives	Number of ticks
Our work is completed - we have a fully developed policy, including the necessary laws, provisions, regulations etc., in order to ensure that all public transport is accessible for all	0
We have come a long way – we have a well developed policy, including most of the necessary laws, provisions, regulations etc., but there is still work to do in this field	11
We are in a state of rapid improvements – a lot of work is put into developing necessary policies, laws, provisions etc.	5
We are improving, but slowly. There are not much focus on this topic, but we are adapting to EU-directives etc.	10
We have hardly started – accessible public transport is not on the agenda	0

are important parts of the legal frameworks.

The countries work with policies and legal frameworks for accessibility of public transport systems in various ways. They also differ in how far they have come, as presented in table 1.

Since 2000, the EU has implemented several directives and regulations aiming at making public transport systems more accessible and useful for all. This has had influence on the countries responding to our survey, as shown in table 2.

Table 2: Influence of various groups on the development of the legal framework regarding accessible public transport. The information is provided by the respondents.

Influence	Low	Moderate	High	I don't know
User groups	1	7	14	2
Development in the EU	0	6	13	2
Politicians	2	8	9	2
The public administration	2	10	8	3
Experts	2	10	6	3
Development in other countries	5	7	2	4

There is a shift going on in the discussions regarding accessibility, from focus on people with disabilities and especially mobility impaired, towards universal design or accessibility for all people. Barrier free environments are understood as useful not only for people with disabilities, but also for e.g. parents with prams, elderly persons and people temporary dependent of crutches as well. According to the respondents, this shift is reflected in policies and legal frameworks of most of the countries attending the survey.

Most countries do have a special focus on reducing transport as a barrier to work, study and independent living. Firstly, reducing transport as a barrier to education, study and independent living is expressed, explicitly or implicitly, as a general objective of policies and legal frameworks. Secondly, special transport services are

organised in order to allow people who are not able to use ordinary transport services to work, study and live independent lives. Thirdly, several countries have particular projects and schemes directly focused on reducing transport as a barrier.

### The Nordic countries

TØI has discussed findings from the Nordic countries in a separate report for the Norwegian Public Roads Administration (Tennøy and Hanssen 2007). Among others we found that the policies of the Nordic countries are ambitious, heading for universal design and accessibility for all throughout the whole journey, while the legal frameworks lack behind in ensuring that this will happen.

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The report Tennøy and Leiren (2008) is the deliverable from work package 1 Review of current policies and regulations within the project For a European Accessibility of Public Transport for People with Disabilities (Euro Access), funded by the DG Research of the European Commission, under the sixth Framework Programme. Partners in the project are INRETS, CERTU, Ann Frye Ltd, University of Lund, TIS-PT and TØI. Subcontractors are FIT Consulting and UBZ. For more information, see <http://www.euro-access.org/>

# How to Look inside Porous Asphalt

*Improved analysis methods for investigating pavement performance have been developed at the Danish Road Institute in a study within the framework of the Dutch Innovative Program on Noise (the IPG programme). These techniques, which use drill cores extracted from the pavement, are CT-scanning and preparation of thin and plane sections. The two different research techniques have been applied for investigating the clogging and ravelling of porous asphalt pavements.*



Carsten Bredahl Nielsen

**E**very material response is based on the microstructure of the material and therefore, this study, which looks at a much smaller scale of the ravelling process was initiated. The objective is to zoom in and out on structural parameters keeping the position in the pavement as a link to the more general level. The two instruments developed are used to assess clogging and the microstructural condition of porous asphalt pavements in the Netherlands. The main objective is to have a look inside the porous pavement looking for microstructural effects of environmental causes of clogging, ravelling and deterioration.

The thin and plane section technique was developed at the Danish Road Institute in the early nineties, supported by the US Strategic Highway Research Programme. Plane and thin sections are slices cut from drill cores and impregnated with a clear or fluorescent epoxy resin, which allows air voids, cracks and binder structure to be visualized when illuminated with UV-light. It is possible to observe signs of aggregate degradation, homogeneity of mortar, adhe-

sion between aggregates and mortar, and location and size of cracks etc. CT – Computer Tomography scanning – creates a series of x-ray images that are taken in a cross section of a core of porous asphalt. A computer can subsequently calculate the relative density of the materials in the scanned cross-section and draw a two-dimensional picture of this. It is therefore possible to see and analyze volumes of aggregates, mortar and voids in three dimensions.

Two applications of the instruments are emphasized:

- Drill cores from highways A28 and A17 in the Netherlands and an urban street (Øster Søgade) in Copenhagen were assessed. The objective was to study the clogging of pavements of different ages in both the Netherlands and Denmark to be able to assess the effect of modifying cleaning processes to improve the acoustic lifetime of the pavements.
- Drill cores from sixteen road sections in the Netherlands with single-layer porous pavements of different age, performance and traffic was investigated. The objective was to understand the ravelling process from the microstructural condition of the bituminous mortar and the voids.

With the CT-scanner used in this study, it is not possible to distinguish clogging from the mortar, only the total content of mortar can be quantified and expresses the amount of clogging. From the clogging study it is observed that clogging is more pronounced in the older pavement and is concentrated between the wheel tracks in the slow lane (SL) and in the emergency lane (EM) (Figure 1). It should be noted that this observation is valid only for the two pavements studied and the difference may be caused by other factors than a general time-dependent clogging process.

In the thin section image (Figures 2 and 3) the voids (and exterior areas) are white, the mortar black with clear light grey sand particles and the aggregate greyish textured. The boundary between mortar and aggregate is clearly seen and clogging is identified as light grey porous accumulations of sand particles and fines. From the assessment of several thin sections it is possible to quantify the amount of clogging and the microstructural condition.

The hypotheses that the condition of the mortar gets poorer with age and that the condition close to the surface is poorer for poorly performing pavements is confirmed in the study. The content of small-size



Figure 2. Clogging in void at the surface of A17 km 20.930, emergency lane. Image size 10 mm wide by 5 mm high.

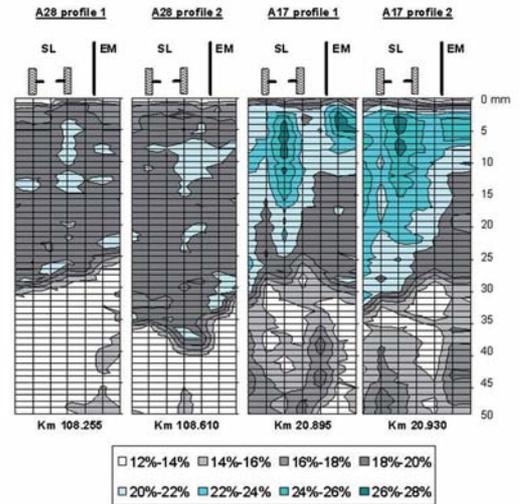


Figure 1. Clogging (mortar volume) of four road cross profiles on A28 (three year old) and A17 (eleven year old) two-layer porous asphalt pavement. Determined by CT-scanning of seven drill cores in each profile.

voids is significantly larger in the top zone for poorly performing roads and the mortar is less coherent. This indicates that voids have been formed due to deterioration of the mortar. This is visually observed on thin sections and considered an important deterioration mechanism. It is observed that clogging correlates with adhesion of the mortar to the aggregate which was not initially expected. This is probably due to the deterioration of the mortar which leaves clogging in the voids.

For further details please have a look at the report "Assessment of porous asphalt pavements – how to look inside" summarizing results from several studies. Reports from the study can be obtained from the Danish Road Institute at [www.roadinstitute.dk](http://www.roadinstitute.dk).

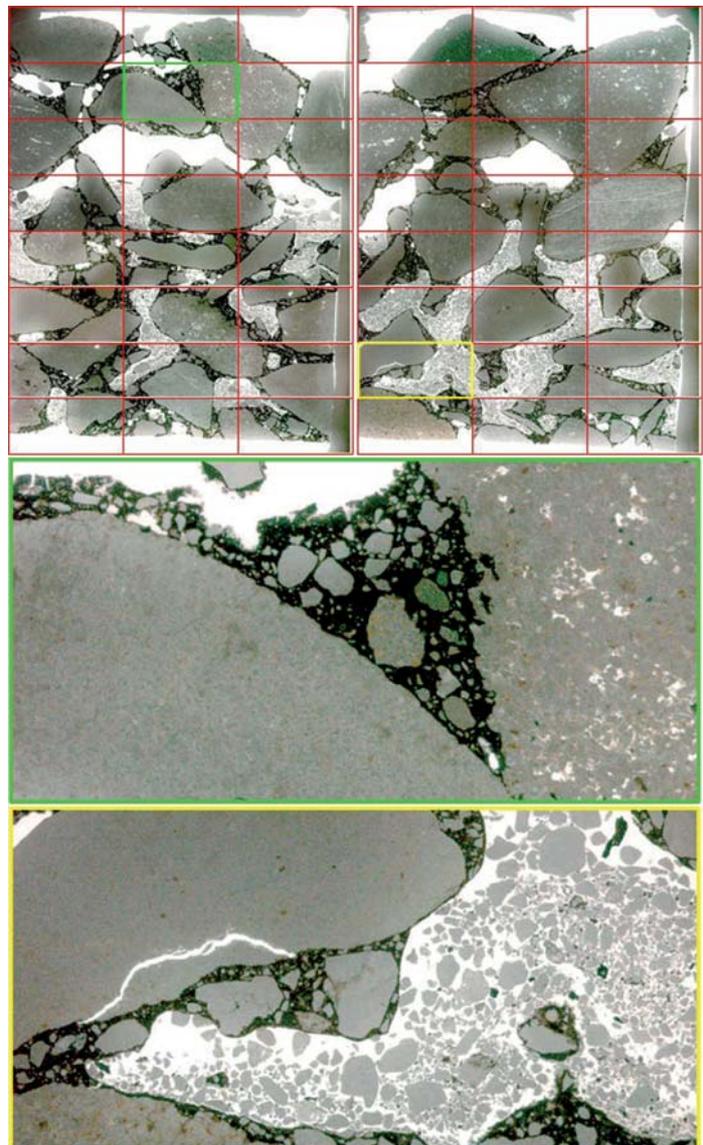
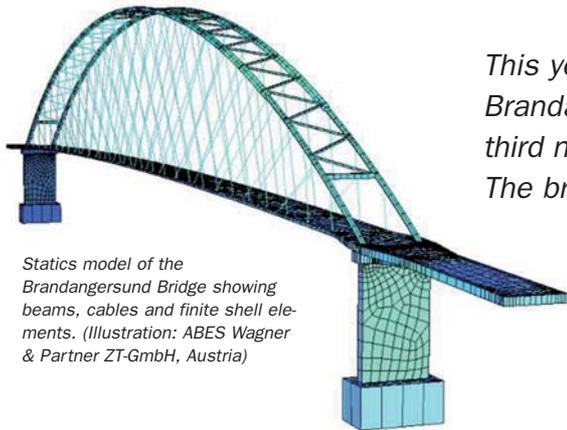


Figure 3. Thin sections (30 mm wide by 40 mm high) of a drill core from mix with poor adhesion. Detailed images (10 mm wide by 5 mm high) from top zone and bottom zone.

# The Brandangersund Bridge



Statics model of the Brandangersund Bridge showing beams, cables and finite shell elements. (Illustration: ABES Wagner & Partner ZT-GmbH, Austria)

*This year a rare network arch bridge will be constructed over the Brandanger strait (Brandangersund in Norwegian). This is the third network arch bridge out of total 17.000 bridges in Norway. The bridge over the Brandangersund will be completed in 2009.*



Monica Stacha

The Brandangersund is located in Western Norway, about 100 kilometres north of the city of Bergen. The strait separates the islands Sandøy, Mjømna and Birknesøy, with a population of about 500, from the mainland. Today Sandøya is connected to the road network by the Skipavik-Sløvåg-Leirvåg ferry. Skipavik, which is located on the island of Sandøy, will be dropped as port of call when the bridge is opened.

Network arch bridges are bridges with diagonal hangers which cross other hangers at least twice. The use of many diagonal hangers gives this type of bridge its characteristic appearance, and at the same time gives the bridge its effectiveness and its name.

The hanger arrangement is the heart of a network arch and constitutes the main difference to tied arches with vertical hangers. The longitudinal bending moments and shear forces are relatively large and decisive in tied arches with vertical hang-

ers. This is not the case for network arches owing to the fact that the hanger net acts more like a truss. In network arches axial forces are predominant in arch and tie for all load cases. The many diagonal hangers also effectively prevent the buckling in the plane of the arch.

The reduction of the local moments combined with a high buckling safety makes the forming of an extreme slender structure possible. These facts result in relatively considerable reductions of material in the upper and the lower cord of the bridge, which makes it very light compared to conventional arch bridges with vertical hangers. Comparisons with some conventional arch bridges show that reduced consumption of construction material up to 75 per cent is possible if the network arch bridge is optimally constructed.

The Brandangersund Bridge has a main span of 220 metres and two side spans of 30 metres and 35 metres. The chosen rise of the arch is approximately 33 metres. The lower cord will be formed as a narrow prestressed concrete deck. The arches are chosen as steel tubes with outer diameters of 711 millimetres and thicknesses between

30 millimetres and 40 millimetres. The number of hangers in each plane of the arch is chosen to be 44. Wind bracings between the arches give the out of plane stiffness.

Many corresponding bridges are built all over the world, but constructed with a single carriage way the Brandangersund Bridge is a special one. The lower cord has a width of only 7.6 metres and that makes the bridge an extremely slender construction. Buckling and wind analyses are therefore of great importance.

The network arch bridge over the Brandangersund will be the third bridge of this type constructed in Norway. The others are Håkkadal Bridge in Steinkjer (Mid Norway) with a span of 79.75 metres, and Bolstadstraumen Bridge in Vaksdal municipality in Hordaland (Western Norway) with a span of 83.7 metres. Both bridges were built in 1963.

More information about network arch bridges at:  
<http://pchome.grm.hia.no/~ptveit/>

# Tilting Trains – A Mature Technology

*Increasing competition by other modes is forcing railway companies all over the world to look for improved performance. Journey times are the most obvious performance indicator which can be improved by introducing high speed trains.*



Tarja Magnusson,  
VTI, Sweden

**T**rains with the ability to tilt the bodies inwards in curves are a less costly option for the development of trains that travel at high speeds than the construction of new lines with large radius curves which are needed for non-tilting high speed trains.

Today, tilting has become a mature technology which is accepted by most operators, but is preferred by few. There are several reasons for this; trains that do not tilt have increased their speed in curves, although with lower riding comfort as the result, which reduces the potential reduction in trip time by tilting trains to 10–15 per cent. Their popularity is also adversely affected by low reliability and motion sickness on certain tilting trains.

## **New top speed for tilting trains**

Tilting trains are now available from all the major train manufacturers. The top speed of tilting trains follows the trend towards higher speeds. The first tilting train with a top speed over 250 km/h, Shinkansen N700 in Japan, was put into service in 2007.

The track shift force can be critical for a high speed tilting train, and improved levels of track irregularities must be considered. Consideration must also be given to the risk of overturning, which may impose restrictions on the permissible cant deficiency at high speeds.



PHOTO: PHOTOS.COM

## **Motion sickness**

Motion sickness in trains with and without tilting is still being reported. The most common explanation for the occurrence of motion sickness is the sensory conflict. The most recent research proposes a model based on vertical acceleration as input data. This agrees well with various hypotheses regarding the occurrence of motion sickness and may, together with an appropriate time function, describe the degree of motion sickness as a function of time. The model, in contrast to earlier models, gives an optimum tilting angle equal to zero.

## **Trip time**

Trip time decreases with higher cant deficiency, top speed and traction performance, but there is little benefit from higher top speed and traction performance over a certain level. On the Swedish line between Stockholm and Göteborg, 15 minutes' trip time (9%) can be saved if cant deficiency, top

speed and traction performance are improved compared with existing tilting trains.

– One interesting conclusion is that a non-tilting train will, irrespective of cant deficiency, top speed and traction performance, have a longer trip time than the existing tilting trains with their cant deficiency, top speeds and traction performance, says Rickard Persson which has performed the VTI study concerning the present position of tilting trains.

The report also gives guidance for the installation of cant that optimizes the conflicting demands for good comfort in non-tilting trains and for low risk of motion sickness in tilting trains. This guidance is compared in the report with the real cant on the Stockholm-Göteborg line.

Title: Tilting trains. Description and analysis of the present situation. A literature study. VTI rapport 595A.

Author: Richard Persson, richard.persson@vti.se

# Recruitment for the Future

*Like many other countries, Norway is struggling with the recruitment in such subjects as science, mathematics and technology. The youngsters are consumers of a multitude of technological products, but they show little interest in contributing to further technological development by choosing an education within the technological disciplines. The decreasing number of young people who pursue a technical career is a matter of great concern for the authorities, politicians, and industrial as well as trade leaders.*



Runar Baune

Recently there have been a number of examples of privately sponsored school scientific programs where funds have been allocated for different activities. The sponsors want to appear as attractive as possible to the students, who hopefully will then choose the right education for the future. This article presents a program developed by the Norwegian Public Road Administration (NPRA) in cooperation with Hovseter lower secondary school in Oslo for youth 14–16 years of age. This is an example of the concept “Partnership School–Industry”. The conceptualization of this partnership was first introduced by Confederation of Norwegian Enterprises (CNE).

## **New National Curriculum**

The new National Curriculum (NC) (2006) introduces a brand new interdisciplinary topic named Technology and Design (T&D). The purpose of this subject is to increase the pupils’ interest in science and technology in our common compulsory education. From 1<sup>st</sup> to 10<sup>th</sup> grade the educa-

tional objectives are primarily formulated in the fields of science, mathematics, and arts and crafts. This is to enable the students the ability to find practical solutions to problems. One then hopes that the pupils will select a technical career by developing theoretical and practical skills in such areas as construction, electronics, mechanics etc.

## **Partnership School–Industry: An example**

CNE has developed a concept of partnership where a school and a company join efforts to develop an educational programme to provide the children knowledge of the company activities. The partnership: Hovseter School–NPRA is one example of partnership school–industry through which both Hovseter School and NPRA have developed a cooperation containing elements of interest. The school wants to carry out concepts and principals of the subjects in the T&D plan mentioned earlier, while NPRA is eager to recruit future employees in the technical areas through vocational training.

This special program implies working theoretically at school with a bridge case and a computing simulation program followed by a visit to one of NPRA construction

sites, in this case an immersed tunnel in Oslo harbour. During the program the pupils are informed about the progress made, and the technological and practical challenges the NPRA meets. For instance the pupils were informed that even archaeologists are involved in the work. They monitor the entrepreneur’s excavations in the harbour sediments which contain artefacts from earlier human activities and are prepared to stop the construction work if exceptional discoveries are made.

Another project is called “Concrete and mathematics”. The pupils mould concrete cubes at school and then tries to calculate ratios and percentages of cement and sand as well as the density of the material. Thereafter the class makes an excursion to the Concrete Laboratory of NPRA to confirm their estimations and get information of the quality of the material. Finally the concrete cubes are loaded into a hydraulic press where the pupils can watch the concrete cracking.

In both excursions the pupils are equipped with helmets, safety glasses and plastic gloves for their safety. Do they see a future engineer in the mirror?



*Pupils from Hovseter School concentrated on pouring concrete in moulds at the Concret Laboratory of the NPRA.*

PHOTO: NPRA

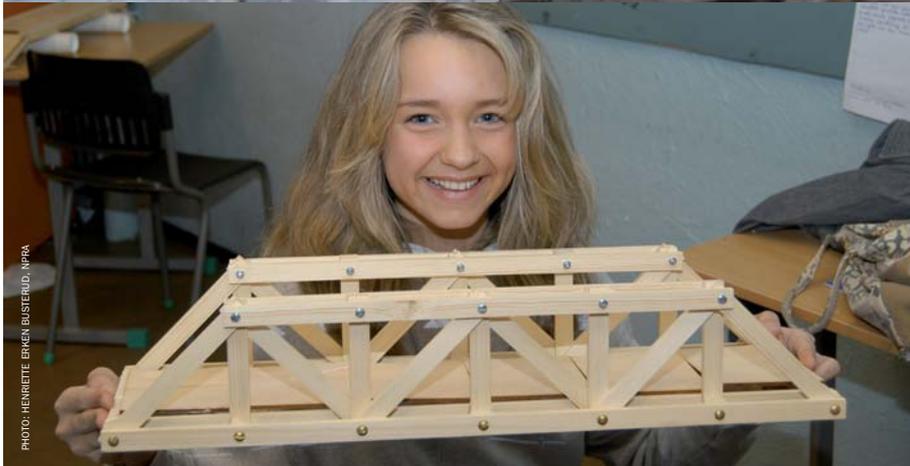


PHOTO: HENRIETTE ERKEN BUSTERUD, NPRA

*A proud bridge constructor at Hovseter School with a bridge made of the bridge modeling kit from the NPRA.*



PHOTO: RUMAR BAUNE, REMYTE

*Pupils enjoying themselves by load testing a truss bridge.*

### **Different approach to constructions**

An on screen bridge simulation program (West Point Bridge Designer – free on internet) is a popular method for achieving construction knowledge. The pupils produce their own bridges and test them after a 15 minute introduction. The computing program shows how tension and compression forces work together. If the structure fails the load test, the beams will change colour depending on the prevailing forces. In addition the price of the solution is calculated in US dollar.

NPRA has also produced bridge model

kits for youth in schools. The wooden kit contains materiel to build eight different types of bridge structures. By building model bridges the pupils learn to take into account forces which influence a construction.

Bridge construction with simple materials, like paper tubes, spaghetti, straws, etc. is soon to become a tradition in many schools in Norway. They are cheap to purchase and easy for the pupils to handle. A bridge made from paper tubes is also constructed by the pupils during their bridge project. In the end the bridges are hung from the ceiling as

a decoration in their classroom.

The partnership between Hovseter School and NPRA shows how this cooperation can give the pupils an idea of a works environment as well as information on education, health and safety etc.

What's in it for NPRA? – The possibility to recruit future employees.

More information at: To download bridge design simulation software, go to:  
<http://bridgecontest.usma.edu/> or  
<http://www.jhu.edu/virtlab/bridge/truss.htm>

# Model Analyses for the Combi Terminal Investigation

*The Swedish Government wants to stimulate intermodal transports. The National Rail Administration has therefore been commissioned to propose a strategic network for combi terminals intermodal road rail nodes.*



Tarja Magnusson,  
VTI, Sweden

**B**anverket, the Swedish Rail Administration, has, in turn, commissioned VTI to carry out model analyses as a basis for its work on combi terminals, referred to as the Combi Terminal Investigation. The analyses were carried out together with the Royal Institute of Technology (KTH).

The Combi Terminal Investigation has defined three strategic networks with four, seven and ten terminals as development scenarios: Network I, II and III. In these networks the transfer costs are assumed to decrease by 15 and 30 per cent respectively.

With the help of the national freight transport model Samgods, VTI has calculated how the ton km performed by road and rail (wagon load and combi are specified respectively) are affected and how the quantities transported as combi transports develop when transfer costs in combi terminals change. In the model, it is assumed that freight transport customers make their choice of mode and route in such a way that the generalised transport costs are minimized. The term generalised costs refers to the sum of operational transport costs and the value of time for the cargo.

It is calculated in the study that combi transport in Sweden increases by nine to twelve per cent (ca 500 million ton km) if a 15 per cent cost reduction is assumed. For a



PHOTO: VTI/HEIDUSA BILDER

30 percent cost reduction, combi increases by 20–26 per cent (about 1.100 million ton km).

It is estimated that redistribution will occur mainly from wagon load to combi. The magnitude of this effect is, however, uncertain due to uncertainty in rail transport costs. The decrease in road transport is estimated to be much lower. However, it is calculated that significant transfers from road to combi take place when a kilometer charge is introduced for heavy road traffic.

It is estimated that a 30 per cent cost reduction for the four combi terminals prioritized in Network I results in 29.6 per cent more TEU (Twenty-foot Equivalent Units) overall. The additional three terminals in Network II are not estimated to bring in many TEU compared with Network I because relatively small centrally located terminals are added. The further three terminals in Network III are estima-

ted to increase the total sum of TEU since they do not compete equally clearly with nearby terminals (as the terminals added in Network II).

Alternative solutions, for example with several terminals, are conceivable, and it is not impossible that these would have a greater effect on the development of combi transport than the setup investigated in the study. A complete comparison of different networks would require information about the investments etc. that are needed to reduce the transfer costs in the combi terminals and consideration of the time in terminals.

**Contact:** Inge Vierth, [inge.vierth@vti.se](mailto:inge.vierth@vti.se)

**Title:** Model simulations to aid the Combi Terminal Investigation. VTI rapport 592

**Authors:** Inge Vierth, John McDaniel and Gerhard Troche

# Report from The Danish Infrastructure Commission: The Danish Transport Infrastructure 2030



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*The Danish Infrastructure Commission published in January 2008 its long awaited report “The Danish Transport Infrastructure 2030.” The commission was appointed by the Danish government in November 2006 to analyze how Denmark can maintain and develop its position as one of the countries in the world with the best transport systems.*

**T**he Infrastructure Commission was given the following main tasks:

- To analyse and assess the key challenges and development potential for the infrastructure and national traffic investments until 2030.
- To identify and assess the strategic options and priorities and to put forward suggestions to strengthen the basis for the national investment decisions in the transport area.

The commission has mainly focused on the national road and rail infrastructure, which is managed by the national government and for which parliament makes decisions through legislation and the annual financial budgets.

## **Increasing traffic growth and congestion problems**

Denmark has long been renowned for having a transport system of high international standard. However, during the past decade central parts of the road and rail network have been experiencing growing capacity and congestion problems, especially during gradually widening peak hours. On the national road network the problems are most serious in the Copenhagen region and in eastern Jutland especially in the Triangle Region: Kolding–Vejle–Frede-

ricia. On the rail network capacity problems have made it difficult to provide more train services on several central rail lines.

Forecasts published by the Commission show that by 2030, traffic on the national road network is expected to increase by nearly 70 percent. This corresponds to an average annual growth rate of 2.2 percent. This growth will create critical congestion problems on major parts of the motorway network in Denmark and feeder routes as well.

With regards to the rail network forecasts show only a minor increase in the demand for rail services. However, the forecast does not assume any improvements of traffic services, which have been an important factor in the growth in train

traffic in the past decades. An analysis by the Danish Ministry of Transport, which includes the effects of new services, predicts a growth in traffic of 34 percent for commuter trains and regional trains for the period 2004–2020.

The increasing demand for mobility raises not only challenges concerning planning and development of the future infrastructure in Denmark, but at the same time poses major climate and environmental challenges, which must also be tackled.

## **“The Robust H” is essential for continued economic growth**

For many years, the Danish national infrastructure has been developed around the vision of “The Big H”, comprised of major road and railway corridors tying Denmark together from north to south and from east to west – and furthermore providing efficient links to neighbouring countries.

The Commission recommends that The Big H continues to form the backbone of the Danish transport infrastructure, but points out that that The Big H must be strengthened and consolidated to accommodate the growing transport demand. The Big H plays not only a vital roll for national and international transport in Denmark, but also for the economic development and growth in Denmark’s two major metropolitan areas: the Copenhagen region and eastern Jutland.

Capacity must be expanded in a number



of the corridors and hubs where steady increases in traffic are expected. At several locations new fixed links must be considered. Public transport services must be improved and existing road capacity can be utilized better through the help of ITS. The Commission emphasizes that continued economic growth and the competitiveness of Danish industry is dependent on that The Big H also becomes "The Robust H".

#### The Commission's recommendations

The Commission recommends that efforts are concentrated within the following six focus areas:

- A number of ring connections on the road and train network in the Copenhagen area are to be completed
- A complete plan for the development of the infrastructure in the urban region of

East Jutland must be prepared

- Efficient secondary links from the different regions to the main transport corridors and hubs must be ensured
- The Danish gateways towards the rest of the world must form a central part of an effective transport network
- Intelligent technological solutions must ensure optimal utilisation of the infrastructure
- The effort to limit the impact of transport on the environment and the climate must be intensified.

Furthermore the Commission recommends that the following basic principles underlie cross-disciplinary efforts:

- Investments are prioritised on the basis of the highest socio-economic returns
- The necessary maintenance of infrastructure is ensured
- The private sector should to a larger

degree be involved in connection with the organisation and management of construction projects (private-public partnerships)

- Physical planning, including urban and commercial development, is coordinated with the infrastructure planning through an overall coherent planning
- Need for further focus on improvement of road safety.

The Commission's report and recommendations are expected to be reflected in a forthcoming governmental "Traffic Investment Plan", which is expected to be ready for political negotiations in the autumn of 2008. The investment plan will be accompanied by a strategy plan for reducing carbon dioxide emissions from the transport sector.

## WHAT'S UP IN THE NORDIC COUNTRIES?

### NORWAY

#### Winter days 2008

The network for winter maintenance sector and the Norwegian Public Roads Administration (NPRA) arranged their first conference for winter maintenance 28–31 January 2008 at Beitostølen, a mountain region in southern Norway.

More than 400 persons participated in the conference. Local governments, Avinor, the Norwegian Armed Forces, equipment suppliers, students and NPRA were represented. The Minister of Transport, Liv Signe Navarsete, also visited the conference.

The conference included lectures, demonstrations and exhibitions.



PHOTO: ANDERS SVANEKIL, NPRA

There were 31 different companies who exhibited their products. The demonstrations were conducted over two days. Rotary ploughs, snowploughs, ice removers, warm wetted sand and friction measurement equipment were demonstrated. The weather and snow conditions were great.

### FINLAND

#### The Via Nordica 2008 congress

Long distances, four seasons and unpredictable weather conditions are all typical features of Northern Europe. The Nordic countries are well known for having a high standard of living, competitive industrial production as well as being at the forefront of innovation in many scientific and technological areas. All this calls for a safe, durable and under all circumstances well-functioning road and transport infrastructure. This cannot be achieved without a high level of competence in research and development as well as an effective utilization of innovations within both traditional and modern technologies. This entails both strong regional cooperation within the Nordic countries and interaction with the wider world.

Via Nordica 2008 offers experts and others within the field an excellent opportunity to share ideas, learn from one another and establish fruitful contacts. The slogan of this congress is Via Nordica – the Road Ahead. It focuses on the challenges of the future and the solutions that must be created to meet them.

The congress is also open for experts outside the Nordic countries, experts who would like to share the Nordic experiences and bring a valuable and welcomed international element to this Nordic event. The exhibition has participants from both within and outside the Nordic countries.

The Via Nordica 2008 congress is the 20<sup>th</sup> Nordic Road Congress arranged by the Nordic Road Association. The congress takes place 9–11 June 2008 in Helsinki, Finland.

For more information:  
[www.vianordica2008.fi](http://www.vianordica2008.fi)

VIA NORDICA 2008



## Noise Classification – Asphalt Pavement

**Title:** Noise Classification – Asphalt Pavement  
**Author:** Jørgen Kragh  
**Series:** Technical Note 61  
**Language:** English  
**Available at:** [www.nordicroads.com/reports](http://www.nordicroads.com/reports)  
**name:** Noise Classification

Traffic noise is a problem for the health and well-being of people in modern society and it has during recent years attracted growing attention in Denmark. The effects of this important type of noise can be mitigated by means of noise barriers or screens but it can also be attenuated directly at the source by applying a noise reducing wearing course. Danish road authorities in conjunction with industry and consultants have worked out a system for the specification and documentation of noise reducing asphalt pavement. The system is based on the Close Proximity Method (CPX) and encompasses

- a guide to the use of asphalt pavement in traffic noise abatement
- a system for the documentation and declaration in classes of the noise reduction of the asphalt surfacing
- three classes A, B and C, where class A pavements exhibit the highest noise reducing effect and class B and C exhibit lower noise reducing effects as compared to regular dense graded asphalt pavements
- reference values of the noise emission as determined by the CPX method
- description of the CPX method including the definition of method variables and requirements on supplementary calibration of the measuring device
- paradigm for use in contracting and preparation of tender documents.

The system is a first attempt in Denmark for contracting noise reducing asphalt surfacings. The system has some limitations and several subjects need to be addressed in the future development of the system.

Especially there is a need for better knowledge on the accuracy offered by the CPX method, and for the development of appropriate acceptance criteria to be used in contracting.

## Effect of Intensified Automatic Speed Control and Decreased Tolerance on Traffic Safety

**Title:** Effect of intensified automatic speed control and decreased tolerance on traffic safety  
**Author:** Riikka Rajamäki and Mikko Malmivuo  
**Series:** LINTU Reports 1/2008  
**Language:** Finnish with English abstract  
**Available at:** [www.nordicroads.com/reports](http://www.nordicroads.com/reports)  
**name:** Automatic Speed Control

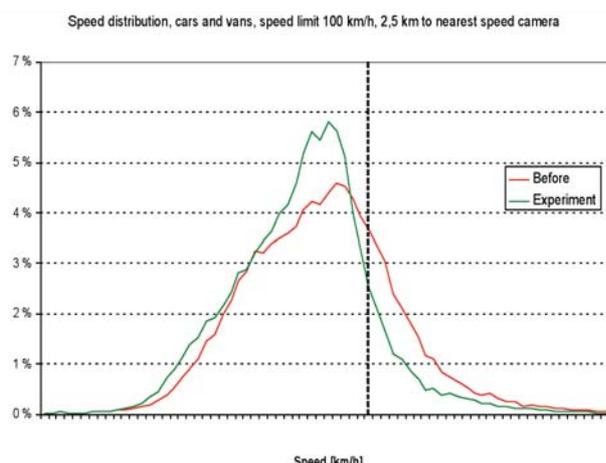
A 43 kilometres long automatic speed control area has been implemented on main road 51 west of Helsinki. In September 2007, intensified automatic speed control was tested along this section. During this phase the number of monitored hours was strongly increased, all speeding incidents were reacted to, and the public was extensively informed about the scheme. The current survey examined the effect of intensified control on traffic behaviour, the number of violations to process, and police workload.

As a result of the intensified control and the lowered penal threshold, the average speed of the traffic decreased by 3–4 kilometres per hour at various measurement points. Later, speeds slightly increased: the long-term effect is thus estimated to be 2–3 kilometres per hour. During the survey, the share of both major (more than 20 km/h) and minor speeding dropped to half, and at some measuring points to a third. The traffic speed distribution became narrower, and the distance between vehicles grew slightly. The share of drivers driving fairly slowly or very slowly (more than 10

km/h below the speed limit) increased a little, but the numbers were still so low that they should have no significant effect on the general fluency of the traffic.

During the intensified control experiment, the cameras picked up 3.4 per cent of the traffic volume as speeding, compared to approximately 10 per cent at other times. 0.4 per cent of the traffic volume drove at a significant (more than 10 km/h) overspeed, the normal share being approximately 3 per cent. Based on the observed change in average speeds it was estimated that in addition to the effect of previous automatic speed control, intensified automatic control decreases the number of accidents leading to personal injuries by approximately 7 per cent, and the number of lethal accidents by 13 per cent.

The intensified control of a 43 kilometre road section required the work of 4–6 people. If it were assumed that the results of the survey could be applied as such to the entire 2 000 km road network currently under automatic control, the intensified automatic control would save tax payers approximately EUR 13 million, including savings from fewer accidents. This calculation does not include the annual income of more than EUR 40 million from fines resulting from intensified control since, in a socio-economic sense, fines are not considered a saving but an income transfer.



## The Safety of Trams – Methods for Collision Prevention in Tram Traffic

**Title:** The safety of trams – methods for lowering the probability of certain types of collisions in tram traffic  
**Authors:** Ragnar Hedström and Sven Fredén  
**Series:** VTI rapport 603  
**Language:** Swedish with an English summary  
**Available at:** [www.nordicroads.com/reports](http://www.nordicroads.com/reports),  
**name:** Safety of trams

Tram traffic and road traffic are two transport systems which must operate in the street zone under conditions that are to some extent dissimilar, and this can result in conflicts and accidents. The most common accident in tram traffic is a collision between a tram and a road vehicle, but collisions also occur between trams. In most cases there are no injuries, or very slight ones, but the cost of repairing the material damage and providing replacement traffic is often quite high.

The external environment in cities with tram traffic is often complex with a large quantity of information that must be interpreted and evaluated by the other groups of road users. The tram often approaches from the rear, and conflicts occur when a car turns to the left in order to cross the tram line. The frequency and magnitude of tram accidents are associated with the safety measures that have been introduced, e.g. various types of light signals, road signs, markings on the street surface, etc., but also with the behaviour and attitudes of other groups of road users. It is therefore important that the traffic environment should be dealt with in a holistic perspective which takes account of the different groups of road users.

By designing a traffic environment that is clear, easy to understand and to interpret, the number of conflict situations can probably be reduced. Where tram traffic is introduced in an existing urban environment, finding solutions that will be entirely conflict-free may be difficult. When arran-

gements are to be made for the provision of tram traffic and road traffic in new areas of a city, it should be easier to find "good" solutions.

The ideas and judgments set out in the report may be summarised in the following conclusions:

- In-depth cooperation among traffic planners, urban planners and behavioural scientists would be of great importance in designing safe and functional traffic environments where both tram traffic and road traffic operate at the same time.
- Where tram traffic and road traffic operate at the same time, warning devices and safety installations must be designed so that they give clear and understandable signals as to what applies in which situation.
- The external design of trams should be discussed from a safety perspective and not, to such a large extent, from an aesthetic perspective that is often the case at present. In view of the design knowledge of today, it should be possible to create a vehicle that can be easily perceived and interpreted by other road users.

It is considered that an in-depth discussion among the authorities and organisations that, to various extents, are involved with the safety issues of tram traffic is urgently necessary. In this way, the conditions can be created for a uniform terminology and a more robust cooperation that can, in the long term, further improve and develop the approach to tram safety.



PHOTO: RAGNAR HEDSTRÖM, VTI

The report also discusses the problem concerning collisions between trams. This type of accident can be prevented with systems associated with the infrastructure or via in-vehicle systems.

## Driver Distraction

**Title:** Driver distraction. A review of the literature  
**Author:** Katja Kircher  
**Series:** VTI rapport 594A  
**Language:** English  
**Available at:** [www.nordicroads.com/reports](http://www.nordicroads.com/reports),  
**name:** Driver distraction

A multitude of methods has been used to assess the prevalence and the types of driver distraction that occur, and to describe the consequences in terms of driving performance and crash involvement. There is strong agreement that distraction is detrimental for driving, and that the risk for crashes increases with it. Only recently the method of remote eye tracking has emerged, which enables real time identification of visual distraction. So far this method has mostly been used in driving simulators, and different algorithms that diagnose distracted drivers have been tested with promising results.

Earlier research has shown that eye glances away from the road rarely exceed the duration of 2 seconds. Most "normal" glances range from about 0.7 seconds to slightly above 1 second. In general, drivers rather opt for repeated glances instead of extending one single glance, if the secondary task demands attention for a longer period of time. It has been shown, however, that repeated glances have more detrimental effects on driving performance than a single glance of the same duration as one of the repeated glances. Apparently the drivers look away from the forward roadway again before they are completely back "in the loop". Consequently, most algorithms that diagnose driver distraction based on glance behaviour do not only consider the most recent glance, but take the recent glance history into account.



PHOTO: WI/FEDD SOOST

Some distraction mitigation strategies have been tested in driving simulators. The drivers were either advised to look back at the road, or the interaction with the secondary task was terminated by the system. The results of those studies were mixed, and it could not clearly be shown that the countermeasures tested improved driving performance. It has to be noted, however, that the results stem from driving simulator experiments, during which distraction was induced artificially. It is recommended to test both the algorithms used to diagnose driver distraction and the countermeasures in the field with naturalistic distraction.

### ITS in Passenger Cars and Methods of Traffic Safety Impact Assessment

**Title:** Intelligent Transport Systems (ITS) in passenger cars and methods for assessment of traffic safety impact. A literature review  
**Authors:** Astrid Linder, Albert Kircher, Anna Vadeby and Sara Nygårdhs  
**Series:** VTI rapport 604A  
**Language:** English  
**Available at:** [www.nordicroads.com/reports](http://www.nordicroads.com/reports),  
**name:** ITS in passenger cars

The background of this study is that many so called Intelligent Transport Systems (ITS) are currently developed and introduced

in passenger vehicles aiming at providing increased traffic safety. This provides a need to assess and evaluate the traffic safety effect of these systems. This report highlights how the effects of these systems on traffic safety are evaluated and gives a review of some ITS which currently can be found in the car fleet. The technical systems described in the report were selected on the basis of that they should be “technically complicated” meaning that they have a potential to improve traffic safety by reducing the number of crashes or by reducing the crash severity, and also be available in the production of vehicles.

In the report 20 systems or groups of systems are described. The report contains a description of the background of why and how the systems have been developed, in which vehicles they can be found as well as details about suppliers when applicable, a short technical description about how the system works, publication of traffic safety effects when such have been found in the literature, and future development plans. On the topic of statistical methods an overview of how they work and the results that have been published using these methods on ITS, are described. In addition, the report contains a chapter consisting of a summary of ways of assessing safety effects of new products or methods from other areas such as food, nuclear power and pharmaceutical industries.

The conclusion of the review is that many intelligent systems that aim at supporting the driver in driving in a safe way have been developed and more will be developed. Many systems that could improve traffic safety are labelled as comfort or driver support systems. There are currently many different ways of supporting the driver in the task of driving the vehicle without becoming involved in a crash. Regarding the estimated and achieved impact on traffic safety from these systems it is still in many respects an open question which evaluation methods to use.

### Benefits of Meteorological Services in Croatia

**Title:** Benefits of meteorological services in Croatia  
**Authors:** Pekka Leviäkangas, Raine Hautala, Jukka Räsänen, Risto Öörni, Sanna Sonninen, Martti Hekkanen, Mikael Ohlström, Ari Venäläinen & Seppo Saku  
**Series:** VTT Research Notes 2420  
**Language:** English  
**Available at:** [www.nordicroads.com/reports](http://www.nordicroads.com/reports)  
**name:** Meteorological Services

This research report looks into the benefits of hydrological and meteorological information services in Croatia. The benefits generated by the day-to-day services were investigated by the beneficiary sector. Each sector was studied by different researchers. The methods used were multiple: literature reviews and statistics, expert interviews and workshops, and analytical, conceptual and qualitative model building and modelling of expected impacts. Assuming that the annual budget of DHMZ (Croatian Meteorological and Hydrological Service) is about 8 million euros per year, this study concludes that the services delivered by DHMZ pay themselves back at least three-fold each year. Taking into account all the excluded sectors, it is further concluded that the factual ratio is even higher. The results seem to be in line with other research results. By improving the services, especially their delivery, substantial additional benefits can be generated, justifying the investments in improving hydrological and meteorological services.

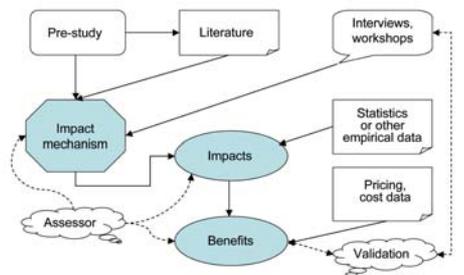


Figure. A meta-method description

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