Road safety, public transportation and international cooperation

The future has a Nordic flavour
**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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EPAM 2012 - Meet the challenges of road infrastructure asset management

The effects of increasing traffic, climate change and need of safety as well as the need of well-being have to be met by even more effective road management. A holistic approach covering a lifetime view of road keeping (e.g. LCA) and preserving the assets is essential. The challenge Europe is facing is to use environmentally friendly materials and technologies providing a sustainable and safe road infrastructure system.

The EPAM 2012 conference will cover all aspects of the road infrastructure including the sub-assets pavements, engineering structures and road furniture and equipment. Papers are expected for the following conference objectives:

- User expectations on road condition
- Innovative asset management contracting (PPF, BOT, etc.)
- Cross asset management (combining sub-assets)
- Innovative design and maintenance techniques
- Long-life-pavements and engineering structures
- Sustainable maintenance strategies
- Decision tools and systems
- Performance prediction
- Life-cycle-modeling (LCC, LCA, etc.)
- Maintenance backlog versus funding
- New technologies for asset monitoring and data acquisition
- Management solutions for secondary networks
- Impact of climate change on asset management
- European harmonization and research activities
- Case studies and experiences from implementation

Time schedule

- January 2011: Announcement and call for abstracts
- 1 June 2011: Deadline submission of abstracts
- 1 September 2011: Notification to authors
- 1 February 2012: Deadline submission of papers
- 1 May 2012: Notification to authors
- 15 May 2012: Preliminary program on website, registration opens
- 1 August 2012: Final program
- 5-7 September 2012: Conference

The 4th EPAM, European Pavement and Asset Management Conference, will be arranged in Malmö, Sweden, 5–7 September 2012 by VTI, The Swedish National Road and Transport Research Institute. For more information visit www.vti.se/EPAM4 or contact epam4@vti.se.

Correction in Nordic No. 1 2010

The article entitled Persuade – a New EU Noise Project inadvertently contained a number of errors regarding the authors’ names. From the Danish Road Directorate, Tine Damkjær was mistakenly named as one of the authors, instead of Emine Celik Christensen. From VTI in Sweden Ulf Sandberg is participating in the project.

How to succeed with your road safety campaign

There is great room for improvement when it comes to designing campaigns intended to change people’s behaviour. This is proved by the now concluded research project CAST, which stands for Campaigns and Awareness-raising Strategies in Traffic Safety. The study has among other things resulted in two books about road safety campaigns. These can now be ordered.

The books give both a theoretical review of road safety campaigns based on a number of European examples that have been studied, and guidance for designing a campaign. The books can be downloaded free of charge from the CAST website, see below.

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The 4th international conference on geofoam (EPS) blocks in construction applications

Using geofoam blocks as a lightweight fill material has become a competitive method globally in constructing roads and railways and other structures on steep slopes or on soft ground in order to solve bearing capacity, horizontal pressure and settlement problems. In some cases it even provides the only solution. As the idea has spread across the globe, more applications have developed like solutions related to seismic hazards, protecting structures from rockfall hazards etc.

Previously three international conferences have been arranged on this subject, Oslo 1985, Tokyo 1996, and Salt Lake City 2001. The 4th International Conference on Geofoam (EPS) Blocks in Construction Applications will take place at Thon Hotel Arena, Lillestrøm, Norway from the 6th to the 8th of June next year organized by the Norwegian Public Roads Administration and Tekna.

DVS-DRI Super quiet traffic

International search for pavement providing 10 dB noise reduction

The Dutch Centre for Transport and Navigation (DVS) and the Danish Road Institute/Road Directorate (DRI) have carried out a joint project to clarify available pavement solutions yielding 10 dB of traffic noise reduction when applied on high speed roads. DVS-DRI invited the Swedish National Road and Transport Research Institute (VTI) also to take part in the project.

VTI to participate in three new European research projects

VTI will be participating in three research projects that have recently been granted funding within the European collaborative consortium ERA-NET ROAD. The first project began during the summer and all three will run for two years.

In ERA-NET ROAD, 11 national road administrations collaborate to promote, develop and facilitate collaborative research by programming, financing and procuring transnational road research.

Road condition status

VTI is coordinating the Heroad (Holistic evaluation of road assessment) project. The project will begin in January 2011 and will compile different countries’ ways of describing the condition of their roads. It will look at the factors that are used in the descriptions, what goals there are and if they can be valued. This will among other things involve investigating pavement, road structures, road equipment, environmental impact and how these affect climate change, increased traffic loads and new materials. How the various elements can be combined in a common value assessment will also be described. The project budget is approximately SEK 4.5 million.

Methods for road managers to handle road-users’ views

Autumn 2010 will see the start of Expect, (Stakeholder expectations and perceptions of the future road transport system). This project will develop methods that road managers can use to handle road-users’ views concerning the road network’s condition when planning and taking decisions. The project budget is approximately SEK 4 million.

Road objects, road equipment, maintenance planning, operation contracts and links to strategies

Ascam, (Asset service condition assessment methodology) will give a picture of the whole chain of road objects and road equipment, maintenance planning and operation contracts and how these are linked to strategies. The project has a budget of approximately SEK 3.6 million and is being coordinated by TNO, Netherlands Organisation for Applied Scientific Research.

Friction insights … when tyres meet ice on the road

When driving a car, we rely on the friction created between the tyres and the road. We need this friction for accelerating, braking and steering. During winter time, motorists in the Nordic countries are likely to encounter snow or ice on the road. As this reduces the available friction level significantly, it is important to have a proper understanding of tyre-ice friction. Recent studies on ice friction give some new insights into how friction is created.

Friction is the result of a complex interaction between the rubber tyre, the pavement, other substances present in the contact area (such as snow, ice, water, sand, or dust), and finally the air layer in which the interaction takes place. There are many processes occurring simultaneously which all constitute the total friction force. Indeed, the complexity of tyre-pavement friction can be overwhelming. Although the tyre is in continuous contact with the road, a fixed point on the road is only in contact for a few milliseconds, depending on the speed of travel. What happens in this split second, in a contact area of less than 0.25 m², determines whether or not we can make that turn safely.

The friction of materials on ice is a heavily debated issue in the scientific literature. For more than 50 years it has been widely accepted that ice sliding friction is governed by the formation of a thin meltwater layer that lubricates the contact area. The reason is that in most practical situations, the ice is very close to its melting point. Heat that is produced during friction is sufficient to melt a fraction of the ice surface. More recent research in surface physics has yielded the insight that melting actually starts already many degrees before the melting point is reached. During this pre-melting phase, the molecules at the surface are becoming more active and start to behave more like a viscous fluid.

Much remains to be learned about ice friction. What has been poorly recognised is that when a material is very close to the melting point, it deforms much more easily. This means that although the tyres are in contact with the ice for only a few milliseconds, this is actually long enough to cause deformation within the ice. This was revealed in both field and laboratory studies performed in Norway. Ice surfaces were investigated by etching and replicating after having been subjected to sliding friction. This is a special technique used to analyse ice surfaces in great detail. It was found that after passage of the tyre, the surface was full of small scratch marks. These scratch marks also occurred at near-melting conditions. So the ice itself was deformed even when it was likely that a lubricating water film was present. A material will always resist being deformed; this is one of the fundamental origins of the friction force.

These observations give new insights into how friction is created and suggest that the contamination of the tyre with small particles such as road dust plays an important role in determining the level of available friction.

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Research to cut collisions with wild animals

Collisions with wild animals are increasing every year and cause fatalities, physical injury and expensive damage. A number of research projects on collisions with wild animals are currently under way at VTI. The aim of the projects is to determine if for example changes in the road environment can reduce the number of collisions.

VTI is investigating various aspects of collisions with wild animals in three separate projects. One is looking at changes in the road environment as a way of preventing accidents. Such changes might for example include clearing vegetation or finding plants that act as deterrents to wildlife. In addition to changes in the road environment, the project is also studying how people and animals behave when they meet on the road and what happens to a car in a collision with an elk.

A collision with an elk often causes extensive damage, but this will naturally vary depending on speed and car model. - The elk problem is not unique to Sweden, but exists in the whole of Scandinavia and also in the northern USA, Canada and Russia, says Tomas Karlsson at VTI. Australia and Arab countries have similar problems with other animals.

By running into VTI’s dummy elk with a modern car at two different speeds, comparisons can be made to investigate the effect of speed. This will hopefully increase awareness in society of the importance of keeping to the right speed. The project may perhaps also contribute to the development of a classification of which cars are the safest in a collision with an elk.

Real accidents are studied in the investigation of people’s and wild animals’ behaviour. VTI also simulates accident situations and tests possible measures in the field. The simulator study is also investigating the driver’s reaction to wildlife warning signs and environments where elks occur. The simulator environment also makes it possible to test which support systems are most effective for avoiding collisions with animals.

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The future has a Nordic flavour

The Nordic road administrations have many common challenges. History has shown that it is a good idea to deal with these challenges together through joint projects, because it gives more value for research funds. It also makes it possible for the most highly qualified staff across national borders to work together. Thus NordFoU, Nordic R&D, was formed. This has been proven to be rather successful.

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In order to see the full article, please go to www.nordicroads.com.

Road traffic noise research - the European needs

A new report has been published by the Conference of European Directors of Roads (CEDR). The report describes the results provided by a survey on knowledge gaps in noise assessment and abatement techniques as seen by the national road administrations in Europe. The survey was conducted by the noise group established under CEDR. The status on the need for noise research within Europe was investigated by sending a questionnaire to twenty five national road administrations in Europe which all are CEDR members. The questionnaire aimed to find out priority themes common to the European countries and to identify a shared approach to the noise problem to promote national and joint future research projects. As many as seventeen countries responded.

The questionnaire included fourteen main thematic domains based on recent publications on research visions and scientific articles on specific subjects related. Each thematic domain comprises a group of subjects connected to the particular domain. In order to identify the items that require in-depth study, research and development, a priority value was to be assigned to the domains and items. The top five road noise research themes are prioritised in the following:

1. Rolling noise (noise reducing pavements and tyres)
2. Advanced noise reduction technologies between source and receivers (improved noise barriers)
3. Improved regulations related to noise emission from vehicles and tyres (including test methods) and noise control management
4. Traffic management (traffic flow, speed, ITS etc.)
5. Improved or new socio-economic instruments to promote efficient noise abatement (tools to integrate noise in road, traffic and urban planning)

In particular, the priority list reconfirms the common opinion that noise must be reduced first at source (rolling noise) and then by using barriers between source and receivers. The questionnaire on knowledge gaps has been produced by Patrizia Bellucci from ANAS S.p.A Centro Sperimentale Stradale in Italy who has also drafted the report on the results with input from many road administrations in Europe.

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Technology behind technology

Carson City is a new test laboratory where active safety systems can be tested in as realistic a traffic environment as possible. This "city" represents a lot of work, and VTI has had an important part in its development.

On the streets of Carson City, pedestrian dummies walk about and automated soft balloon cars drive on them. In this new test facility, different critical situations in conjunction with driving in an urban environment can be evaluated in a safe and realistic way. The road to Autoliv’s Carson City has been long, and VTI has played an important role in this journey.

Driving robot

As early as 2004, VTI developed a driving robot to drive a bus into a road barrier.

In 2007, in collaboration with Autoliv, VTI began further development of the system with brake and accelerator so that, among other facilities, two cars could be manoeuvred into a frontal collision.

The most important and perhaps the greatest challenge was to develop a function for synchronising two or more vehicles, i.e. to get two vehicles to be at a certain place at a certain time. The solution we developed was to fit all the robots involved with a GPS clock to which every robot sets its clock when the test commences. This provides very high accuracy at the point of collision.

Soft balloon cars

For the development of active safety systems for cars, safe methods and equipment are needed. VTI was therefore involved in starting the project Scenario Based Testing of Pre-Crash Systems.

The project focused on systems that actively brake or issue a warning when a vehicle or some other object is in the risk zone in front of the vehicle. These systems use radar, vision and laser to detect objects in their surroundings. In this type of test it is necessary to make large series of tests - in view of this, collisions cannot take place between real cars as this would be both expensive and difficult. Soft balloon cars are instead used as target vehicles. These can stand up to repeated collisions without being destroyed.

Balloon cars are nothing new in this type of tests, but what was needed was an autonomous balloon car, i.e. a robot driven balloon car. In these tests it is essential to be able to determine the positions of vehicles and also to measure the relative distance. In view of this, the existing robot systems of VTI and Autoliv were highly suitable since they already have positional accuracy.

The already developed driving robots had good positional accuracy, the difference now was that it was necessary to develop a driving system for moving the balloon car. Another requirement was that the balloon car was not to weigh more than 50 kilograms. If it is heavier, this may be dangerous for the driver of the test vehicle.

The result is a balloon car that is driven by an electric motor from a model plane and a position sensor that measures the distance it travels along a rail. The motor and driving wheel of the car are situated in the middle of the vehicle. Today, the balloon car has the same precision as the driving robots, but those involved in the project already see new possibilities in the rapid development in e.g. the field of GPS technology.

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A survey on the costs of logistics in Norwegian manufacturing and wholesale trade shows logistics costs that on average constitute 14.2 percent of the turnover. The cost share is 16.7 percent of turnover for the wholesalers and 13.7 percent of turnover for the manufacturing industries. The building and construction industry have the lowest logistics cost share in the survey.

**Drawback of distance**

One of the main goals in the Norwegian communication and transport policy is to reduce the drawback of distance. Norway is located in the periphery of Europe, far away from the main marketplaces. The drawback of geography enhances the importance of cost efficient logistics. Norwegian exports are to a large extent raw materials and semifinished products. This means that Norwegian companies are often parts of a bigger supply chain. The relative cost level in Norway compared to other countries is high, giving Norwegian export industry a drawback in the price competition. These are factors that underline the importance of a cost efficient logistics operation in Norwegian export industry.

**Transportation the largest component**

The survey was conducted during the fall of 2008. The survey shows that the costs of logistics constitute on average 14.2 percent of the turnover. The costs of transportation represent the largest cost component, about 45 percent of the total logistics costs. Warehousing and capital cost amount to a further 36 percent, while the other cost components sum up to 20 percent of the total cost of logistics. From Figure I we see that the wholesale trade has the highest cost shares, while building and construction have the lowest cost share in the survey.

**International comparisons**

The methodology chosen for the survey enables us to compare the results with similar studies from other countries. In particular, results from “Finland–State of logistics” and LogOnBaltic.

- LogOnBaltic shows a cost of logistics in manufacturing industries of between 11 and 15 percent of turnover, when excluding the extreme values of West Mecklenburg and Lithuania. The corresponding result from the Norwegian study LIN is 12.8 percent and in line with the results from the Baltic Sea region.

- The other results for wholesalers in the LogOnBaltic study vary between 13 and 17 percent of turnover. In Norwegian wholesale trade the share is 16.7 percent of turnover, and hence in the upper region compared to the results from the Baltic Sea region.
Safe and green agency vehicles

Congestion problems exist even in sparsely populated countries like Norway. Near the big cities, increasing traffic causes daily queues. Although the Norwegian Public Roads Administration (NPRA) considers decreasing accessibility to be a problem, there is also a keen focus on safety and the environment.

And what about the focus on the environment? All NPRA vehicles in Trondheim are either hybrid or electric. The electricity has been generated by hydropower, which means that it is 100 percent green. Moreover, users of electric cars enjoy easier access to the town centre. They are allowed to use the bus lane and do not need to pay for a parking space.

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Can roundabouts decrease traffic noise?

There are on-going discussions about the implications for traffic noise to establish or modify roundabouts. Roundabouts are often used as a way to reduce traffic speeds and thereby improve road safety. The reduced velocity and the change in driving pattern can also have an impact on noise.

On roads where traffic is moving at regular speed, the rolling noise coming from the contact between the tyres and the road is the dominating source of noise.

At crossings, the picture is slightly more complicated. For vehicles with constant speed through the crossing this tyre/road noise will still be dominating. For vehicles that slow down and accelerate the propulsion noise will dominate. It is not clear how the modification of a crossing into a roundabout or the extension of an existing roundabout affect their noise emission. In an attempt to further elucidate this issue the Danish Road Institute looked at a number of concrete projects. A report presents the result from two of these roundabouts.

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Further details on this subject can be found in a longer article on www.nordicroads.com. There is also a link to the final report.
Opera Tunnel is the keystone to “Fjord City”

How 675 metres of tunnel can change the face of a city

King Harald the 5th of Norway opened the Opera Tunnel in Oslo on September 17th, signalling not only the opening of a new traffic system, but also the most significant urban renewal of Oslo since the great fires of 1624. The Opera Tunnel is both a piece of impressive traffic engineering in its own right and the keystone of change which will transform Oslo into “the Fjord City”.

The Fjord City Plan is the result of a four-year process of planning and collaboration, which among others provides the groundwork for environmentally friendly transportation systems and ensures general access to the waterfront. The total Fjord City area comprises 225 hectares, from Frognerstranda in the west to Ormsund in the southeast. It is a comprehensive vision. It is multi-faceted. It is ambitious. And it faces severe challenges.

The main challenge concerns the harbour area of Bjørvika in central Oslo. This small strip of land, squeezed in between the fjord and the railroad tracks leading into Oslo Central Station, is not only packed with container-ports and ship traffic services – it carries the E18 motorway, the largest traffic artery in the country. Every day, existing tunnels in both ends allow 100,000 vehicles to surface and move through Bjørvika. This traffic lies as a barrier between the city and the fjord. In order for “the Fjord City” to become a reality, the traffic has to be teased out from Bjørvika and routed through someplace else.

The Opera Tunnel consists of three intersecting tunnels running, for a total of six kilometres, from east to west below the city. It is the midmost of these, the Bjørvika tunnel, which is the keystone to “Fjord City” as it removes the barrier – the surface traffic of the E18 motorway – and places it in an immersed tunnel running beneath the fjord. Although the sub sea elements of the Bjørvika Tunnel consist of only 675 metres, it links up with the existing tunnels at both ends of the fjord. This allows the main brunt of the traffic to pass under Oslo through a six kilometre long tunnel system, allowing the existing E18 motorway to be torn down. This then provides room for the new borough of Bjørvika to be developed on the waterfront.

Oslo is now undergoing its largest transformation since the great fires of the seventeenth century. The old barriers of road and harbour are giving way, and the city is reclaiming its access to the fjord which has been lost for almost half a millennium. Over an increasingly large stretch of prime estate, the vision of the “Fjord City” is slowly manifesting itself in concrete, steel and glass. The lynchpin of it all is the six kilo- metres long Opera Tunnel. And the most crucial part of the Opera Tunnel consists of the 675 metres of immersed concrete we know as the Bjørvika Tunnel.
Public transport’s challenges

Sustainable transportation is a key concept in the EU’s transport policy. Many consumers around Europe nonetheless have a low opinion of the quality of public transport and are demanding improvements in various respects. The EU has therefore initiated two projects, called SPUTNIC and LINK.

Public transport is facing many challenges. It is important to improve its bad reputation, to get municipal administrations to make substantial shake-ups and to scrap functioning vehicles to achieve a "reasonably modern" level. These challenges and many more have been studied in a project called SPUTNIC, an acronym for Strategies for Public Transport in Cities.

Much appreciated recommendations

SPUTNIC has resulted in a number of recommendations that have been well received by the public transport sector. The recommendations may prove useful since the new EU Regulation no. 1370/ 2007 concerning public passenger transport by rail and road demands the public transport sector to be modernised.

Among other things, SPUTNIC proposes public transport planning to be coordinated with community planning and that legislation should promote integration between different forms of public transport. Regardless of whether services are procured in competition or not, clients and providers should always have an incentive contract. A further recommendation is that the fare system should be developed to improve cost coverage and that new sources of funding should be sought, in particular for investments.

One ticket - several modes

In Sweden and some of our neighbours, people are accustomed to travelling by bus, coach, train and air on the same ticket. Many other countries, however, have very divided responsibilities with rigid barriers between the players.

The LINK project, i. e. the European Forum on intermodal passenger travel, has been working to get different modes of transport, including cars, cycles and motorcycles to work better together for long-distance journeys. In LINK, VTI’s main task has been to create a so-called virtual library for intermodal research and draw up proposals for future research in the field.

The work done within the LINK project has resulted in a number of recommendations for intermodal journeys in Europe. The EU’s policies and legislation apply in all 27 member states but the different practical prerequisites require players to learn from each other.

Exchange of experience

Both SPUTNIC and LINK have had 16 different partners collaborating. The International Association of Public Transport, UITP, has led SPUTNIC in a consortium while LINK was coordinated by ILS, Institut für Landes- und Stadtentwicklungsforschung, in Dortmund. Both projects have been so-called Coordination Actions, which means that practitioners, consultants, researchers and politicians have taken part in workshops and seminars in order to share their experience.

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Read more: www.sputnicproject.eu,
www.linkforum.eu
Tracking down the rail bonus

More and more cities are choosing to invest in trams. In many cases the number of passengers using a new tram line exceeds the forecasts that were made. Tramways are also constructed for other reasons than to transport passengers. Political visions of transforming the city environment, and building attractive cities also play a major role.

“The rail bonus in public transport” aims to increase knowledge of how tram systems are planned, funded and put into operation. The motives for (re-)establishing tramways are also illuminated. The pilot study describes expected and actual effects of new or expanded tramways, for example changes in the relationship between public transport and individual travel, location of dwellings, workplaces and service organisations, changes in real estate prices, and environmental impacts.

Capacity must be able to be increased as needed

The pilot study has studied experiences from tramway expansions in Paris, Zürich and Heidelberg and compared them to projects in Stockholm, Göteborg and Norrköping. This has given much valuable experience.

The first modern tramway in Paris was planned during the 1970s and 1980s. It was designed to handle 55,000 passengers a day. 19 years later, over 100,000 passengers use it every day. The number of passengers was grossly underestimated and both track and vehicles were dimensioned for the forecast number of passengers.

The unexpectedly high number of passengers has led to congestion problems and capacity cannot be increased simply. In Paris, no provisions were made to increase capacity at a later date. It is therefore a very delicate task today to for example extend and widen platforms while traffic is operating.

Another interesting lesson is that the tramway’s role in better integrating the troubled suburbs with the city’s more central parts appears to be working as intended.

Continued faith in the tram

Even if the cities studied have very different prerequisites, the continued expansion of tramways seems to indicate that there exists some kind of general faith in this particular mode of transport. The pilot study has not been able to determine exactly what this faith is based on.

It is clear that decisions to expand tramways are not merely founded on socio-economic aspects. In some cases, calculations and forecasts of passenger numbers have not shown results that would justify establishment or expansion. At the same time, passenger numbers have in other contexts far exceeded the original forecasts made using conventional planning tools. Political vision should perhaps therefore be given more weight in decisions on future establishment and expansions of tramways.

The possibility to fund the projects has proven to be a very important factor for all tramway expansion. In Sweden, the state’s role in new tramway projects is very unclear. Some cities have therefore funded their tramways themselves, while others have made use of ad hoc funding arranged by special negotiators.

Political vision scrutinised

The final report from the pilot study will be published in autumn 2010. It will take a careful look at the importance of political vision in the cities in question. The analysis will also among other things take into consideration transformation of the city environment and the social integration of troubled suburbs in connection with the introduction of trams.

The visions will be compared with more detailed conventional traffic planning. The initial investigations will be made taking routes, capacity needs and estimated passenger loads into consideration. This will be weighed against, among other things, the actual outcome as regards passenger numbers in the subsequent tramway traffic. It is hoped that the pilot study will constitute a step forward in efforts to describe the rail bonus.

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A way to predict flooding on major roads ...

Extreme rain events are expected to become more frequent in the future, and flood risk has gained renewed focus due to the climate changes in recent years. Flooding poses a great threat to roads. In severe cases it may lead to massive obstruction to traffic and damages to road structures. Consequently, identifying and improving road sections to prevent flooding are of great value.

In the SWAMP project, the critical issue of finding the most vulnerable parts of the road network in a future climatic setting has been targeted. A method to assess flood risk tested on a large area in the middle and southern part of Jutland, Denmark, was developed for the Danish Road Directorate. The assessment was primarily based on a digital terrain model (DTM) covering 7,500 square kilometres in a 1.6 x 1.6 m grid. The high-resolution terrain model was chosen in order to get an accurate estimation of the potential flooding in the road area and its immediate vicinity. High resolution in this case means a high performance of the applied methods, hardware and software.

The SWAMP reports include guidance and instructions for engineers, people in charge of inspection, maintenance and repair, and decision makers responsible for renewal of the drainage system. Furthermore, the reports contain instructions on how to perform the work in the field in a systematic way over the season, and also how to prepare the road system before, during and after a heavy rain event.

The SWAMP project is part of an ERANET ROAD initiated transnational research programme called "Road Owners Getting to Grips with Climate Change". There are four projects commissioned under this programme. The projects are funded jointly by the road administrations of Austria, Denmark, Finland, Germany, Ireland, Netherlands, Norway, Poland, Spain, Sweden and United Kingdom.

Read more: www.nordicroads.com, issue 2 – 2010. Here you will also find the link to four SWAMP reports.
The road safety programme for Stockholm has been revised. For the 2009–2020 programme, the Institute of Transport Economics (TØI) recommend a 40 percent reduction target in the numbers of road users killed or severely injured.

Table I. Recommended safety performance indicators and targets for Stockholm, and their potential to reduce the number of killed and severely injured road users in 2020. Parentheses indicate the result of a sensitivity analysis.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Current condition</th>
<th>Target: 2020</th>
<th>Potential: 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed</td>
<td>Proportion in compliance with the speed limits</td>
<td>20–70 %</td>
<td>98 %</td>
</tr>
<tr>
<td>Safety belts</td>
<td>Belt use in front seat</td>
<td>92 %</td>
<td>98 %</td>
</tr>
<tr>
<td>Cycle helmets</td>
<td>Helmet use all ages</td>
<td>~ 65 %</td>
<td>80 %</td>
</tr>
<tr>
<td>Standard main road</td>
<td>Proportion of safe crossings</td>
<td>Presumed 20 %</td>
<td>80 %</td>
</tr>
<tr>
<td>Standard local road</td>
<td>Proportion of safe crossing for cyclists and pedestrians</td>
<td>Presumed 25 %</td>
<td>75 %</td>
</tr>
<tr>
<td>Management and maintenance</td>
<td>Management and maintenance of tracks for cyclists and pedestrians</td>
<td>Current standard</td>
<td>Optimal standard</td>
</tr>
<tr>
<td>Alcohol</td>
<td>Proportion of traffic consisting of sober drivers</td>
<td>99,76</td>
<td>99,9</td>
</tr>
<tr>
<td>Heavy goods vehicles</td>
<td>Safety strategy for heavy duty vehicles</td>
<td>No strategy</td>
<td>Strategy</td>
</tr>
</tbody>
</table>

Table II. Possible measures to reach the recommended safety performance targets.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed</td>
<td>- Increased enforcement</td>
</tr>
<tr>
<td></td>
<td>- Speed humps e.g.</td>
</tr>
<tr>
<td></td>
<td>- Reduced speed limits</td>
</tr>
<tr>
<td></td>
<td>- Information and campaigns</td>
</tr>
<tr>
<td>Safety belt</td>
<td>- Increased enforcement</td>
</tr>
<tr>
<td></td>
<td>- Information and campaign</td>
</tr>
<tr>
<td></td>
<td>- Automatic belt-reminders</td>
</tr>
<tr>
<td>Bicycle helmets</td>
<td>- Obligatory by law</td>
</tr>
<tr>
<td></td>
<td>- Information and campaign</td>
</tr>
<tr>
<td>Standard main road</td>
<td>- Grade-separated junctions</td>
</tr>
<tr>
<td></td>
<td>- Bypasses</td>
</tr>
<tr>
<td></td>
<td>- Separation of the traffic lanes</td>
</tr>
<tr>
<td></td>
<td>- Separation of different road users</td>
</tr>
<tr>
<td></td>
<td>- Footpath and cycle path/lanes</td>
</tr>
<tr>
<td></td>
<td>- Securing pedestrian crossings</td>
</tr>
<tr>
<td>Standard local road</td>
<td>- Improvement of complex junctions</td>
</tr>
<tr>
<td></td>
<td>- Speed reductions</td>
</tr>
<tr>
<td></td>
<td>- Footpath and cycle path/lanes</td>
</tr>
<tr>
<td></td>
<td>- Separation of different road users</td>
</tr>
<tr>
<td></td>
<td>- Crossing/sub passage</td>
</tr>
<tr>
<td></td>
<td>- Speed reductions</td>
</tr>
<tr>
<td>Management and maintenance</td>
<td>- Increased standard on winter maintenance</td>
</tr>
<tr>
<td></td>
<td>- Increased maintenance in general</td>
</tr>
<tr>
<td></td>
<td>- Increased lightening</td>
</tr>
<tr>
<td>Alcohol</td>
<td>- Controls and sanctions</td>
</tr>
<tr>
<td></td>
<td>- Alco-lock</td>
</tr>
<tr>
<td></td>
<td>- Information and campaign</td>
</tr>
<tr>
<td>Heavy goods vehicles</td>
<td>- Heavy goods vehicle road network (routes)</td>
</tr>
<tr>
<td></td>
<td>- Traffic management by ITS</td>
</tr>
<tr>
<td></td>
<td>- Speed plan</td>
</tr>
<tr>
<td></td>
<td>- Green supplying of goods</td>
</tr>
<tr>
<td></td>
<td>- Campaign</td>
</tr>
<tr>
<td></td>
<td>- Black-spot analyses</td>
</tr>
<tr>
<td></td>
<td>- Safety standard on road network</td>
</tr>
</tbody>
</table>

Table I gives an overview of the most relevant and effective measures to reach the eight performance targets.
Tiredness at the wheel - research status

Tiredness when driving is a problem that causes accidents and injuries on the roads. Interest in counteracting this problem has grown and several research projects and studies have treated the subject from various angles. Two researchers at VTI have now compiled the knowledge that exists today in a report.

Sleepiness in drivers is first and foremost a result of driving after too little sleep, having been awake for too long or driving at times of the day when it is most natural for us to sleep. The risk groups are primarily young drivers, professional drivers, shift workers and drivers suffering from sleep disorders.

Current knowledge
There are several indications that a driver may be tired. The most common ones are related to driving behaviour, driver behaviour and modelling of sleepiness or wakefulness. The vehicle-based indicator generally used is the vehicle’s position on the road. Ordinary driver-based indicators are blink duration, blink frequency, degree of eyelid opening and closure, and opening or closing speed in relation to blink amplitude. Where model-based indicators exist, the most common of these are the time of day and time awake during the previous 24 hours.

Ways to reduce tiredness at the wheel
It is important that efforts to reduce the risk of sleepy drivers, and thereby accidents, are made with a holistic approach.
- Merely developing a driver support system that detects sleepiness has no great potential to contribute to fewer accidents on its own, says Christopher Patten. The driver must realise that it is dangerous and know what to do. It is also important to create conditions for professional drivers that allow the individual’s physical limitations or prerequisites to control, for example, scheduling of working hours and driving and resting times.
- The main challenge when it comes to driver support is probably to convince the driver that stopping and sleeping and taking caffeine are the only scientifically proven effective measures that have a lasting effect, says Anna Anund.

This in turn means that there must be places that are safe and accessible for drivers who need to stop.
- Even if a driver is well prepared, he or she may nonetheless become sleepy. When drivers involuntarily leave the road, rumble strips at the edge of the road can draw a driver’s attention to the situation. Rumble strips at the shoulder on motorways and in the middle of 2-lane roads have also proved to have a high degree of acceptance among drivers, says Christopher Patten.

Factors that indicate tiredness as the cause of an accident
Regarding what must be considered to determine if tiredness might have contributed to an accident, this is a very difficult task.
- Factors that describe this are principally the number of hours the person has slept, the number of hours he or she was awake out of the previous 24, shift work or travelling home after working a night shift, and the presence of sleep problems, say VTI’s researchers.

They also propose a two-step procedure that, based on what is known today, primarily considers road-related aspects such as departure angle and alignment and the time of day. Alongside this, it is also good if cooperation with the police authorities can be strengthened in order to obtain more insight into the sleep and wakefulness history of the people involved in an accident.

Tarja Magnusson, VTI, Sweden

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Read more: Tröttet vid ratten – kunskapsläget 2010, R 688. (The report is in Swedish but contains an English summary.)
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