

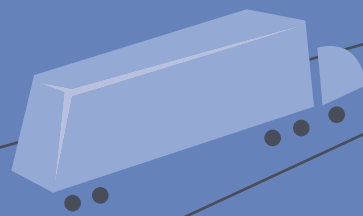


Project results from the RISIT-programme

Programme
Risk and safety in the transport sector – RISIT



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The RISIT research programme – Risk and safety in the transport sector

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Safety across the transport sector

Results from projects in the RISIT programme

Contemporary society is characterised by increasing mobility and stronger calls for safety and reliability in the transport system.

Almost 350 people are killed in transport accidents each year, and more than 80 per cent of all accidents with more than five fatalities have occurred in the transport sector. Further, we know that the risk of being killed or injured while travelling is 4 to 10 times greater than when pursuing other activities in the home or leisure time activities.

Against this background, the Research Council of Norway has organised a programme for research on risk and safety in transport (RISIT). The primary objective of the programme is to produce knowledge that can yield a better understanding of transport risk and provide a stronger foundation for risk management within the transport sector. Important secondary objectives are to help make Vision Zero more operational, to analyse the normative foundations of transport safety policy, to study transport risk in a broader societal perspective and to investigate how different ways of organising risk management can affect transport safety. The programme, which is funded by the Ministry of Transport and Communications, the Ministry of Fisheries and Coastal Affairs and various administrative authorities in the transport sector, has been implemented between 2002 and 2007.

Of the seventeen projects within the programme, four have submitted reports. In order to demonstrate the scope of the programme and some of the findings that have emerged to date, we have chosen nine projects in which results have been reached. The programme board hopes that this will give some impression of the current level of knowledge and the challenges facing work to improve safety in the transport sector.

Finn Harald Amundsen
Chairman of the Programme Board
15 February 2007



“Human error” does not explain accidents

“In order to understand the causes of transport accidents, it is crucial to see the context in which they occur. Explaining that an accident is the result of human error is often inadequate”, says Fridulv Sagberg.

Fridulv Sagberg, chief research psychologist of the Department of Safety and Environment at the Institute for Transport Economics (TØI), finds simple explanations for transport accidents unsatisfying. You haven’t explained much if you say “The reason for the head-on collision was that one of the vehicles crossed over into the wrong lane”, he observes.

“Perhaps the vehicle crossed over into the wrong lane because the driver dozed off. But was it because this was a professional driver whose employer pressured him or her to violate the hours of service regulations? Or had the driver been at a party the day before and not gotten enough sleep? Perhaps there was something wrong with the vehicle? Perhaps the stretch of road where the accident occurred was poorly signed or not properly constructed? Perhaps something unexpected happened that distracted the driver’s attention? We must be aware that transport accidents can be explained in a number of different ways and on a number of different levels”, Sagberg says.

Thus placing the blame on human error is too simple, whether we are dealing with road accidents, rail accidents, aviation accidents or accidents at sea. “An action that results in an accident in one context need not result in an accident in another context. Explanations based on human error contribute to an unnecessary focus on the individual. We will not be able to achieve a significant reduction in the number of transport accidents if we only focus on improving the people who are involved”, Sagberg emphasises. By way of illustration: The number of fatal accidents on route E6 through Vestby in Akershus county dropped sharply when the road was upgraded from a winding two-lane road to a four-lane carriageway with a median barrier, but the people driving on that stretch of road are unlikely to have changed.

Context is crucial

Fridulv Sagberg is head of a research project that has confirmed the importance of considering the context in order to understand the connection between behaviour and accidents. “The primary objective of the project is to refine and test models and methods for analysing human errors that can result in traffic accidents. Our findings confirm that knowledge about the context can help us achieve this objective”, Sagberg reports. But what does he actually mean by ‘the context’?

“In the first place, the context of an accident has to do with the interaction between a person and the system being oper-

ated. This can apply either to the driver of a vehicle or to the air traffic controllers or train dispatchers who control rail and air traffic. Further, the context has to do with the surroundings, this person’s communication with other people in the surroundings, and the relevant organisation and workplace, as well as the existing culture and unwritten rules for teamwork. On an even higher level, the context also has to do with the framework provided by legislation and regulations. In this project we are trying to gather knowledge about all these levels, in order to reach an optimum understanding of why certain types of behaviour result in accidents in certain contexts. If we can manage to identify the context variables that are most frequent when accidents occur, we will have a better basis for designing measures to reduce the risk of accidents”, Sagberg observes.

This research focuses in part on confirming and systematising circumstances many players have already suspected. “We researchers find it important to document circumstances we previously only suspected”, he says.

High-speed boats, train dispatchers and traffic control centres

The researchers have conducted a number of case studies. Research in the control room of a high-speed boat was conducted in cooperation with the Royal Norwegian Navy, which allowed researchers from the Institute of Transport Economics (TØI) and NTNU to join them when they were on duty. The work of the navigators in the control room was observed and video recorded over extended periods of time, and potentially dangerous episodes were studied in detail. One of the conclusions was that improved design of the control room could help reduce the accident risk.

In collaboration with the Norwegian state railways (NSB BA), researchers studied the context of episodes in which train drivers had passed through red lights or stop signals. It should be mentioned that this happens very rarely.

“Passing through stop signals appears to be related to complexity. For instance, if the train driver is required to relate to a lot of information at the same time, or if a signal is placed differently than usual, this may create a dangerous situation. Passing through stop signals can best be avoided through a combination of design, information presentation and what we call barriers”, Sagberg explains.

The crucial barriers

The most important barrier in this type of situation is Automatic Train Control (ATC), which has been installed on nearly all stretches of railway in Norway. If a train driver fails to stop at a red light, ATC intervenes and stops the train; and if ATC contrary to expectation should fail, the train dispatcher can resort to the final barrier and switch off the power supply.

“These barriers are necessary because we must acknowledge that without them train drivers would pass through



Why did the vehicle run off the road? The simple explanation is that the driver did something wrong, but there are many other possible explanations on a number of levels. (PHOTO: TORE BRAATEN, THE NORWEGIAN PUBLIC ROADS ADMINISTRATION)

stop signals from time to time. When this happens, it is not because they do not respect the signal, but because they do not notice it”, Sagberg emphasises.

Barrier analysis has been adopted in several areas where safety is a critical factor, such as in the Norwegian offshore oil and gas industry. A greater awareness of the use of barriers is also growing within the transport sector in Norway. A barrier, which is intended to prevent the occurrence of a particular course of events, may be a median barrier on a road, airbags in a car, or a traffic regulation.

Road and rail traffic centres play a key role in transport safety efforts. Researchers from the Institute for Energy Technology in Halden have studied the activity at rail and road traffic control centres in order to assess how operators relate to safety regulations and procedures. They concluded that the systems of regulations reflect the tasks of the operators and that the operators are concerned about safety. “However, we did find some variation, which could largely be explained as differences in individual attitudes and group norms”, Sagberg observes.

Falling asleep at the wheel

The researchers have also analysed reports from the road accident analysis groups of the Norwegian Public Roads Administration, which confirm that known risk factors such as drink or drug driving, high speeds and failure to use seat belts are still important. “However, falling asleep at the wheel is perhaps a greater problem than we have been aware of. It appears that some 15 per cent of all fatal accidents on Norwegian roads are caused by fatigue and falling asleep. Approximately 10 per cent of all drivers report having fallen asleep at the wheel, fortunately for only very brief periods, during the course of a year. Falling asleep at the wheel is one of the explanations for the head-on collisions that mar accident statistics on Norwegian

roads”, Sagberg points out. He adds that most of those who fall asleep at the wheel on straight stretches of road have a tendency to veer to the right, as roads are constructed to promote drainage of rainwater.

The Institute of Transport Economics (TØI) has also conducted an evaluation of organisational measures in transport enterprises, which revealed a substantial potential for improvement of accident risk and reduction of sick leave.

A comparative study of bus and air transport has also been conducted. The results show that the safety culture is better among employees in Norwegian aviation than among the bus drivers who were tested.

In addition, using data from an earlier questionnaire, TØI has analysed the reasons drivers give when explaining car accidents they have been involved in. “We found that place of residence and educational level are the two variables that are most closely linked to the explanations given. Those with the least education, and/or those who live in rural areas, have a stronger tendency to explain accidents as a result of surrounding circumstances and to a lesser degree as a result of driver error. There is reason to believe that the tendency to attribute accidents to external factors is linked to a higher risk of being involved in an accident”, says Sagberg.

by Bjarne Røsjø

the project: Human error, information processing, barriers and accident risks in operating and monitoring various means of transport (2003-2007)

- Contracting partner: Institute of Transport Economics (TØI)
- Collaborating partners: Institute for Energy Technology in Halden, NTNU's Department of Product Design, Department of Psychology at the University of Oslo

Chance characterises major accidents in Norway

“It is largely a question of chance whether what we call an ‘unwanted event’ turns into a major accident or simply becomes a less serious mishap”, says Rune Elvik, chief researcher at the Institute of Transport Economics. But despite the role of chance and luck, the possibility of preventing major transport accidents is good.

Researchers at the Institute of Transport Economics and SINTEF have studied major accidents – defined as accidents with at least five fatalities – that occurred in Norway from 1970 to 2001. There were a total of 63 such accidents, or an average of two annually. Most of them were within aviation or maritime transport, while there have been somewhat fewer major accidents within road and rail transport. The researchers have established that major accidents occur at random.

“We have not been able to identify any particular factors that are crucial in determining why some events become fatal accidents, while others remain near misses. In other words, these accidents occur quite randomly”, says Rune Elvik.

With two doctoral degrees in traffic safety, Elvik is a leading researcher in his field, both in Norway and internationally. One of the four events that was investigated in Elvik’s project involved two planes heading for a collision.

“Because these planes were from different airlines, the navigation systems were different, which meant that their courses were the slightest bit different and they just managed to swerve. If these aircraft had been from the same airline company, their course would have been identical, and they would have crashed. In other words, it was sheer luck that they were not both SAS machines”, Elvik says.

Horribly bad luck behind the Åsta train crash

Because it is difficult to identify a single particular cause that always pertains in major accidents, each accident must be considered separately. The Åsta crash, in which two trains collided on the Røros line, illustrates how human, technical and organisational factors can all play a part. The train probably failed to stop for a red signal, but as there have been incidents of unreliable signals on this particular line, the possibility remains that the train driver had a green light. In other words, both human and technical problems. On the other hand, it is certain that this accident would have been avoided if automatic train stop had been in use on this line. Once the control room discovered that the trains were heading for a collision, the train driver was phoned, but the mobile phone in question was on another train. By the time the office managed to locate



the right phone number, it was too late. In other words, a combination of human and organisational factors, compounded by the role of chance:

“There is little traffic on the Røros line, so it was terribly bad luck that two trains crashed on this line”, says Rune Elvik.

Declining trend

Although the data are somewhat sparse, the researchers believe that a long-term trend towards fewer major accidents in Norway can be expected. In order to attain a sounder basis for their conclusion, they have made use of data from similar accidents elsewhere in Europe from 1991 to 2003 and in the UK between 1967 and 2003. These figures indicate precisely such a decline.

“There is no reason to believe that Norway differs substantially from the other European countries. Moreover, we have actually experienced a reduction in accident rates in recent years. Our study covered the period through 2001, but as far as I know there have not been any major accidents since 2001 apart from the *Rocknes* cargo vessel, which capsized in 2004.”

But why is the number of major accidents declining? “Largely because of new and improved technology. But other factors, such as a changing safety culture, also play a role”, says Elvik.

Prevention is possible

Although ‘unwanted events’ and probably a number of accidents will always occur, prevention can make a great difference:

“We are actually quite close to Vision Zero in both rail and air transport. It is difficult to achieve the same result with regard to road and maritime accidents, the reason being that there are few requirements and practically no holds barred when it comes to driving a boat or a car, whereas airplanes and trains are closed systems with strict regulations”, Elvik explains.

“On the whole it is easier to prevent major accidents than minor ones. Major accidents are investigated thoroughly, giving us a chance to learn more from them. They are also often what we call ‘organisational accidents’, which means that a transport enterprise or an organisation is involved and assumes the responsibility for implementing better safety measures.”

by Synnøve Aspelund

There have not been any major transport accidents in Norway since January 2004, when the cargo vessel *Rocknes* capsized in the straits just outside Bergen. 18 people lost their lives. (PHOTO: AFP – SVEN NACKSTRAND)



the project:

Major accidents in transport: frequency, long-term trends and preventability

Contracting partner: Institute of Transport Economics

Project manager: Chief researcher Rune Elvik

– Vision Zero means greater public responsibility for road traffic accidents

“The introduction of Vision Zero as the guiding principle for traffic safety work in Norway has altered our perceptions of who is responsible for road accidents. Whereas it was previously the individual’s own responsibility to adapt to the road traffic system, more emphasis is now placed on the responsibility of the authorities”, says philosopher Beate Elvebakk.

Vision Zero is a long-term vision of no one being killed or permanently disabled in traffic. This principle was adopted by the Norwegian parliament in 2001 as part of the national transport plan. The inspiration derives from Sweden, where a corresponding vision was adopted in 1997.

“Vision Zero applies for all branches of transport, but it has had a particularly significant effect with regard to road traffic. The very approach to road traffic safety has been changed, as the authorities have assumed more responsibility. There is a greater focus on the road traffic system – including speed limits and technical measures and less on the individual road user”, says Beate Elvebakk, philosopher and researcher at the Institute of Transport Economics (TØI).

One important reason why Vision Zero has had its greatest effect on road traffic is that the other branches of transport are already more regulated and professionalised, with stricter safety regulations than those governing road traffic.

A car-friendly vision

Researchers at the Institute of Transport Economics, in collaboration with SINTEF, have studied how Vision Zero is perceived by different players, including the police, the Public Roads Administration, the Norwegian Council for Road Safety (*Trygg Trafikk*) and non-governmental organisations. Many of them feel that Vision Zero has improved safety prevention, particularly by assigning more responsibility for safety to the National Public Roads Administration. At the same time, some of them expressed the danger of this vision degenerating into sheer rhetoric.

“Even players that have traditionally concentrated more on mobility than on safety, such as the Norwegian Automobile Federation and the Norwegian Road Federation, are positive to the safety focus of the vision. One reason for this may be that road improvement will be a crucial safety measure”, says Elvebakk.

But surely no one can oppose Vision Zero, with its goal of less traffic fatalities?

“No, it is practically unassailable. But some groups, including motorcyclists, cyclists and environmentalists, are a bit sceptical because Vision Zero is perceived as car-friendly. After all, the focus is on making already existing roads safer, not on reducing car traffic and persuading more people to take public transport or to cycle.”

Even though most people would understand what is meant by Vision Zero, the concept is not well known: “We have found that it primarily functions as an internal vision and a method for those working professionally with traffic safety”, Elvebakk concludes.

by Synnøve Aspelund

Involving the general public may improve transport safety

For most people, transport safety is largely about the worry and concern related to the consequences of a possible accident, while experts focus more on statistics and probability. “Appealing to people’s emotions is a possible supplementary strategy in promoting change, in addition to convincing them with rational arguments”, says Professor Torbjørn Rundmo.

Torbjørn Rundmo is interested in the importance of people’s perceptions and emotions related to transport safety. “If people are inundated with facts and rational arguments and moralising messages informing them that they must change their behaviour or their attitudes, they tend to ignore these messages. Emotional reactions, on the other hand, have a stronger tendency to trigger actions, and ‘the man and woman in the street’ are inclined to demand more safety measures than the experts”, he reports.

Professor Rundmo, of the Department of Psychology at the Norwegian University of Science and Technology (NTNU), has headed a large-scale research project to investigate risk assessment among the general public, experts and pivotal decision-makers in the transport sector. Associate professor Stig H. Jørgensen has been responsible for the project segment conducted by the Department of Geography at NTNU. The two doctoral fellows Bjørg Elin Moen and Sveinung Eiksund have also played a key role.

“We see that experts who work with traffic safety on a daily basis focus on the probability of an accident occurring. But if you ask the man or woman in the street, you will find that most people are more concerned about the *consequences* if an accident were to occur. Accidents in aviation epitomise this phenomenon: The probability of an accident is slight, but the consequences can be great”, Rundmo explains.

Emotions trigger involvement

It is the possible consequences that determine whether people get involved and that trigger popular demands for traffic safety measures to be instituted by the government. The train crash at Åsta on the Røros line in January 2000, with 19 fatalities, gave rise to strong popular demands for improved safety measures in the railway system.

“Our results show that the thought of serious consequences generates worry and concern, or what we psychologists call affectivity or emotions in the broadest sense, and this in turn

can trigger involvement and action. By comparison, probability statistics and rational arguments have relatively little significance for people’s actions and what measures they call for”, Rundmo elaborates.

Rundmo does not conclude that the experts are wrong and that ordinary people have a more correct risk assessment. “There is one objective truth, which is that accidents happen and can be observed. Apart from that, all risk assessments – whether they are based on probabilities or intuitive estimates – are based on choices and decisions. In my opinion there is no such thing as objective risk”, Rundmo says.

“But serious accidents rarely occur, which shows that people’s risk perception is quite good! They perceive risk in such a way that for the most part they avoid accidents”, he adds.

Dangerous rural districts

Researchers in this project have also conducted a survey among young people in seven rural and urban municipalities in the counties of Sør-Trøndelag and Nordland. This part of the study focused exclusively on road traffic safety. They found that young people in urban and rural areas believe that they are at the same risk of being involved in a road traffic accident

The seat belt campaign of the Norwegian Public Roads Administration is well designed and triggers emotions, says Torbjørn Rundmo.
(PHOTO: THE NORWEGIAN PUBLIC ROADS ADMINISTRATION)



The train crash at Åsta in January 2000 was an accident with serious consequences that aroused the emotions of the general public and triggered calls for safety measures.

(PHOTO: TOR RICHARDSEN, SCANPIX)



but their assessment is wrong, as the risk is considerably higher in sparsely populated regions.

“The number of accidents is higher in cities and urban areas and on heavily trafficked stretches of road, but the risk for the individual is greater in sparsely populated areas. National accident statistics show that particularly young men in these areas have high levels of accident risk”, Rundmo explains.

“Of course, it is interesting to discuss whether the main objective of traffic safety efforts should be primarily accident reduction or risk reduction. If politicians want to reduce the total number of accidents, obviously much can be achieved by implementing physical and technical measures where the volume of traffic is greatest. However, that may involve a geographic redistribution of risk, and it may be relevant to discuss whether we are willing to accept a greater level of risk for young people in rural districts than for young people in urban areas.”

The higher accident risk in sparsely settled regions is closely linked to the local culture. “Young people in rural districts are more interested in cars, they drive more, and the car is a more important symbol of status, freedom and mobility. There is also a subculture in which cars are associated with excitement and speed. We believe that this subculture is one of the reasons the risk is higher in rural areas, although strictly speaking we do not have any evidence.”

Rundmo adds that traffic safety measures in sparsely settled regions should be designed differently from in urban areas. “Physical and technical measures are effective on heavily trafficked stretches of road, but not necessarily where the volume of traffic is low. Measures targeting attitudes and behaviour may be relevant in such areas”, he points out.

Unshakable faith in median barriers

The NTNU researchers have investigated attitudes among 21 key decision-makers in the four transport sectors, namely aviation, maritime, road and rail transport. “We found that these are result-oriented individuals who consider challenges and solutions to be synonymous. They focus on physical and technical measures, to a greater extent in the road transport sector than in the other three. The decision-makers also mention that

the most important measure for reducing the number of accidents is to build new roads, and they have an unshakeable faith in median barriers. Moreover, many decision-makers report that organisational changes within the authorities that are responsible for safety in the transport sector could contribute to traffic safety”, Rundmo reports.

Professor Rundmo emphasises that this study does not provide any basis for criticising the decision-makers. He does believe that it can be important to take the feelings of the general public into account in transport safety initiatives. “It may be wise to listen to the ordinary road user or traveller. If the general public is drawn in more actively as suppliers of terms, it may be possible to assign greater priority to preventive measures”, he observes.

The knowledge that the general public is more responsive to consequences and emotions than to rational arguments should also be taken into account when designing safety measures that target behaviour. “Appealing to people’s emotions is probably more effective in promoting change than trying to convince them using cognitive or rational arguments. It is important that information not be moralising; there is ample literature documenting that people do not *wish* to change. Rational argumentation appears to have little effect on behaviour and actions. And if the message is too unpleasant, people will definitely not heed it. That is what I like about the recent seat belt campaign by the Norwegian Public Roads Administration: it appeals to the emotions in order to influence behaviour. If it had also appealed more strongly to people’s anxiety and worries, it might have been even more effective”, Rundmo suggests.

by Bjarne Røsjo

The project:

Risk judgment, risk tolerance and demand for risk mitigation in transport
Contracting partner: Faculty of Social Sciences and Technology Management, NTNU
Project manager: Professor Torbjørn Rundmo, Department of Psychology, NTNU

Great enthusiasm for and little knowledge about risk analysis

Risk analysis in the transport sector is quite a new field, which means that analyses are not always conducted by the book. Decisions are sometimes taken before analyses are conducted, while transport enterprises exhibit great enthusiasm and little knowledge. “This is actually a good point of departure”, Øivind Solberg says.

Doctoral fellow Øivind Solberg, who is doing field work to chart current practice in the use of risk analysis and risk tolerance criteria in the transport sector, reports that he is almost always warmly received by transport enterprises, regulatory authorities and on the political level. “When I am out in the field, I am often met with enthusiasm and a thirst for knowledge”, Solberg observes.

But Solberg has also found that reality differs considerably from textbook theories on how risk and vulnerability analyses should be used. “According to theory, the analyses should be conducted first, in order to gather all the facts and develop new knowledge of conditions that may help reduce the risk in a transport system. But on a higher level, among the political decision-makers and within the regulatory agencies, we see that decisions are often taken prior to the analyses. This makes it appear as though the analyses are conducted to legitimise the decisions”, Solberg adds.

Nor is the use of risk analysis by transport enterprises entirely according to the book. “These analyses are often conducted because the enterprises are required to do so. The current practice reflects that the analyses are conducted out of sheer obligation rather than in pursuit of new knowledge. Risk analyses are intended as input in a decision-making process, but at present that is rarely the case. The people we talk to out in the field have difficulty identifying decision-making situations in which risk analyses could be used. This can explain why risk analysis reports are shelved, to be left there until the next time a revision is required”, says Solberg.

New territory

Even so, Solberg has no desire to criticise the transport enterprises or the authorities. “This is new territory for the transport sector, and I would be hesitant to claim that textbook theories are always feasible in practice. Moreover, this is not a question of unwillingness on the part of those involved, but rather a general lack of knowledge combined with great enthusiasm and limited resources. The practice involves a process of adjustment that will necessarily take time”, he points out.



The ‘mechanical’ approach to risk analysis that is prevalent in the transport sector may mean that certain risk factors will not be detected, but trends are moving in the right direction. (PHOTO: MICK TULLEY, NORWEGIAN NATIONAL RAIL ADMINISTRATION)

Trend in the right direction

The objective of risk analysis and risk management is – of course – to bring to light circumstances that may cause accidents and to identify measures that can reduce the risk of accidents. Øivind Solberg is concerned that the somewhat mechanical approach that is currently prevalent in the transport sector may mean that certain risk factors will not be detected. “In that sense it would be beneficial to raise the level of knowledge about the use of risk analyses”, Solberg observes. But a lot of good work is being done, and there appears to be a favourable climate for cooperation between the Directorate for Civil Protection and Emergency Planning and the transport trade with respect to hazardous goods.

“If we consider developments in the transport sector over time, the accident trend is predominantly positive. Perhaps a more targeted use of risk analysis could influence this trend even more favourably. An important final point is that safety costs money, and risk is only one of many ‘values’ decision-makers must take into consideration”, Solberg concludes.

by Bjarne Røsjø

the project: Risk analysis, tolerance and management

Contracting partner: University of Stavanger (UIS)

Project manager: Researcher Ove Njå

Both the tram driver and Oslo Sporveier were found guilty after a tram accident in November 2002. (PHOTO: JON EEG, SCANPIX)



Punishment does not necessarily yield increased safety

The focus by the police, the prosecuting authorities and the courts on punishment and blame in relation to system accidents does not necessarily contribute to increased transport safety. Many accidents have complex causes, and it is not always easy to identify individuals who can be prosecuted and punished.

159 persons died in a fire aboard the passenger ferry Scandinavian Star in 1990. In January 2001 a tram passenger died when she fell under the tram at a tram stop in Oslo. These are two vastly different accidents, but a shared feature is that both of them had various, complex causes, and it was difficult to place all the responsibility on a single person.

The fire on board the Scandinavian Star was catastrophic due to an arsonist and poor safety routines. Following the tram accident, the tram driver was found guilty of negligence, while the employer Oslo Sporveier was convicted of involuntary manslaughter and contravention of the conditions for operating trams. Following the accident in November 1999, when 16 persons died after the catamaran *Sleipner* hit a rock north of Haugesund at a high speed, only the captain was convicted.

Systems with barriers

Lillian Fjerdingen, Erik Jersin and Terje Skjønhal, all researchers at Sintef, have examined a number of sentences from transport accidents during the past 30 years and presented their findings in a Norwegian book containing twenty narratives about safety. One of their findings is that the sentences reveal great variation, and that the legal system often focuses on individuals.

“These are not instances of drink driving or speeding or the like, where it is generally easy to establish who is to blame for an accident. These are complicated systems which must take

into account the fact that the people operating the systems will sooner or later make a mistake. As a result, the systems must be built with a maximum degree of tolerance for human error, so that such errors do not cause accidents. One of the means for achieving this is to integrate various types of safety barriers”, Fjerdingen explains.

“If accidents do happen, we must not simply punish the individual who was the direct cause, believing that we have solved the problem. If we are to prevent new accidents, we must first and foremost find the gaps in the barriers and close them”, she adds.

Methods questioned

“The results thus far may cast doubt on whether the current investigation methods are adequate for accidents with complex causes. In many cases it can be difficult to ascertain why certain individuals in the chain of causes are prosecuted and not others. This may be due in part to long-established formulations in the penal code, which do not take into account today’s complex reality and the latest knowledge about human limitations. Thus the courts’ assessment of negligence may, in some instances, be at variance from perceptions within current safety research.”

“It also appears that the courts’ emphasis on general deterrence does not always have the intended effect. The threat or possibility of punishment does not constitute a predominant motive for avoiding accidents within most types of professional transport”, Fjerdingen concludes.

by Bjarne Røsjø

the project:

Transport accidents - responsibility and safety consequences
Contracting partner: Sintef Technology and Society
Project manager: Senior advisor Lillian Fjerdingen

Each branch has its own safety culture

Safety is a crucial matter throughout the transport sector, but distinctive types of safety cultures evolve in the different branches.

Sociologist Stian Antonsen is one of a group of researchers who investigated the safety cultures of the Airport Express Train (*Flytoget*), the Norwegian Public Roads Administration and Statoil's service vessels (which transport cargo out to the platforms). The researchers found three unique cultures, with divergent thinking and differing practices in their approach to safety.

"In Statoil, maritime culture still has a strong hold. Seamen come from a long and proud tradition within which individual judgment and practical experience are valued highly. This may come into conflict with stringent, formal safety routines imposed by others", Antonsen explains.

He underscores that being 'good seamen' is important to employees on the service vessels, who attach great weight to safety, but who also consider a knowledge of safety to be something they have built up through practice. Formal regulations and procedures cannot always be introduced without any hitches in this type of culture.

"While there appears to be a fair amount of nostalgia linked to the idea of a good seaman, there is more standardisation and less improvisation than previously. In any case, the off-shore sector is characterised by a strong degree of safety management", says Antonsen.

Modern safety culture on rails

Many of the airport express train drivers are previous employees of the Norwegian State Railways (NSB) who have taken much of the traditional approach to rail safety with them into their new job. Thus the airport express train has inherited some of the traditional 'railway culture'. At the same time, this is a small, modern company, and not such a large organisation as NSB, which made it possible for a 'state-of-the-art' safety culture to be developed quickly. Whereas seamen are used to shifting for themselves, employees on the airport express trains are more willing to accept formal regulations and procedures.

"Some slight turbulence between the operative and the administrative sectors within the organisation may have created a degree of cultural distance between them. Even so, the airplane express train has developed a strong safety culture with broad consensus", observes Antonsen.

Volunteer culture in the Norwegian Public Roads Administration

In the Norwegian Public Roads Administration, by contrast, a "volunteer culture" prevails. Work to improve safety is much



less formalised and centrally administered, which means that it is individuals who tend to be the driving forces in safety efforts. It is the enthusiasts – those who voluntarily get involved – who provide the impetus", Antonsen reports. Safety work is simply not as structurally formalised as in the other branches of transport. The informal networks within the organisation play an important role for safety work in the National Public Roads Administration.

In contrast to Statoil and the Airport Express Train, the National Public Roads Administration does not conduct much operative work, as this has been organised in a separate publicly owned enterprise (Mesta). Thus the employees do not experience the same personal safety risks as in the other two branches – which may perhaps be reflected in the safety culture.

"Even though there are far more injuries and fatalities on the roads than on the rails and at sea, these are third persons, and the responsibility for safety is more indirect", Antonsen comments.

the project:

Safety culture in transport: descriptions, comparisons and changes
Contracting partner: NTNU Samfunnsforskning AS
Project manager: Professor Per Morten Schiefloe



Maritime culture, with its strong emphasis on individual judgment and practical experience, retains a strong position in Statoil.

(PHOTO: DAG MYRESTRAND, STATOIL)

Shared tensions

Although the three workplaces in the study have distinctive safety cultures, the researchers see some shared features.

“A major finding is the tension between the formal and the informal aspects of safety work. On the one hand there are formal, stringent regulations and procedures, on the other hand the more informal, practical approach”, says Antonsen.

This tension is perhaps best illustrated by the Statoil service vessels, but there have also been some indications of friction in the Norwegian Public Roads Administration when stronger control of safety routines has been introduced.

“How well the formal and the informal aspects match says a lot about the success of a safety culture. The vocational expertise and professional pride of the employees can be a substantial resource. In order to improve safety, the employees must be taken seriously and there must be room for new measures they propose”, Antonsen observes.

The tension between costs on the one hand and safety on the other is another shared feature. But despite the demands for cost-efficiency and competitiveness, Antonsen does not believe that safety will be given less priority:

“Safety is a pressing issue with a much greater prominence than twenty years ago. The authorities place stringent demands on transport enterprises, and the media swiftly report catastrophes, which helps make safety a concern of both the general public and politicians.”

by Synnøve Asplund

Transport risk: From a technical focus to system assessment

Transport risk is now assessed in a more complex manner than previously. Once an accident has occurred, there is more focus on the system than on the individual train driver or ship’s captain.

“We are investigating changes over time within road, rail, air and maritime traffic. Even though there are differences between the various branches of transport, we see some shared characteristics in the perception of transport risk cross-sectorally and over time”, says Tonje Osmundsen, political scientist at NTNU Samfunnsforskning.

Whereas engineers have traditionally been responsible for assessing transport risk, other occupational groups – including social scientists and historians – are now being drawn in.

Commissions of inquiry were previously very technically oriented, but over time a greater system emphasis has emerged, making the picture more complex and comprehensive. From a preoccupation with assigning blame, there is now a shift to finding areas for improvement.

Differing traditions

Another change over time is an increased focus on systems and organisations rather than on individuals. “This is a consequence of the more complex models now used to assess transport risk”, says Osmundsen.

There are, however, still substantial differences among the various branches of transport. As most road accidents involve private individuals, there has traditionally been less of a system focus in this field than for instance within aviation. Maritime transport, too, retains quite a strong focus on the individual. A ship’s captain is still attributed more individual responsibility than for instance a train driver.

The inquiries into the Åsta train crash and the Sleipner catamaran accident appear to confirm this difference. Whereas the captain of the Sleipner was brought to trial, there was a greater emphasis on system failure after the Åsta accident than on the deceased train driver, even though the possibility that he may not have observed a red signal light was not ruled out.

“In the various transport sectors we see that differing traditions still exist to a certain extent, yielding differing mandates and thereby different types of commissions of inquiry,” Osmundsen concludes.

the project:

Perceptions of transport risk in a societal perspective
Contracting partner: NTNU Samfunnsforskning AS
Project manager: Professor Per Morten Schiefloe

Anti-terror measures versus protection of privacy: 1-0

In the wake of the terrorist attack on the United States on 11 September 2001, Norway, like most other countries, has introduced a number of new and stricter security measures in the transport sector. On the whole the general public is favourably disposed to such anti-terror measures, even though they undermine the protection of privacy.

“It is difficult to imagine terror prevention that would not infringe on privacy. And the more measures that are introduced, the more conflicts that arise in relation to the protection of privacy”, says Torkel Bjørnskau, researcher at the Institute of Transport Economics (TØI). However, a reduction of the individual’s freedom of action is acceptable for most people, as long as the focus is on terrorism.

“There is widespread acceptance among the general public and legislators for providing information about me and you when the objective is to prevent terrorism. If, on the other hand, the objective had been to get people not to drive too fast, there would have been much less acceptance for new security measures. Terrorism creates fear and anxiety, which appears to give considerations of privacy lower priority”, Bjørnskau observes.

Do as the EU

Bjørnskau’s research project sheds light on three different areas: First, it describes the various security measures Norway and the EU have introduced in the transport sector in recent years. Second, legal aspects of these measures are considered

in relation to the protection of privacy. Third, key decision-makers in transport enterprises will be interviewed, to find out what thoughts they have about the protection of privacy when they introduce new security plans. A survey may also be conducted among the general public.

“So far we have described the measures that have been introduced and looked into the legal aspects. It appears that Norway, as a member of the European Economic Area, introduces the new EU measures more or less as direct copy. The national scope of action is apparently not very great”, says Torkel Bjørnskau.

Most at sea and in the air

There are differences among the various branches of transport in terms of curbing terrorism. While numerous security measures have been introduced in aviation and at sea, relatively little has been done with regards to rail traffic, trams, the metro and roads. “A clever terrorist might choose something other than air traffic in light of the vast difference in levels of security among various modes of transport. The fact that the last two major terror attacks were on trains (Madrid 2004) and buses/the underground (London 2005) is perhaps not so strange”, says Bjørnskau.

Airport screening procedures have become much more stringent in recent years. Luggage and cargo are screened, and the most recent measure to be introduced imposes restrictions on the amount of liquids allowed through airport security checkpoints. Airport employees must present certificates of good conduct, and new regulations require better illumination and more security personnel. In maritime transport, port security has become stricter, containers are sealed and scanned, and seamen are required to have biometric identity cards.

Difficult roads

Why is there such a difference in security measures among



Most people accept strict security measures in the transport sector, while privacy is allowed to be given lower priority. (PHOTO: ERLEND AAS, SCANPIX)

the various modes of transport?

“Both maritime and air traffic have long-standing traditions of international legislation, with systems already in place. Road and rail traffic are of a more national nature, without the same international regulations”, Bjørnskau observes.

“And not least, it is much more difficult to monitor road and rail traffic on a practical level. For instance, it is practically impossible to envision airport-level security in the Paris metro system. It would create such a bottleneck in the system that it would not be feasible. Nevertheless, the EU is working on improving road and rail security so that the disparity will be reduced somewhat”, says Bjørnskau.

Boundaries are being pushed back

Bjørnskau believes that many anti-terror measures are implemented on the basis of past events, which means that security is always lagging slightly behind.

“At the same time, there is an increased focus on preventive police work so that plans can be uncovered before they

are realised. However, increased police powers also impinge on privacy. In connection with gunshots fired at the synagogue in Oslo, the police had placed a microphone in a suspect’s vehicle for the first time in Norway. Boundaries are being pushed back, and privacy is being undermined”, Bjørnskau observes.

But why is weakening the protection of privacy problematic?

“Knowing what people are doing and where they are can be abused if we think of regimes quite different from ours. Moreover, we must pose the question of whether we want to live in a society of surveillance, in other words a society based on mistrust of others, in which our customary perceptions of integrity and privacy are challenged”, Bjørnskau concludes.

by Synnøve Aspelund

the project:

Safety, security and efficiency: Limits of privacy

Contracting partner: Institute of Transport Economics (TØI)

Project manager: Torkel Bjørnskau

People’s gut feeling often in tune with reality

Most people consider airplanes, trains and buses to be the safest modes of transport. Motorcycles, on the other hand, are the least safe according to the vast majority. These are among the results of a study conducted by TØI to investigate people’s perceptions of safety in the transport sector.

“People’s perceptions of what modes are transport are safest harmonises with the actual accident risk. The fact that most people are sceptical of motorcycles, while collective means of transport are considered safe, corresponds well with reality”, says Torkel Bjørnskau.

Airplanes, trains and buses rank first when people assess safety. Cars are ranked second, cyclists and pedestrians third, while motorcycles rank at the very bottom. The study, which was conducted in autumn 2003, was a follow-up of a similar study in 2000 by the leading newspaper *Aftenposten*.

“It is interesting that people considered trains and boats much safer in 2003 than in 2000”, says Bjørnskau. There may be a simple explanation for that change: The 2000 survey was conducted shortly after the Åsta (train), Lillestrøm (train) and Sleipner (catamaran) accidents. That made it seem ‘scarier’ to travel by boat or train.

“These accidents, which were the subject of intense media focus, have probably influenced people’s perceptions. In a sense the responses in 2000 reflected a temporary feeling of ‘false insecurity’.”

Women feel more unsafe

Men generally feel safer than women when using the various modes of transport. This is particularly true in relation to public transport.

“This difference may be related to a fear of being harassed by others, or of being sexually assaulted, or the like. We know that many women are afraid to take the metro alone late in the evening”, Bjørnskau reports.

There is also an age difference: the younger the person, the safer he or she feels in traffic.

The study is weakened by the fact that ‘feeling unsafe’ is not precisely defined: Does it refer to a fear of dying, or of accidents, or of quite other things, such as harassment or claustrophobia? A new survey will be conducted with a more precise definition of the concept of feeling safe.

“We know too little about feeling unsafe in relation to the danger of terrorism, or tunnel phobia, or the fear of harassment. In order to design suitable measures for reducing this feeling, we need to know why people feel unsafe and what they fear”, Bjørnskau points out.

Deregulation in itself does not threaten safety

“Although there have been some accidents that can be linked to deregulation, we find no clear indications that deregulation in general results in more accidents”, says Stig O. Johnsen, senior researcher at SINTEF.

When Stig O. Johnsen and his colleagues started examining the connections between deregulation and safety in the international transport sector in 2003-2004, they had expected to find that deregulation results in more accidents. “We were actually quite surprised not to find such a connection. This conclusion has been rather painful, and it is somewhat contrary to public perception. But as researchers we must communicate this perspective as well”, Johnson observes.

A well-known example of deregulation and opening up for competition comes from the UK, where British Rail was split up into some 120 companies exposed to competition in 1994. British journalist Christian Wolmar has depicted this deregulation in a critical light, in a number of books with titles such as *Broken Rails: How Privatization Wrecked Britain's Railways*. In the USA both aviation and rail travel were deregulated in the 1970s and 1980s, and in recent years the EU has focused on deregulation within both rail and air travel.

Less accidents each year

“When we started working on this project, we soon realised that there were train accidents in the UK that could be ascribed to deregulation. Yet we found that Professor Andrew Evans had thoroughly examined the accidents that occurred both prior to and after deregulation, and he established in 2006 that the total number of accidents had been reduced each year after the deregulation of British Rail. We engaged a professor at the Norwegian University of Science and Technology to check the data for us, and he could not refute Evans’ account. The same applies from the USA and other instances of transport deregulations: It appears that deregulation does not result in more accidents,” Johnsen elaborates.

The volume of traffic was relatively steady for the first four or five years following deregulation in the UK, while in recent years rail traffic has grown rapidly and is approaching its peak during the heydays of British railways from 1945–1970.

“There may be those who claim that the number of accidents would have been reduced even more without deregulation, but that claim is extremely difficult to verify”, Johnsen comments.

You'll be fine if you're careful

Johnsen's explanation is that deregulation in itself does not

necessarily bring about increased safety. “Walking on a tight-rope is inherently more dangerous than walking on the road. But when great numbers of tightrope walkers adapt to the risk and no one falls off, we must conclude that the level of safety is quite good. If the transport companies and the regulatory authorities and others involved implement deregulation in the proper manner, there will not be more accidents. It is somewhat like telling your children to be careful when they cross the road. If they do, they will be fine”, Johnsen observes.

The researchers have looked for indicators that could help to reveal the level of risk in British Rail. “We found one indicator that was related to SPAD (Signals Passed At Danger), and we identified at least one accident related to this problem. But both the regulatory authorities and the rail companies had addressed the problem and implemented relevant measures. This reduced the number of signals passed at danger (SPAD), resulting in a reduction of the number of accidents caused by SPAD”, Johnsen reports.

An accident that can be linked to deregulation is the derailment in Hatfield in 2000. Somewhat simplified: Those who were responsible for maintenance of the worn track worked for one company, while another company which operated the trains did not want to give way for the maintenance workers, as that would impair punctuality. This resulted in a broken section of track as a train passed at high speed, with the subsequent derailment and four fatalities.

In other words, this accident happened because the responsibility for track maintenance had become unclear in the process of deregulation, and because safety and maintenance were not assigned sufficient priority in relation to punctuality and profitability.

A critical public eye

The good results in the UK do not mean that the authorities did everything right in connection with deregulation. There are very few today who believe it was right to split the sector up into more than 100 companies. One result was that railway research was neglected for several years, because no one was responsible for it. Eventually the organisation Railway Safety and Standards Board was established to revitalise British rail research, and many other adjustment measures have been implemented.

“If I were to explain why deregulation of the railways in the UK did not result in more accidents, I would claim that a vital factor was the critical public eye. Deregulation aroused considerable controversy, and it is reasonable to assume that those who were involved were both vigilant and cautious”, Johnsen says. Moreover, all the rail companies were required to implement a ‘safety case’ describing in detail the safety management measures in place in the new regime.

Norway implemented deregulation in the railway sector



Deregulation of rail transport in the UK has not resulted in more accidents. The picture shows a EuroStar train attempting to set a new British speed record of 205 mph. (PHOTO: SCANPIX/ EPA PHOTO/PA/MARTIN KEENE).

when NSB BA (the Norwegian state railways) and the Norwegian National Rail Administration (Jernbaneverket) became separate organisations in 1999. There is an ongoing process of deregulation within the railway sector in the EU; one of the objectives is to ensure that European trains to an increasing degree will be allowed to cross national borders. “EU’s summary of the British experience indicates that the authorities should bear substantial responsibility for the infrastructure. In the UK the infrastructure was assigned to a private company at first, but this proved unsatisfactory”, Johnsen reports.

The researchers at Sintef have also taken part in research projects commissioned by the European Railway Union. “One of our Belgian colleagues reported that they had once found a train driver sleeping in a freight train! He had started in the Czech Republic and was on his way to deliver goods at a terminal in Belgium, but stopped to sleep when he was tired and drove on the next time the signal light was green. This reveals something of the new reality that may emerge when divergent railway cultures meet. It is important that the employees be taken into consideration, focusing on the work environment and safety while moving ahead slowly and ensuring that there is a shared understanding of regulations and safety”, Johnsen emphasises.

Revenues influence safety

Johnsen stresses the fact that the public competition authorities and safety authorities have vital – and complementary – roles in deregulation. “The transport companies that took part in the deregulation of rail freight transport in the USA, later reported that this change made their operations more profitable. This made it possible for them to invest in equip-

ment that made this transport safer. The same point is made in other studies. The regulatory authorities should, then, make sure that the companies’ earnings are satisfactory, and that the competition does not become so fierce that it threatens safety”, Johnsen observes.

“The main conclusion from this project is that deregulation in itself does not impair safety and cause more accidents. However, we have also found that deregulation must be followed up by proactive regulatory authorities with the power and authority to ensure that operations are carried out in compliance with existing regulations. Moreover, it is important to be aware that a transition to other forms of transport in connection with deregulation may often have a greater effect on the total risk than the changes within the deregulated sector. For instance, if deregulation of the railway sector in the EU results in more people taking the train instead of driving, the outcome will be substantial safety gains”, Johnsen concludes.

By Bjarne Røsjø

the project:

Safety consequences of deregulation within the transport sector
 Contracting partner: Sintef Technology and Society
 Project manager: Senior researcher Stig Ole Johnsen

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