VINNOVA

VINNOVA ANALYSIS
VA 2007:09

SUMMARY

Effects of Swedish traffic safety research 1971 - 2004

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SUMMARY OF VINNOVA ANALYSIS VA 2007:10

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About VINNOVA

VINNOVA, the Swedish Governmental Agency for Innovation Systems, integrates research and development in technology, transport, communication and working life.

VINNOVA´s mission is to *promote sustainable growth* by funding *needs-driven research* and developing *effective innovation systems*.

Through its activities in this field, VINNOVA aims to make a significant contribution to Sweden´s development into a leading centre of economic growth.

The VINNOVA Analysis series includes publications of studies, analyses, official reports and evaluations that have been produced or commissioned by VINNOVA´s Strategy Development Division.

Effects of Swedish traffic safety research 1971 – 2004

Summary

by

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VINNOVA´s foreword

Traffic accidents are a major social problem. Costs for killed and injured in 2005 have been estimated to exceed 29 billions Swedish crowns. To this number should be added considerable human pain.

However, the ongoing development as regards traffic safety is positive. During the period 1970 – 2004, the number of killed per year has been reduced to one third, from 1307 to 440 per year, despite the fact that the amount of traffic has more than doubled in this period. This positive development includes unprotected road-users as well as drivers and passengers in vehicles. Furthermore, there are no signs that this positive development should not continue.

The present impact analysis demonstrates that research on traffic safety has had great importance for the increase of traffic safety. At the same time, it has formed the basis for considerable commercial success within the automotive industry.

To our knowledge, this is the first time that an analysis of an entire research field over a period as long as 33 years has been concluded, allowing an overview of the full effects of the research.

The following questions were asked at the start of the analysis: What effects and benefits society, companies and university research has been generated by the contributions made by VINNOVA and it's predecessors KFB, TFB and TFD, as well as the Programme Council for Vehicle Research (PFF)? And what mechanisms have been important to achieve these effects?

A first step of the analysis was to gain an overview of the research that has taken place, ref. Svensk trafiksäkerhetsforskning i tätposition (VA 2005:08), author Anders Englund (in Swedish only).

The analysis has been performed by a team at the Norwegian Institute of Transport Economics (TÖI), composed by Marika Kolbenstvedt project leader, Rune Elvik and Beate Elvebakk. The team was complemented by professor Arild Hervik and Lasse Braein at Molde University College, both recognised evaluators in Norway. Knut Sandberg Eriksen, Rolf Hagman and Fridulv Sagberg at TÖI have contributed with case studies. The analysis draws partly from VINNOVA's analysis Impacts of Neck Injury Research at Chalmers University of Technology (VA 2005:05), also performed by TÖI and Molde University College.

The analysis has been supported by an experienced reference group including Anders Englund, Christer Hydén Lund Institute of Technology, Claes Tingvall Swedish Road Administration, Hans Norin Volvo Car Corporation, Hans-Erik Pettersson Swedish National Road and Transport Research Institute, Maria Krafft/Anders Kullgren insurance company Folksam, Per Lövsund/ Mats Svensson Chalmers University of

Technology, Yngve Håland Autoliv, plus Joakim Tiséus and Ove Pettersson at VINNOVA. The group has contributed with deep understanding of Swedish traffic safety research, with viewpoints and enthused discussion.

VINNOVA gives considerable importance to analyses that describe the impact that results from our funding. Viewpoints on the present analyses are welcomed - please contact Torbjörn Winqvist at our Strategy Development Division, who has served as VINNOVA's project leader.

VINNOVA in May 2007

Per Eriksson
Director General

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Effects of Swedish traffic safety research 1971 – 2004

Traffic accidents are a major social problem, estimated by WHO to become the world's third largest health problem by 2020. On a global basis, some 1 – 1.5 million people are killed in traffic accidents annually. To this should be added all those who are injured. In Sweden alone, the total socio-economic costs of traffic accidents each year are around SEK 30 billion SEK (table S.1). Thus there are great human and socio-economic benefits to be gained from increased traffic safety.

Table S.1: Numbers killed and injured *) in Swedish traffic accidents in 2005 together with an estimate of the costs based on SIKA's evaluation (2001-prices). In million SEK

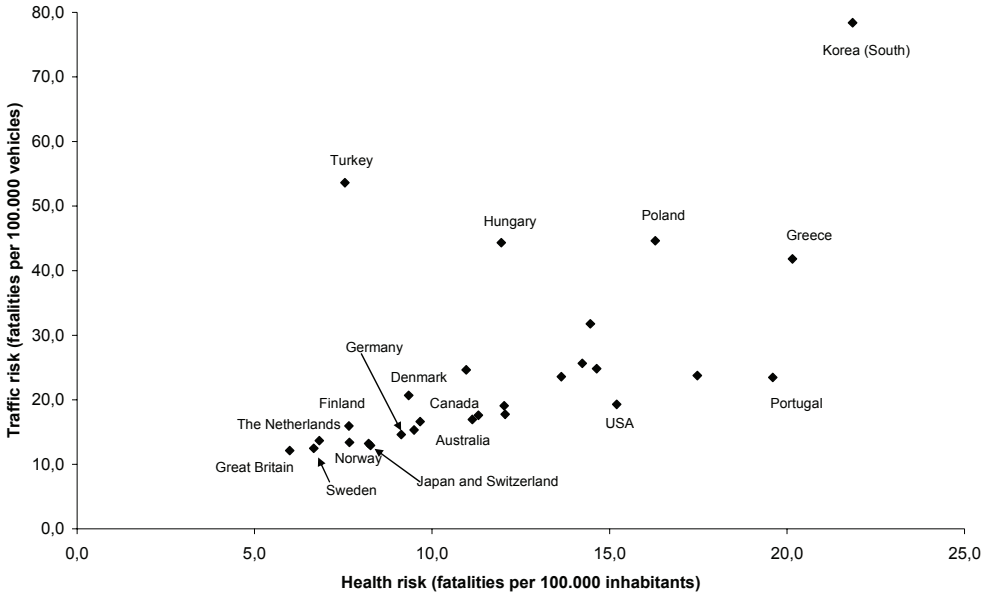
Degree of injury	Annual total for 2005	Cost per injury	Social cost
Killed	440	17,50	7 700
Seriously injured	4 400	3,12	13 700
Minor injuries	44 000	0,18	7 900
Total			29 300

**) The statistics for injuries are not complete. According to SIKA's accident statistics, the reporting level is 59% for serious injuries and 32 % for minor injuries. This gives a ratio between fatalities, serious injuries and minor injuries of 1:15:160 respectively. The report uses the ratios of 1:10:100 in order not to overestimate the numbers of people injured.*

There are major differences between countries with regard to risk in traffic. The level of risk is affected by a country's economy, degree of motorisation, knowledge of effective safety measures and the resources available for preventing and reducing injuries.

Traffic safety in Sweden is very good compared both to what it was in 1970 and to what it is today in other countries with a high level of motorisation. Today Sweden is one of the world's leading countries within traffic safety (figure S.1). Sweden has succeeded in reducing the numbers killed in traffic from 1307 in 1970 to 440 in 2005, despite the fact that the amount of traffic has more than doubled in this period.

Figure S.1: Health risk (fatalities per 100,000 inhabitants) and traffic risk (fatalities per 100,000 vehicles) in 2000 in countries that are members of IRTAD



Source: IRTAD

One important reason why Sweden has been successful in the area of traffic safety is that the effectiveness of knowledge-based safety measures was recognised at an early stage. Sweden has also invested significant resources in traffic safety research during the last fifty years. This study concludes that public funding and input into VINNOVA and its predecessors and the Programme Council for Vehicle Research (PFF) have contributed to the following:

- Annually Sweden saves 481 lives, which represents a societal benefit of SEK 8.4 billion and prevents many serious and minor injuries in traffic accidents
- The Swedish car industry has developed a number of safety products which favourably influences its global competitiveness
- Swedish research is of a high academic level
- Sweden has built up institutions that educate highly competent professionals within all areas of traffic safety.

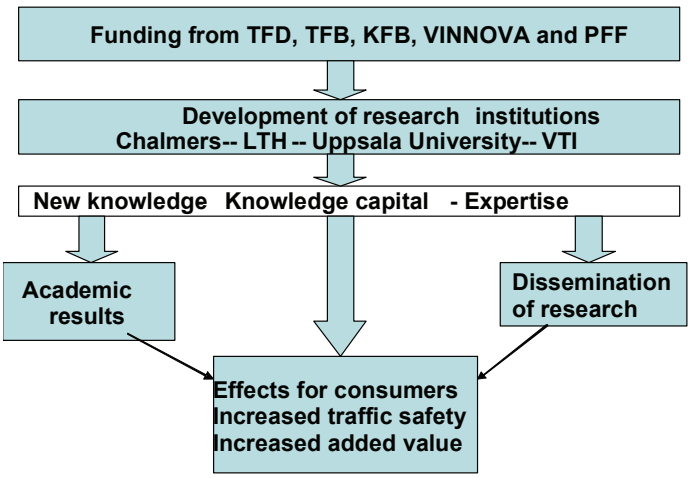
Objective of the evaluation study

A previous evaluation of Swedish whiplash injuries research found great benefits for society, industry and research. On the basis of this, VINNOVA wanted a broader study of the effects of Swedish traffic safety research. The Institute of Transport Economics (TØI) and Møreforsking Molde (MFM) have therefore carried out an evaluation study in order to answer the following questions:

- What effects and benefits has publicly- funded traffic safety research generated for research, industry and society?
- Which mechanisms have been particularly significant for the effects that have been achieved?

The analysis focuses on effect chains, from funding research to the behaviours of the research institutions and different forms of dissemination of knowledge to the end results such as a reduction in the numbers of killed/ injured in traffic and increased added value in Swedish safety-related industry (figure S.2). The design and results of the study have been discussed with Swedish research institutions and VINNOVA as part of the project.

Figure S.2: Effects of publicly funded Swedish traffic safety research – a model of effect chains



Accidents occur as a result of a failure in the interaction between the three main elements of the traffic system – the road user, the vehicle and the road/ surroundings – and between these and the regulatory system. Hence the starting point for our analysis is that traffic safety should be seen in a system perspective.

Comprehensive public focus

Traffic safety research is largely research directed towards one sector- the transport sector. Sector research can and must be based upon more basic research done by the universities and can itself contribute to this kind of research. Nonetheless, it requires separate funding, since scientific research councils do not normally support sector research.

The history of traffic safety research in Sweden goes back to the 1940s, and from 1949 to 2000 there were sector specific support bodies. The study covers the period 1971 – 2004. As complete data for research funding is not available for the years before 1974, this is used as the starting point. The analysis focuses on the contributions of the following public funding bodies:

- Swedish Transport Research Delegation (TFD)
- Swedish Transport Research Board (TFB)
- Swedish Transport and Communications Research Board (KFB)
- Swedish Governmental Agency for Innovation Systems (VINNOVA)
- Programme Council for Vehicle Research (PFF)

The first four are actually the same body, renamed as a result of numerous re-organisations, while PFF is a collaboration between the state and industry that started in 1994. Both PFF and VINNOVA normally require that projects be funded jointly with industry or with other public bodies. This kind of additional funding is not included in the analysis.

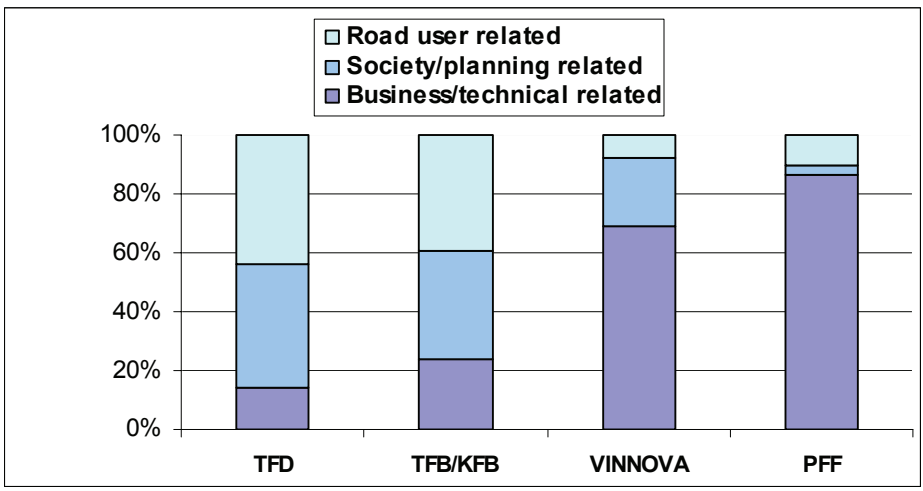
For many years, Swedish society has invested relatively large sums in traffic safety research. In total the five bodies listed above have granted SEK 0.44 billion between 1974 – 2004 (table S.2).

After KFB was merged with other research councils in 2000 and VINNOVA took over, annual funding has been somewhat curtailed and its direction has changed. The focus is now more on industry-related research (including technology and biomechanics) than it was before (figure S.3).

Table S.2: Traffic safety research funded by TFD, TFB, KFB, VINNOVA and PFF 1974-2004. Number of projects and million SEK (2000 values). SEK 12.7 mill ion for other objectives comes in addition to this

Source	Period	Grant in mill SEK	Number of projects	Mean annual grant mill SEK
TFD	1971-88	101.8	112	4.6-11.0
TFB/	1988-93	232.1	279	13.0
KFB	1993-00			
VINNOVA	2001 --	33.3	13	10.3
PFF	1994 --	60.6	30	8.4
Total		**427.8**	**434**	

Figure S.3: Research funding from TFD, TFB/KFB, VINOVA and PFF in the period 1974 -2004 according to subject content of project. Proportion of projects (N=431)



The funding bodies that have been studied are not the only contributors to Swedish traffic safety research. This research has also been granted significant funding from state and municipal authorities and from industry and insurance. In addition, public funding has been given in the form of basic research grants to the universities and research institutions such as the Swedish National Road and Transport Research Institute (VTI). However the contributions from other public sources have not been studied in this project.

The Swedish National Road Administration (VV), which is a major player in this field, has funded research and contributed to the development of research institutions through separate departmental programmes and funding for investigations, and also administers the Registration Plate Trust Fund. The Road Safety Inspectorate and the National Traffic Safety Administration, which existed between 1968-1993, have also played an important role. At the international level the EU's framework programme has been particularly significant.

Most of the funding goes to the university and the institutes

The majority of the funding from the research councils has gone to universities and universities of technology or to research institutes. These account for 58% and 26% of the projects respectively, making a total of 84%. VINNOVA and its predecessors, and PFF have invested heavily in creating research institutions and a total of 60% of the funding has gone to the following four institutions, which occupy a leading position within Swedish traffic safety research:

- Department of Applied Traffic Safety (TTS), Chalmers Technical University (Chalmers) –
  SEK 56.7 million spread across 34 projects
- Department of Technology and Society, Lund Institute of Technology (LTH) – SEK 47.4 million spread across 62 projects.
- Department of Psychology, Uppsala University – SEK 47.8 million spread across 54 projects
- The Swedish National Road and Transport Research Institute (VTI)– SEK 102.7 million spread over 105 projects.

While TFD, TFB and KFB spread their funding across all the above institutions, PFF and VINNOVA have so far only supported Chalmers and VTI.

The rest of the funding is divided relatively evenly across 105 institutions. Beyond the four main institutions, six other institutions have taken on more than five projects. The input into the smaller institutions has often been done in co-operation with the larger institutions.

The evaluation is limited to the four institutes listed above. Case studies have been chosen to cover at least one of each of the environment's areas of work, namely:

1 Speed reduction measures in towns/ cities, including roundabouts (LTH)

2 Developing and standardising rearward facing child seats in cars (VTI and Chalmers)

3 Developing better protection against neck injuries and side impact protection (Chalmers)

4 More effective police enforcement against speeding and drink driving (Uppsala University and VTI)

5 Development and use of VTI's driving simulator (VTI)

This means that the report does not go in depth into other important Swedish research areas, such as trials with ISA (Intelligent Speed Adaptation), Driver training, Stability of heavy vehicles, Children in Traffic, The power model of the relationship between speed and road safety or Conflict studies – theory and methodology - for studies of interaction in traffic.

Sweden is a safe country – research has contributed to this

From 1970 to 2005 the number of fatalities in Swedish traffic has gone down by about 67% (from 1307 to 440) and the number of seriously injured by about 45%. Given that road traffic during the same period has increased by over 100% (from 37 to 77 billion vehicle kilometres), the risk of being killed or injured in traffic in Sweden has been reduced by over 80% and 50% respectively. In other words, every road user now travels more safely than before.

We have tried to estimate the contributions of different factors to the improved road safety in Sweden after 1970, and the extent to which the different measures have been based on research. The study is limited to factors that have been widely tested in practice and where previous evaluation studies provide a basis for estimating their effects. Other factors may be equally important, but their effects cannot be estimated on the basis of the available data. It is important to be aware of this when interpreting the results.

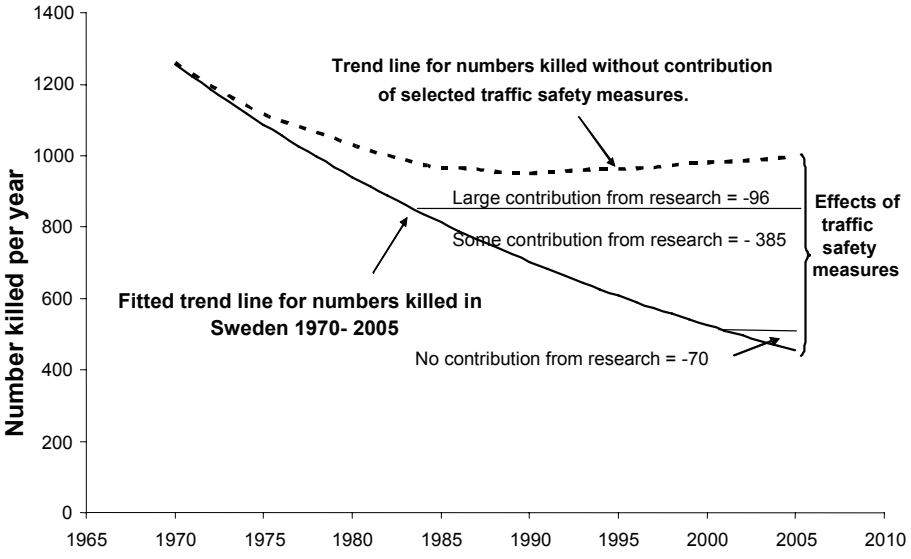
The importance of research for the development and use of safety measures has been assessed in terms of the amount of research done in the different areas, the country of origin of the research and its impact in Sweden.

In total, the factors included in the analysis may account for a reduction in the annual death toll in Swedish traffic of 551 people. Figure S.4 shows the development in the numbers killed and the unobserved counterfactual development that might have taken place *without* the factors whose effects have been estimated. Even without the measures and the development trends included in the study, a decrease in the number killed in Sweden would have been expected.

Research and research-based safety measures have contributed significantly to the large reduction in the numbers killed in traffic accidents in Sweden. Figure S.4 shows that

measures that to a large extent are based on traffic safety research, may have reduced the numbers killed by 96 persons per year. Measures where research has provided a significant contribution may have reduced the numbers killed by 385. Factors not influenced by research are estimated to have contributed to an annual reduction in road deaths of 70 people.

Figure S.4: Long-term development of numbers killed in Sweden. Trend line fitted to actual data and curve showing possible development without contributions from selected traffic safety measures and the significance of traffic safety research.

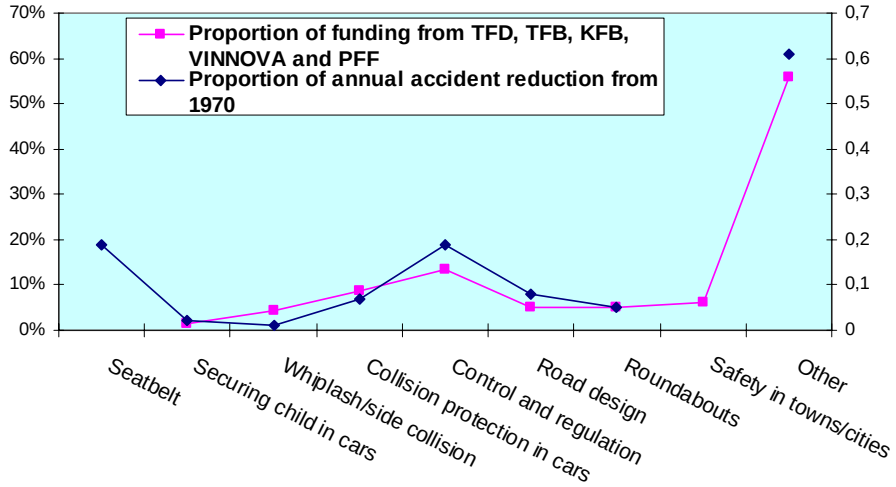


Comment: The total number killed, resulting from different measures, does not take into account any interaction between the measures.

We have also classified research projects according to the type of road safety measure they are most closely related to in the combined portfolio for VINNOVA and its predecessors and FFP, and assessed whether the size of research funding is statistically related to the estimated size of the effects of the road safety measures (figure S.5). The effect of seat belts is included even though much of the research input dates from before 1971.

Figure S.5 further shows the amount of research for safety measures in towns and cities other than for accidents at crossroads, even though we do not know the safety effects of the different measures. However, we do know that safety in Swedish towns and cities has increased significantly.

Figure S.5: Calculated effect of different traffic safety measures and research input (number of projects) within groups of measures supported by VINNOVA and its predecessors and PFF in the period 1974-2004



In other words, it can be concluded overall that the funding provided by VINNOVA and its predecessors and PFF has contributed to improving road safety and that investments have been made in important project areas.

Investment has provided great socio-economic benefits

In a macro perspective, Swedish traffic safety research has been found to be useful. The estimated effect on road accident fatalities of all the factors that have been studied, all of which were based on a (large or given) research input, amounts to 481 lives saved per year. This represents a socio economic benefit of SEK 8.4 billion, based on SIKA's evaluation of a human life as SEK 17.5 million (2001-prices). The benefit far exceeds the support from VINNOVA with its predecessors and PFF. If we also take those injured in traffic accidents into account, the benefit is several times higher, see table S.1.

In the case studies, we find that:

- Speed reduction measures in Swedish towns and cities have given a socio-economic benefit (present value) of SEK 17.1 billion for a total cost of SEK 6.9 billion. It is estimated that the measure has contributed to 40 fewer being killed, 170 fewer being seriously injured and 180 fewer minor injuries per year
- The benefit to society of child restraints in cars is SEK 1 350 million (present value). The cost is estimated at SEK 210 million. The measure has contributed to

16 fewer fatalities, 38 fewer seriously injured and 504 fewer minor injuries per year.

- The benefit of better neck injury protection (whiplash) in new vehicles is estimated at SEK 1.9 billion (present value), while the development costs are calculated to be about SEK 100 million and the costs for car buyers are around SEK 100 million. The measure has contributed to 63 fewer seriously injured and 250 fewer minor injuries.
- The benefit of side impact air bags is estimated to be SEK 4.6 billion (present value). The costs can be estimated at around SEK 450 million. The measure is estimated to have contributed to 10 fewer fatalities and 75 fewer seriously injured per year. No data is available for minor injuries.
- More effective police enforcement has contributed to 150 fewer fatalities per year, 250 fewer seriously injured and 220 fewer minor injuries. The annual cost of police enforcement in Sweden is around SEK 500 million. The benefit in the form of fewer people being injured or killed is estimated to be around SEK 3.4 billion per year.

The measures included in the case studies have produced a major net benefit, amounting to around SEK 20 billion in total. The figure is not exact as it is difficult to calculate a total ”savings” benefit over a number of years for different measures. This particularly applies to police enforcement where the benefit normally occurs during the period when it is taking place.

The estimates refer to the benefit for Swedish society of the research based measures, but products/ measures that the research has initiated, will also have benefits outside Sweden. The value of these is not included in the figures.

Effects on society’s way of thinking

Through their input, VINNOVA with its predecessors and PFF have ensured long-term co-operation between researchers and users. This has led to effective use of research results, including changes in perspective and also enabling researchers and users to develop a joint understanding of questions and problems.

The rearward facing child seat is a good example of how an innovation in research can revolutionise our way of thinking. The car industry, the traffic authorities and the insurance industry's joint concept of ”the Swedish child seat culture” is an expression of this. By understanding that a child's body cannot withstand collision forces in the same way as an adult, realisation has dawned that children are not small adults and they have different physical and psychological requirements and abilities. This has also been significant for planning measures to protect children in traffic.

Similarly we find that a successful emphasis on traffic safety in towns can be copied to a research- based way of thinking. This has been demonstrated in cities such as Växjö and Göteborg, where VINNOVA's predecessors, TFD, TFB and KFB, have supported different projects. The Swedish Vision Zero is an example of how research-based knowledge has changed the perspective on where the focus should lie in traffic safety policy and which measures are effective.

These effects are not only national. The Swedish traffic safety discussion has had great influence in the EU and we find the Swedish argument for shared responsibility, "forgiving" roads and road surroundings in the EU's policy documents. It can also be mentioned that the ISA concept (ISA = Intelligent Speed Adaption), where research began at LTH in Sweden, is beginning to gain a foothold within the EU.

Traffic safety is an important part of the Swedish trademark. It is well known within the EU system that professionals in Sweden invariably have a high level of expertise and have achieved good results within this field. Sweden has been in a position to impose a successful traffic safety policy partly due to the fact that the policy is based on solid research. It has been possible to adopt relatively broad decisions regarding traffic safety because it has been possible to justify the decisions by referring to large, documented effects.

There is also the fact that the Swedish traffic safety system is research-intensive that has made it possible to export this. Research- based knowledge, where the effects of measures have been systematically studied using scientific methods, allows others to check and utilise the results.

Sweden is regarded from outside as one of the countries where you can rest assured that traffic safety measures will not just be set by law but will also be implemented and evaluated. The basis for this successful policy appears to be knowledge of the causes of accidents or injuries, which in turn makes it possible to carry out effective prevention. The rationality in the system is therefore important in Sweden's international influence in this field, and this rationality is contingent upon highly competent research institutions.

Focusing on safety is also valuable for Swedish vehicle related industries

Right from the start, Swedish traffic safety research has had a close relationship with different sectors of society. The National Road Safety Council, which operated between 1949 and 1971, had members from the authorities, organisations and industry on its board. The link to the vehicle industry for example was an important precondition for the rearwards facing child car seat going into production relatively

quickly. The link to authorities and organisations contributed to laws and other measures which accelerated their use.

The case studies involving safety systems developed by industry all show that the link between basic research (in medicine, psychology, biomechanics) and industry has been decisive for the results which have been achieved. Knowledge of the biomechanics leading to whiplash injuries has made it possible for Volvo Car Corporation, Saab and Autoliv to develop competitive, innovative products.

The co-operation with VTI and using their advanced simulator has also been fundamental for the development and has contributed to PhD projects and the development of the necessary expertise to get ahead in international competition. In industry it is not regarded as possible to develop traffic safety products that are not based on research.

Autoliv, Volvo Car Corporation and Chalmers are now working together on the further development of the BioRID crash test dummy and the American dummy THOR, to a ”multidirectional” frontal collision dummy. PFF is involved in financing the project that is also developing dummies in women and child sizes. On the basis of this research, Autoliv, together with Chalmers and Folksam (insurance company), is working on improving frontal airbags and the overall protection afforded by seat belts and airbags with respect to neck injuries.

New vehicle based systems for preventing accidents have gained increased attention recently from Autoliv, Chalmers and vehicle manufacturers. These are electronic systems which help the driver avoid accidents or to reduce the effect of accidents by reducing engine power or by active intervention. Research into these types of systems requires knowledge of both biomechanics and human behaviour. A new generation of products within this field will come onto the market and is expected to have major commercial potential.

The report also tries to estimate the added value in Swedish industry as a result of the products based on Chalmers’ research into whiplash. Autoliv, which is one of the world's leading manufacturers of safety equipment for cars, estimated in 2002 that the global market for side-on impact protection was around SEK 10 billion. The industry's producer surplus in Sweden was estimated to be SEK 920 million per year. This estimate is based on the costs of producing the equipment, as it is assumed that the benefit from the products on the market is *at least as great* as the costs of producing them, otherwise they would not have been marketed. The real benefit is obviously greater but cannot be calculated precisely.

The total socio economic benefit for Swedish society of better safety as a result of focusing on research is high, and industry also shares the benefits in that safer vehicles (produced in Sweden) sell better than less safe vehicles (wherever they are made)

Industry has also benefited from research support for projects such as building infrastructure (simulators) and developing products (crash dummies). Funding for PhD students and the development of expertise at the universities have enabled industry to buy services from these institutions and given them access to competent staff. The case studies clearly illustrate that state support for these products has also been useful for industry.

Qualified research institutions within traffic safety research have been of great significance in supplying the vehicle industry with expertise. This may have been decisive for the production of vehicles and equipment still being based in Sweden; even after Ford and GM took over Volvo Car Corporation and Saab respectively.

Traffic safety and safer vehicles are valuable trademarks for Sweden. Increased competition will mean that Swedish research co-operation will face major challenges in the future. The on-going development of the infrastructure for research at Lindholmen in Göteborg concerning the vehicle industry cluster is an important measure for further developing comparative advantages in Swedish safety- related vehicle- and supply industries. These include Test Site Sweden and the new safety research centre SAFER. Both Chalmers and VTI are a part of this, together with VINNOVA and a number of industrial partners.

Strong, diverse research institutions have had an effect

Support from VINNOVA and its predecessors and PFF have laid the foundations for a number of strong Swedish research institutions in the area of traffic safety. The following have been achieved:

1 Several universities have elected to focus on traffic safety in their research and teaching

2 Research which is of a high international standard and researchers who actively participate in international research co-operation

3 The development of research institutions with complementary disciplinary specialties

4 Ensuring professionals within Sweden who can fulfil expert roles and disseminate international research.

Teaching in the field of traffic safety is very important in order to ensure highly competent co-workers in Swedish administration and industry. Further education for administration at the municipal level is an important activity at both LTH and VTI, which have both spread Swedish expertise through courses in a number of developing countries. Uppsala University has trained psychologists for the other institutions and Chalmers has contributed with different types of expertise for industry.

Research funded by VINNOVA and its predecessors and PFF is of a high international standard, has good international coverage and the players participate in international organisations. Sweden's share of articles in *Accident Analysis and Prevention, Journal of Safety Research* and *Safety Science* (the highest ranked scientific journals within the field according to the *Institute of Scientific Information*) in the period 2000-2005, for example, was 6.7%, while England had 8.6% of the articles.

Representatives for DGTREN[1] and ETSC[2] estimate that Swedish research institutions are amongst the best in Europe, which is also supported by the fact that Sweden takes part in about half of the projects in the area of traffic safety in the EU 6th framework programme. VTI and Chalmers have been particularly active in the EU system and the 6th framework programme and LTH is also actively participating in international project co-operation.

The diversity of topics covered applies either to what we see in the thematic profile (figure S.6), or the areas of measures where funding has been obtained. Chalmers focuses on technical, biomechanical and business- related research, while Uppsala University has concentrated on road user-related research. LTH has a high level of expertise in planning in towns and cities, developing road systems and in understanding conflicts and interaction between roads and road users.

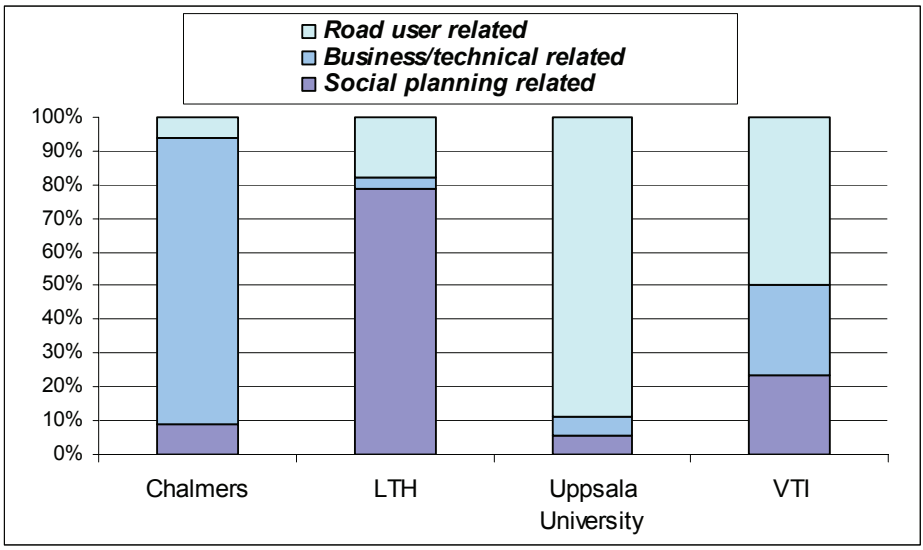
As a sector institute in the area of transport, VTI naturally has a broad spread of activities and around 40% of VTI's work is linked to the area of traffic safety. VTI has access to technology for testing safety equipment such as collision tracks and driving simulators. They also work with traffic- related research: use of safety equipment, driver training and children in traffic. Analyses of accidents and factors influencing them are another core area at VTI.

Traffic is an interaction between road users, vehicles and roads. Knowledge of all these three elements is therefore required in order to increase safety. The fact that the research institutions have developed different profiles has clearly been a strength for Swedish traffic safety, since this breadth has given society a professional research basis for many of the areas that make up the traffic system. With good access to resources, the research institutions have not felt that they are competing with each other, but have been able to draw upon each other as required.

[1] DG TREN (*Directorate General for Energy and Transport*) is responsible for development within transport and energy policies and finances, and organises much of the EU- funded research within traffic safety.

[2] ETSC (*European Transport Safety Council*) is an independent organisation which works with European decision makers to promote traffic safety. The organisation is funded by the member organisations, the EU commission and through sponsorship funding.

Figure S.6: Research funding from VINNOVA and its predecessors and PFF for four Swedish traffic safety research institutions from 1974-2004 according to the subject content of the project. Proportion of projects (N=253)



An illustration of this is research into police enforcement at Uppsala University and VTI. The research at Uppsala compared the effectiveness of various techniques of enforcement, while the research at VTI documented the need for enforcement by demonstrating the significance of speed for safety and by showing that speeding is very common. This convinced the authorities to focus more on enforcement as an effective measure.

Swedish traffic safety research – an example of a good research circle

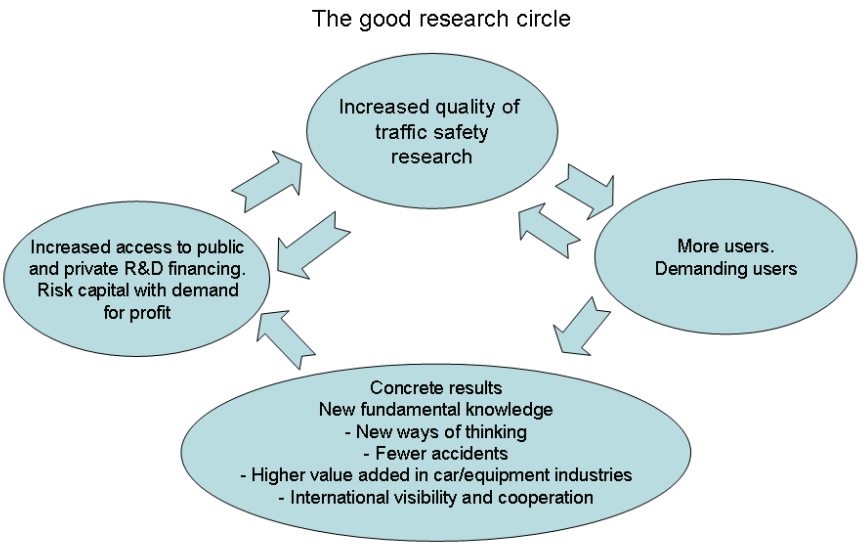
Expertise within traffic safety in Sweden is very good and there is no doubt that the funding from VINNOVA and its predecessors and PFF has created what we call a good research circle. Swedish research has contributed to adding value in the vehicle related industry and to policy development in the area of traffic safety both nationally and internationally

The quality of the research is a necessary condition for creating a good research circle (figure 7). This is often underrated in discussions about what contributes to innovation and creative processes. Where unity in the mechanism contributes to developing high

quality research, this will enable spin-offs in all directions. High quality generates both more users and more demanding users, which will motivate the research institutions to raise the quality even further.

With high quality and users who have an understanding of the importance of basing their choices, strategies and actions on research knowledge, the probability of good results for society and for industry also increases. Good mechanisms for making the results and the effects visible creates better opportunities for research and innovation.

Figure S.7: An illustration of a good research circle with effects for society and for industry.



The following elements characterise the Swedish focus on safety research:

- Understanding the significance of knowledge and tradition for the systematic evaluation of measures in the area of traffic safety amongst Swedish politicians and authorities, which for almost sixty years have set aside public resources for safety research.
- Developing highly competent research institutions that together cover the most important challenges within the road user - vehicle - road interaction that causes deaths and serious injuries in traffic. Swedish administrative bodies have thus obtained tools for managing traffic safety from a system perspective.

- The funding systems have contributed to the development of networks and arenas for learning and interaction. Highly competent users in administration and industry ask for research to be carried out, and have paved the way for important knowledge being converted into practice in administration and in industry.

The network of researchers and other professionals have contributed to the diffusion and dissemination of knowledge to the whole of society. This has contributed to changes in the way of thinking and to visions and strategies for traffic safety work based on scientific knowledge. Organisations and municipalities have also contributed to these effects.

What makes a good research circle?

The good research circle illustrates the significance of quality. The research institutions' self-evaluations, dialogues with them and with users, the five case studies and corresponding evaluation studies in other countries provide some important conditions for achieving this type of circle:

- Focus on increasing expertise through support for the education system and basic research combined with incentives in order to ensure that the discipline-related research at universities and polytechnics elects to work on traffic safety in their research, their PhD programmes and in their teaching. The support systems have ensured that there is prestige in working in safety research.
- Competent and non-bureaucratic support for researchers and research institutions is vital to get the best possible return for the input. All the institutions in the study emphasise simple, competent handling of applications as an important characteristic of VINNOVA and its predecessors and PFF.
- The research institutions stressed the fact that during the period from 1971-2000 they had relatively stable and predictable funding for example through thematic programmes, rather than fundraising for individual projects.
- The research institutions have received support during critical phases when other sources have not provided support or shown interest.
- The breadth and size of the focus from 1971 has opened the way for cross-disciplinary innovation and for interaction rather than competition. The breadth indicates a willingness to take risks on the part of the funders that has paid off and has created greater chances for dealing with unexpected knowledge demands.
- Making the effects visible in a form that the grant -making authorities can understand, for example through socio-economic measurements of results, has contributed to demonstrating the relevance of the research. This has been an important way to increase the funding levels.

- Good contact with the whole user spectrum has also contributed to overturning practical and political barriers to implementation. Contact with the users has also contributed to the research results being ”packaged” in a suitable way.
- There are also good circle effects in the support that is given to international activities and participation. This has led to a raising of quality that has in turn resulted in spin-offs both nationally and internationally.

The good research circle illustrates the need for overall responsibility for unity in the whole mechanism. Our main impression is that VINNOVA with its predecessors and PFF in many ways have created the way to run a good research circle. After KFB was dismantled in 2000, conditions changed, so that there was no longer one single authority with a total, all-encompassing responsibility for Swedish traffic safety research.

The research institutions that we have interviewed, express some unease for financing doctoral programmes and for the long -term, fundamental development of knowledge and theory development within traffic safety in the future. It is the support for such activities that has given the university institutions incentives to put time into traffic safety research. No matter where they come from, the interviewees also state the need for resources for behavioural science and planning-related research.

A total, all-encompassing responsibility for Swedish traffic safety research over fifty years has ensured that there have been no gaps in the funding of long term research or for important parts of the unity which is needed in order to understand and manage traffic safety in a system perspective. Sharing responsibility between VINNOVA and Vägverket (Swedish Road Administration) imposes new demands for co-operation between the players if the breadth and long-term perspective of the research are to be dealt with in the best possible way.

Additionality in all directions

The evaluation has relied upon evaluation research’s understanding of additionality as a central concept for describing effect chains:

- *Input additionality* describes the degree to which different tools contribute to increased research input and institutional development and measures the accuracy of what happens by releasing more research funding. We find clear examples where such support has released new funds from industry.
- *Behavioural additionality* shows how the tools, here the public research funding, affects the behaviour in a complex system. Effects that we have seen are better links between research institutions and industry/ administration, and changes in the external players’ behaviours as a result of new knowledge, innovations and product development.

- *Output additionality* characterises the end results of the effect chains. In the analysis, the benefits to society of fewer deaths/ injuries have been estimated, together with the increased added value for Swedish industry, specifically the vehicle manufacturing industry. Additional effects include improved competitive ability and increased exports as a result of a head start in safety inbuilt in Swedish vehicles and Swedish safety equipment.

In order to make the different types of effects visible, we have used several perspectives and a combination of methods. The study utilised a socio-economic perspective in order to quantify given parts of the benefit gained in crowns for Swedish society and for industry and to weigh this up against the costs. Many factors will fall outside this type of analysis but it provides an indication of the size of the value of the research input.

Use of knowledge occurs both directly and indirectly and over very different time spans. We have therefore concentrated on obtaining data for effects where values cannot be so easily quantified. In order to obtain an understanding of a more diffuse transfer of knowledge, of what contributes to effects, of how support arrangements and effect potential are evaluated, we have used qualitative methods: document analysis, interviews, group discussions and self evaluations.

One challenge is that research is often not the only knowledge base and nor is it a sufficient condition for achieving effects. Research that is not used can nonetheless be useful. It can provide background knowledge and help to inform choices, and it can be fundamentally important in meeting future knowledge requirements.

On the basis of this study we can maintain that Swedish traffic safety research has had significant effects for traffic safety and the vehicle manufacturing industry in Sweden, and that these effects would probably not have occurred to the same extent without the long-term, broad focus on such research that has been provided by TFD, TFB, KFB, VINNOVA and PFF. The public research funding has provided additionality in all areas, in the form of increased input from other sources of funding focus on safety in important research institutions and a number of significant effects for society.

VINNOVA´s publications

May 2007

See www.VINNOVA.se for more information

VINNOVA Analysis

VA 2007:

01 Nanoteknikens innovationssystem

02 Användningsdriven utveckling av IT i arbetslivet - Effektvärdering av tjugo års forskning och utveckling kring arbetslivets användning av IT. *For brief version in Swedish and English see VA 2007:03 and VA 2007:13*

03 Sammanfattning - Användningsdriven utveckling av IT i arbetslivet - Effektvärdering av tjugo års forskning och utveckling kring arbetslivets användning av IT. *Brief version of VA 2007:02, for brief version in English see VA 2007:13*

04 National and regional cluster profiles - Companies in biotechnology, pharmaceuticals and medical technology in Sweden 2004. *Only available as PDF. For Swedish version see VA 2005:02*

05 Nationella och regionala klusterprofiler - Företag inom fordonsindustrin i Sverige 2006

06 Behovsmotiverade forskningsprogram i sektoriella innovationssystem

07 Effekter av den svenske trafikksikkerhetsforakningen 1971-2004. *For brief version in Swedish and English see VA 2007:08 and VA 2007:09*

08 Sammanfattning - Effekter av den svenska trafiksäkerhetsforskningen 1971-2004. *Brief version of VA 2007:07, for brief version in English see VA 2007:09*

09 Summary - Effects of Swedish traffic safety research 1971-2004. *Brief version of VA 2007:10, for brief version in Swedish see VA 2007:07.*

10 *Under production.* Effects of Swedish traffic safety research 1971-2004. *For brief version in Swedish and English see VA 2007:08 och VA 2007:09*

11 Svenskt deltagande i sjätte ramprogrammet. *Only available as PDF*

12 The role of Industrial Research Institutes in the National Innovation System

13 Summary - User-driven development of IT in working life - Evaluating the effect of research and development on the use of information technology in working life. *Brief version of VA 2007:02, for brief version in Swedish see VA 2007:03*

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05 Offentligt stöd till universitetens samverkansuppgift - en internationell kartläggning. *Only available as PDF*

06 Inkubatorer i Sverige - analys av indikatordimensioner och nyttoefektivitet. *Only available as PDF*

VINNOVA Forum

VFI 2007:

01 Universitetet i kunskapsekonomin *(Innovation policy in Focus)*

VINNOVA Information

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01 Forska&Väx - Program som främjar forskning, utveckling och innovation hos små och medelstora företag

02 MERA-programmet - Projektkatalog. *For English version see VI 2007:03*

03 The MERA-program - Projects. *For Swedish version see VI 2007:02*

04 DYNAMO 2 - Startkonferens & Projektbeskrivningar

05 IT för sjukvård i hemmet - Projektkatalog

06 VINNVÄXT - Ett program som sätter fart på Sverige! *For English version see VI 2007:09*

07 Årsredovisning 2006

08 Het forskning och innovationskraft - VINNOVA 2006. *For English version see VI 2007:10*

09 VINNVÄXT - A programme to get Sweden moving! *For Swedish version see VI 2007:06*

10 Red-hot research and innovation power - VINNOVA 2006. *For Swedish version see VI 2007:08*

11 Research and innovation for sustainable growth. *For Swedish version see VI 2006:20*

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13 VINNOVA´s activities in Biotechnology

14 Arbetslivsutveckling - VINNOVAs satsningar inom arbetslivsområdet

16 Competence Centres in Figures - Kompetenscentrum i siffror

17 E-tjänster i offentlig verksamhet. *For English version see VI 2006:18*

18 E-Services in Public Administration. *For Swedish version see VI 2006:17*

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VINNOVA Report

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01 Design of Functional Units for Products by a Total Cost Accounting Approach

02 Structural Funds as instrument to promote Innovation - Theories and practices. *Only available as PDF*

03 Avancerade kollektivtrafiksystem utomlands - mellanformer mellan buss och spårväg. Tillämpningsförutsättningar i Sverige. *Only available as PDF*

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10 The Development of Growth oriented high Technology Firms in Sweden. *Only available as PDF*

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12 Om rörlighet - DYNAMO-programmets seminarium 12 - 13 juni 2006

13 IP-telefoni - En studie av den svenska privatmarknaden ur konsument- & operatörsperspektiv

14 The Innovation Imperative - Globalization and National Competitiveness. Conference Summary

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VINNOVA´s mission is to promote sustainable growth
by funding needs-driven research
and developing effective innovation systems

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