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Social shaping of transport telematics: The case of Germany

1. Introduction

Urban congestion problems, environmental impact of traffic growth, and difficulties in funding new transport infrastructure are very important concerns in many European countries. Different strategies to cope with these challenges, social as well as technological have emerged. Recently, transport or road telematics has been promoted as a major new set of technologies that may solve or at least reduce these problems, for example by optimising traffic flows, regulating access to city centres or managing new and more efficient forms of traffic taxes.

The fact that there are distinctly different options for developing and implementing transport telematics means that it is important to study the way transport telematics is socially shaped. What political, economical or professional concerns influence the choice of some options and rejection of others. To what extent are such shaping influences an outcome of national policies, relative to local policies? These are issues that we will analyse in this paper by focussing on and compare some Europewide initiatives with developments in Germany and in particular the city of Hanover. Germany is very interesting in this respect because it has Europe's largest car manufacturing industry as well as a long tradition of liberalism in traffic policy. This creates an expectation that in the German context, transport telematics will be developed primarily to improve cars and not to impose regulations on traffic.

Transport telematics can be said to be a set of technological systems that use information and telecommunication technology in vehicles and infrastructure, to perform or support services intended to improve road transportation from the point of view of safety, efficiency, comfort and environment (Juhlin 1997). This broad definition points to a wide area of potential applications, as well as a considerable scope of flexibility of interpretation of what transport telematics should be about.

The area of transport telematics has been characterised by a considerable degree of technological optimism, although clearly it is the outcome of a complicated interplay of many factors, including new political and socio-economic relations, technological and commercial development and specific developments within the transport sector. Generally, new solutions tend to be promoted by an alliance of both private corporate interests and public actors. The development of this technology is therefore not only politically motivated but rather a result of both corporate and public influences: "*The introduction of transport telematics in Germany is based on a clear task-sharing between political and industrial circles, the transport modes and service providers.*"[1]

There are some quite radical expectations related to ideas about automated highways and intelligent vehicles:

> "It's a misty morning in the suburbs, 2005. Another drive to work. Why are you smiling? As your up-marked automobile waits in the driveway, it already knows whom you are, how you like your seat to feel and where you're likely to going. It will plan the route, avoid bad traffic and weather, steer perfectly in the centre of the road, pay the tolls and even reserve a parking spot. All the while, it talks to you about anything you want. You listen to stock prices, surf the Internet, sort e-mail, make reservation for lunch and even learn a foreign language".[2]

This is a kind of science fiction vision of the future traffic development or a visionary consideration or a prospect of the future development of the transport sector. The main goal is to manage the constant increase of cars on the roads.

While such visions may be attractive, not the least to car manufacturers who may see this as a way of selling new cars, a more realistic and less fanciful example may be provided by reference to recent developments in the city of Trondheim, the third largest city in Norway. It has about 150,000 inhabitants, and the number of automobiles per inhabitant amounts to around. An extensive use of land means that the city never really have had considerable congestion problems. Nevertheless, Trondheim has implemented an electronic toll road system. The revenues generated were used to finance more and better roads, as well as providing funding to other measures like bike lanes and noise barriers. More recently, planners, environmentalist and economists have taken the opportunity to redefine this toll ring as a kind of road pricing tool by making use of the possibility of introducing time differentiated fees. The main argument is that those who drive during rush hours are responsible for the need to expand road capacity. Thus, they should pay more. In addition, time differentiated fees are supposed to provide an incentive structure that encourages people either to use public transport during rush hours or to go to work at an earlier or later period.

We cannot here explore in any detail the reasons why Trondheim shaped transport telematics in this fashion. Clearly, the understanding that a steady increase in the number of cars would produce large traffic problems has been important. Moreover, during the last two decades, traffic-related negative aspects such as the amount of time spent in congestion or waiting for public transport and diseases caused by air pollution received much more attention.

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[1] http://www.baunetz.de/bmvbw/sprachen/englisch/10301c__.htm

[2] Time Magazine: "BMW Becomes a PDA". September 6, 1999 VOL. 4 NO 4

However, these shaping factors are shared in most western countries. The choice to cope with such problems by installing an electronic toll ring in a quite small city with a dispersed population and a non-remarkable density of cars indicates in principle that such an application of transport telematics is feasible in most cities in Western Europe.

However, from a different perspective, why Trondheim chose to implement an electronic toll ring and to develop this as a kind of road pricing tool may seem like a paradox since, relatively speaking, there were no great need to do so. The idea that the user has to pay for its usage has its origin in economic theory and has been heralded as the "polluter pays principle". Ideas of ecological modernisation (Hajer 1995) and the introduction of the idea of sustainable development through the so-called Brundtland Commission report "Our common future" in 1987 promoted an understanding of road pricing as a "green tax". The polluter has to pay for his or her damage. According to Hajer and Kesselring (1996) telematics has been "*(...) seen as measure of coping with the continuously increasing quantities of mobility and its spatial extension. Today telematics are often seen as a synonym for sustainable mobility technologies*" (Hajer and Kesselring 1996:4). Road pricing solutions like the one implemented in Trondheim clearly has such a "green" interpretation (Næss 2000).

One interesting feature in the case of Trondheim is the city's willingness to provide a testing ground for the company Q-free that designed an automated collect system based on surface acoustic wave technology in the late 1980s. The argument was that if the technology could be demonstrated to work properly, it could be sold to cities all over the world (Bye 2000). However, the main argument from city and transport authorities was that the revenue generated by a toll ring would greatly help in the funding of the plans of the local road authorities. The reinterpretation of this as green taxes was mainly a political move to generate sufficient support.

Thus, when we briefly compare the application of transport telematics in Trondheim and in Hanover, it is to emphasise that in theory, a great range of possibilities were available in both cases. In the rest of the paper, we will examine more closely some of the factors that have shaped transport telematics in Germany. This will be done with some curiosity towards the fact that the kind of radical solution to congestion problems, represented by road pricing or access limitation, were rejected in favour of efforts directed towards the optimisation of traffic.

In line with the concerns of the INTEPOL project, we will also explore the dynamics of local technology policy with an emphasis on the relationship between innovation and regulation and between ideology and technology. Transport telematics is an area that in particular offers interesting opportunities to look at the interaction between the economic interests of road authorities and the industrial interests of suppliers of relevant technologies.

2. Transport telematics as a godsend?

There has, as mentioned, been mobilised considerable optimism on behalf of the potential of transport telematics as a universal problem-solver. Both in terms of environmental and logistical issues. In their study "*Sustainable mobility in Munich*" Hajer and Kesselring (1996) investigated the strength of the connection between the idea of sustainability and transport telematics technologies. They found that apparently there was a close link between the two, that all actors involved saw the implementation of new technologies as a necessity for sustainable mobility, but that the actors stressed different sides of the technology's potential. From Hajer and Kesselring's analysis it became apparent that an integrative practise of local mobility politics were missing (ibid). Marc van Lieshout (1993) had a more pessimistic outlook and claimed, in a description of the development of transport telematics in the Netherlands, that instead of promoting sustainability, transport telematics are contributing to a further entrenchment of contemporary trends in road transport. Incentives for introducing new technologies in the design of private cars in order to promote sustainability seem to be absent. The trend is that new technologies are implemented to increase the safety of the car, rather than to reduce the environmental impacts following car traffic (ibid).

In his book "*Prometheus at the wheel*" Oskar Juhlin (1997) claims, in a similar manner, that the engineers involved in developing this new technology seem to be more concerned with getting more people on the roads rather than trying to reduce environmental impacts following traffic, at least at first glance. With a constructivist perspective he particularly studies technical testing and technical demonstrations. He claims that the development of transport telematics is a contingent practise, where technology never appears on its own, but where engineers enrol whatever elements necessary at the local level in order to create a more persuasive image of their work (ibid). This is a point we will return to later in this paper.

Nijkamp et al (1996) was more concentrated on the users of this new technology and their response to it. In this book it was claimed that it is necessary to understand the behaviour of the users before optimistic claims about the impact of the technology can be made. Their recommendation was that the users has to be convinced that the new technology works to their advantage, and that the demonstration effects of the new technology must be publicised widely in order for the usage of the existing transport and telecommunications infrastructure to be optimised. The main challenge for policymakers is therefore, in their opinion, that the public needs to be convinced that use of transport telematics and charging for real time information and the use of road space is of benefit to both the individual and society as a whole (ibid). The loss of freedom of mobility must be seen in relation to the costs following private car traffic. They therefore see the new technology as a possible tool to redress the balance between the external costs created by individual car ownership and the benefits for the individual.

In "*Smart highways, smart cars*" Richard Whelan (1995) gave an elaborate overview of current projects as well as a vision of the future development within what he calls intelligent vehicle-highway systems. His main focus was on projects in the U.S., but he also gave a description of projects in Europe and in Japan. What he found was that the projects tended to be local or regional in nature. His argument is that this is a consequence of the problems following from traffic inherently being a local problem and therefore local solutions are sought. In the U.S. this has been tried remedied through the creation of the Intelligent Vehicle Highway Society of America. IVHS America was to function as a co-ordinating and planning entity oriented towards building a national IVHS program (ibid). In Europe a similar organisation was created to oversee and co-ordinate the research, development, and implementation of intelligent highways and vehicles in Europe. It was called ERTICO (European Road Transport Telematics Implementation Coordination Organisation) (Ibid).

Rienstra et al (1996) reckons that if nothing is done in terms of shifting the modal split in favour of a more sustainable transport sector, and thereby decreasing the negative externalities following from car traffic, the environment will suffer. The question of sustainable mobility is, in their opinion, a question of making the right policy choices and they see new transport telematics systems as one way of doing this. However, this will not be enough when taking into account the expected rise in mobility and because the technological improvements only will be minor. In their opinion several different policy choices have to be made if a sustainable transport system is to be reached. First, one needs to decide whether collective modes or development of cleaner individual modes should be prioritised. Second, there is a need to decide upon the future spatial organisation of society. Third, a possible policy choice might be to make car traffic more unattractive despite resistance in society. Fourth, governments may stimulate new options by setting a good example.

The common denominator in all these books and articles seem to be that transport telematics holds a promise of a better future. Even though many of the stories told are pessimistic, there seems to be a general technological optimism in all these works, but the process of enrolling both the users and the technology has not been successful yet. Within the perspective of social shaping of technology (SST) the innovation process is described as the process of building 'sociotechnical systems'. SST builds both on a critique of the so-called 'linear innovation model' that sees innovation as a rational-technical problem solving process, and a critique of the idea of technological determinism. The first critique must be seen in relation to a central premise to SST, which is that there exists a range of choices in the design of artefacts and systems of artefacts. The innovation process can be described as a 'garden of forking paths' (Williams and Edge 1996). What the technological outcome will be is never given, but is rather the outcome of a negotiation process. Different groups will have different expectations and interpretations the technology depending on their interest in it. The concept of *closure*, the way in which innovations are stabilised, or *black boxed*, becomes important in relation to this (Pinch and Bijker 1984). The social construction of technology perspective (SCOT), which is the particular strand of SST that Pinch and Bijker (ibid) represents, highlights the importance of analysing how relevant groups of actors works towards shaping technologies to meet their ends. In relation to the field of transport telematics this can be fruitful in regards to analysing how the implementation of telematics is local in character. Different groups in different location will have a varying degree of relevance and influence on the decision of implementing telematics.

The negotiability of technology is also an important part of SST's critique of the idea of technological determinism. The assumption that technological change will produce social and organisational change is rejected by a notion of technology as also being shaped by political, social and economical factors, as well as technological. Williams and Edge (1996) says that SST research investigates the ways in which social, institutional, economic and cultural factors have shaped the direction as well as the rate of innovation, the form of technology and the outcomes of technological change for different groups in society. Technology is by definition heterogeneous. This means that SST also broadens the policy agenda by enabling social scientists to get inside the world of technology and science, rather than tinkering at the margins (Latour 1988). Democratising the technological decision-making has, according to Williams and Edge (1996), been an important aspect of SST already from the outset. In relation to transport telematics technologies democratising the decision process may be very important. Telematics are in many aspects a control technology, which may inflict to a large extent on drivers' behavioural pattern. There is a large potential in this technology for surveillance, and providing a window into the decision making process may therefore be very important, since the information obtained from the telematics systems may also be used for purposes other than regulating traffic.

A particular strand of SST that stresses the importance of analysing the development of technology in terms of a democratising process is actor network theory (ANT). This is perhaps the most elaborate and influential perspective within the field of science and technology studies. In actor network theory it is both a theoretical and methodological point to study the processes by which a scientific fact or artefact is established (Latour 1987). The development and diffusion of a new technology is understood as a series of translations needed to establish a given artefact (or fact) as a *black box*. *Translation* is the process by which actors are enrolled into a given scenario and where the meaning of the innovation is changed in order to cater for local needs and interests. The actors enrolled in a scenario will not passively adopt an artefact, but they will adapt it to accommodate to their specific needs. They will translate the artefact. According to Latour (Ibid) this means that the fate of an innovation always will be in the hands of its users. Thus the innovator needs to do two things simultaneously: "to enrol others *so that they participate in the construction of facts*; [*and*] to control their behaviour *in order to make* *their actions predictable*." (Ibid.:108). The latter point because users tend to be notoriously deceitful. Within ANT it is argued that it is important to perceive technologies as texts and that using them may comparable to reading. In this aspect both the symbolic and action aspects of the technology becomes important (Latour 1992). This opens up for a flexible interpretation of the technology.

By showing how micro-actors macro-structure the world, actor network theory displays how technologies are prone to be shaped locally. A central point to this paper is that in the case of transport telematics local interests will play a decisive role in the shaping of the preferred solution. These local interests can be summarised in the concept of a *mobility regime*. A mobility regime consists of a number of dimensions such as the physical shaping of cities and landscapes, the available transport systems, the relationship between mobility and economic, social and cultural activities, and the meaning attributed to mobility (Sørensen 1999). According to Sørensen this concept allows us to include the practise and meaning of mobility as well as the car and the physical infrastructure in our analysis. Thus, when trying to establish a transport telematics solution decision-makers have to take into consideration these and other interests.

3. Transport telematics as a local practise: Some methodological reflections

Different countries have made different initiatives to handle the growing use of vehicle in cities. In our reading it becomes clear that it does not exist a clear overall picture or interpretation of the concept transport telematics: each city has to find its own path towards implementation because the mobility regimes will vary considerably. Thus, these local social, economical, cultural, political, and transportation aspects will in different countries and cities affect the interpretation, shaping and implementation of the technology. In reference to this matter it is believed that the transport telematics technology is very anarchistic in that it can be used in manifold directions and be given different meanings in different contexts (Lieshout 1993). In spite of this interpretative flexibility, the common interests or superior goal for the cities that have a car problem seems not to be to reduce the number of cars, but rather to balance it. This means that every country and city wants to have people on the move, mobility is thought of as good, but because of the problems associated with it they want to make this movement more efficient. As we will see later in the paper, the common denominator for all these strategies is an expectation of an well-educated and enlightened public, which will conform and applaud the implementation of the new transport telematics technologies. The quote from Time Magazine illustrated quite well that transport telematics technology is filled with different control mechanisms (as instructions, route guidance, news etc). This will in turn demand a disciplined and kind driver. According to Geertz can these control mechanisms "*(...) as plans, recipes, rules,* *instructions for the governing of behaviour* [be compared with] *what computer engineers call 'programs'*"(Geertz 1973:44).[3]

We have concentrated on four projects that have been carried through in Europe and Germany. The projects are PROMETHEUS, DRIVE, CONCERT and MOVE. It starts with PROMETHEUS and ends up with MOVE. The empirical data used in this paper includes previous studies of the subject and different project reports from the CONCERT project. It also includes descriptions of the MOVE project, information from MOVE's Internet site and previous research done on the MOVE project, and information from EU databases on the Internet as well as from local and federal government in Lower Saxony and Germany, respectively.

4. Smart cars, smart highways or both? PROMETHEUS and DRIVE

The origins of transport telematics as an idea can, as we have seen, be traced to the 1980s. It was presented at about the same time as the phrase "sustainable development" was coined. If we look to the United States the development of such systems has been a national enterprise. This has not, however, been the case in Europe. The pioneering projects PROMOTHEUS and DRIVE are examples of this.[4] The expressed goals in these projects were to increase road safety and road capacity, decrease environmental pollution and support European industry. Key words in their visions were "integration" and "organisation" (Juhlin 1997). In a European context most of the efforts to achieve intelligent cars and highway systems are associated with these two programs. PROMETHEUS (PROgramme for European Traffic with Highest Efficiency and Unprecedented Safety) was a seven year research project. It was initiated by the car industry and performed within the framework of the EUREKA-Programme (European Research Co-ordination Agency: A European government-funded programme that promotes the development of advanced technology to be used in the design of new products by companies that work in partnership with public research institutions). Thus, already from the beginning the development of transport telematics in Europe involved public-private partnerships. The $800 million program aimed at improving road transportation and alleviating transport problems in Europe (Whelan 1995). The project was born out of the desire to use the new technology's potential for two-way communication (both between vehicles and between vehicles and infrastructure) for the sake of traffic planning.

PROMETHEUS was principally a private sector initiative aimed at developing a uniform European traffic system incorporating transport telematics technologies (Nijkamp/Pepping/Banister 1996:31). The ambition at

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[3] In relation to this it is tempting to quote Qtto von Bismarck who said that: "*Laws are like sausages, it is better not to see them being made.*"

[4] Prometheus was the wisest of the Titans (The titans, also known as the elder gods, ruled the earth before the Olympians overthrew them). His name means " forethought " and he was able to foretell the future.

the outset was to treat traffic as an overall system. However, private car traffic was to become the dominant perspective in PROMETHEUS (Prätorius and Lehrach 1998). As mentioned earlier a mixture of university research institutions, technology suppliers and various automobile companies (Ford, Jaguar, Rolls Royce, Volvo, Saab, Daimler Benz, Volkswagen, BMW and Fiat) established the project. It also had a management committee made up of eleven of the participating automobile companies. The initial phase of the programme did, for example, lead to several topics for co-operative research involving 56 electronics and supplier companies and 115 basic research institutes (Whelan 1995).

PROMETHEUS was a pre-competitive research program aimed at demonstrating technical feasibility, assessing the impact of the technology on traffic and arriving at a consensus on the functional interface between different system components (Ibid.). Information technology represented a whole new range of technological options that had to be explored, as a possible way to improve the transport system. Common European Demonstration (CED) was the standard format in PROMETHEUS for the type of co-operative research that was done in this program. Prototypes were not developed in this stage of the development. First one had to agree upon the problems that the new technology were to solve. Therefore, in this early stage interfaces were defined and acceptable functionality was demonstrated so that companies subsequently could enter into a competitive phase of development, production and deployment (Ibid.). The project was broken down into three areas of industrial research and four areas of basic research. The industrial research areas were: *Pro-car* (the use of on-board, self-contained technologies to monitor vehicle performance and help the driver), *Pro-net* (communication between vehicles) and *Pro-road* (communication between vehicle and road). The four areas of basic research areas were: *Pro-art* (use of artificial intelligence), *Pro-chip* (use of micro-electronic components for the various sub-systems), *Pro-com* (communication between vehicle and driver, other vehicle and roads) and *Pro-gen* (evaluation of the general impact on the traffic environment) (Prätorius and Lehrach 1998)

According to Prätorius and Lehrach (1998) there were five main areas of development where PROMETHEUS achieved significant improvements. First; developing systems of accident prevention allowing complete registration of all safety-relevant information for the drivers. Second; trying to make traffic more efficient and economical through homogenising traffic flow, reducing detours and overcoming air drag (by driving in convoys). Third; making a better road capacity utilisation through improving traffic organisation on the basis of route- and car-dependent facilities. Fourth; obtaining a higher efficiency through the development of a co-operative system between private car transport and public transport. And fifth; through increasing traffic efficiency and improving public transport the strain on inner city traffic was to be relieved, thus protecting the environment. The applications developed in PROMETHEUS therefore focused on applications for safer, more efficient driving, which did not rely on advances in the road infrastructure. The projects were carried out at three levels of control: Safe driving, co-operative driving, and travel and transport management (Whelan 1995).

Prätorius and Lehrach (1998) claim that the PROMETHEUS project during six years of development underwent four essential conceptual changes. First, there was a shift in focus from private car mobility to integrability into the overall traffic system. Second, instead of just focussing on passenger traffic freight traffic was also integrated. Third, a shift from focusing on automated driving to the informed driver and traffic participant. Fourth, a shift from being a strictly technological project to becoming a socio-organisational concept. According to Prätorius and Lehrach (Ibid.) these changes were caused by both a limited time frame regarding a possible realisation of the project, and a change in the definition of the problem to be solved. What becomes apparent is that the changes made resulted in a higher appreciation of the complex nature of the traffic system and not focusing on purely technical or economical factors. Traffic is perhaps more than just a logistics problem.

In the later phase of PROMETHEUS there was a close collaboration between PROMETHEUS and the DRIVE program. DRIVE (Dedicated Road Infrastructure for Vehicle safety in Europe) was another important project in terms of applying telematics on the transport system, and it was the main program aimed at introducing ATT in Europe. The collaboration between the programs had no formal means to integrate the separate activities. This lead to the founding of the European Road Transport Telematics Implementation Coordination Organisation (ERTICO) in 1991. It was formed as a private-public partnership designed to oversee and co-ordinate the research, development, and implementation of intelligent highways and vehicles in Europe (Whelan 1995). ERTICO is financed by annual fees from its partners and by contributions from third parties including the European Union.

DRIVE I, which was completed in 1991, was a three-year research program oriented toward exploring options for possible implementation of transport telematics in Europe. To balance the scale in relation to PROMETHEUS' focus on the inside of the vehicle, DRIVE was more concerned with road related infrastructure. However, it also included projects that integrated vehicle systems into the ATT environment (Whelan 1995). As with PROMETHEUS the objective of DRIVE (I+II) was to carry out a framework that would validate and improve the results already achieved as well as establishing common specifications and promoting standards for RTI/ATT systems (Keller 1994).

The first phase of DRIVE resulted in significant advances in the European integrated road transport environment. According to Keller (Ibid.) one of the main achievements of DRIVE I was that the CEN programming committee decided on the creation of a dedicated technical committee on "Road Transport and Traffic Telematics", the Traffic Computing Telematics (TCT 278). Other achievements were advancements in transport telematics technologies, evaluation of strategy options and contributions to an implementation strategy, and specifications, protocols, and, as mentioned, standards.

DRIVE II, which ran form 1992-1994, concentrated on strategies for management and introduction of telematics systems for communication and traffic control, development of new technology and experimental systems, and test projects and field tests. These three areas can be further subdivided into the following topics: Demand management, traffic and travel management, integrated urban traffic management, integrated interurban traffic management, driver assistance and co-operative driving, freight and fleet management, and finally public transport management (Whelan 1995). 64 projects and field tests with more than 500 participants from industry, science and governments, and a financial frame of 140 mill ECU, were examined in over 30 cities under real traffic conditions regarding their practical ability and their cost-benefit relation within the context of DRIVE II (Prätorius and Lehrach 1998). These (specifications) have their links to IVHS programme in the United States and Japan. In the United States there has not been much emphasis on demand management. This is due to the fact that much of the interstate highway system is toll-free. Whelan (1995) takes the European focus on demand management as a symptom of a more advanced state of congestion in Europe. In Europe this includes projects on access control and congestion and road pricing. Automatic toll collection facilitates the introduction of various adjustable pricing schemes and this is an area of technology that is already well established.

5. Taking telematics one step further - the CONCERT programme

The CONCERT programme (COoperation for Novel City Electronic Regulation Tools) was conceived as an action led by local authorities to address and tackle problems related to private car usage, such as air pollution, congestion and noise. While PROMETHEUS and DRIVE concentrated on developing technology that would contribute to giving the drivers good information, CONCERT took it one step further. The view of urban mobility demonstrated in PROMETHEUS and DRIVE was enlarged by the introduction a set of different push and pull measures to promote a modal shift in favour of public transport and responsible car usage in cities. There were eight different European cities participating in CONCERT. These were Barcelona, Bologna, Bristol, Dublin, Hanover, Marseilles, Trondheim and Thessaloniki. CONCERT was partly financed by the European Commission under the fourth Research and Development Framework Programme (40%), while the participating cities contributed with the 60% of the total cost. The project started in 1996 and was finished summer of 1998. The Commission's contribution to the CONCERT programme came from two different departments, DG VII and DG XIII, something that was reflected in the project objectives. CONCERT was subdivided into two different projects, which was named CONCERT –P and CONCERT TR 1013. The DG XIII part of the project (CONCERT TR 1013, which was a part of the 4th Framework Telematics Applications Programme) was more concerned with the technological applications. The DG VII part, however, was more concerned with studying the need for further policy development and user acceptance of such systems. Traffic authorities joined together with transport service operators and technology suppliers to configure and build innovative demonstrations of multimodal travel demand management.[5]

The starting point for the CONCERT programme was testing different prototypes for integrated payment of transport services. The main premise of the project was that price is the most important factor which influences travel behaviour (choice of travel mode and service type). CONCERT can be seen as a continuance of an earlier project named GAUDI where a vision of multiservicing (all mobility services uses the same standardised electronic purse as payment instrument) through integrated payment was concept-tested.[6] CONCERT addressed two key sub-areas of this multiservicing framework and tried to determine the kind of behavioural impact that can be generated by these new demand management strategies. First: *«increasing the connectivity of public transport as an alternative to «car-all-the-way» travel (...)»*, and second: *«introducing charges for (restriction of) the supply of roads serving private road traffic.»*[7] From this three different hypotheses were derived. First, there was the notion that implementing integrated payment would lead to an increased usage of public transport. Second, the shift from private to public transport will necessitate different pricing/restraint measures in order to be successful. This leads to the last hypothesis, which states that the wanted behavioural shift can be accomplished through the usage of integrated mobility data to deliver multimedia demand management. This is to be accomplished by constructing a system architecture where payment and access control give input to mobility centres that process the data in order to generate multimodal travel information services. In CONCERT this was tried accomplished through pre-trip information delivered to drivers through the Internet.

Technologically speaking, there were three different building blocks used in creating the CONCERT demonstrators. These were smart cards, transponder units and the Internet. Other applications were also used, such as video-conferencing, DATEX, VMS (Variable Message Signs), public access terminals with touch screens etc. Another objective of the programme was to facilitate the creation of common European standards on technological solutions in the area of transport telematics. One important goal in this respect was to work towards solutions and systems that are interoperable and thus not dependent on any specific supplier. Two out of the three hypotheses involved some sort of pricing scheme. Either through integrated payment of public transport through the use of smart cards, or through transponder units in the

[5] CONCERT Project (TR 1013), Final Report Draft version, Transport Telematics & Transport RTD Programmes.
[6] Ibid
[7] Ibid: p 6

case of different types of road pricing. There were built two different demonstrators for integrated payment. These were the TRON1 pilot in Trondheim and the CAROLAN demonstration in Dublin. Road pricing trials were conducted in Bristol and Trondheim, while advanced access control demonstrations were made in Barcelona and Thessaloniki.[8] The last hypothesis, which was concerned with multimodal Internet travel information, resulted in three different demonstrators in the cities of Barcelona, Marseilles and Hanover.

6. The case of Germany: Some contextual information

As mentioned earlier, different countries will have different interpretations of how they understand the concept of transport telematics, and in Germany is this not different. If we for example look at the CONCERT project, the German contribution did not involve any pricing schemes, although this was an important premise for the whole project as well as for the hypotheses concerned with multimodal Internet travel information. The technological shaping will be dependent on the socio-cultural, industrial, geographical and political situation in Germany and Hanover.

Germany has a population of about 82 million, the largest in Europe after the Russian federation. Geographically, Germany is surrounded of nine neighbouring countries and is a bridge to the Central and Eastern Europe. This also means, because of its location, that Germany is a common passage for European traveller and can also in the future expect an increasing use of their infrastructure.

Germany possesses the world's third most powerful economy, with its capitalist market system tempered by generous welfare benefits. Germany is among world's largest advanced producers of iron, steel, coal, cement, chemicals, vehicles, machine tools, electronics (advanced telecommunications systems), food and beverages. The main source of the German economy is industry. Germans 44,500 industrial companies employs close to 6.2 million people. Only about 1.7 percent of industrial enterprises is large companies with more than 1,000 employees: nearly three-quarters are firms with fewer than 100 on the payroll. Thus the great majority of industrial enterprises in Germany are of small or medium size (Jørgensen and Hende, unpubl.). Three of the biggest companies in Germany are car manufactures. Because of Germanys industrially global level it is crucial that innovation can undergo structural change; firms must concentrate on areas of technological and industrial growth.

According to Federal Transport Network Plan will the number of registered cars in Germany increase from a current fleet of 40 million vehicles to 46.5 million vehicles in the year 2005. By 2010, the number of vehicles will have reached 48 million (Federal Environmental Agency 1997). Germany also expects that the number of vehicle kilometres in motorised private traffic will

[8] Ibid

increase by 25% in the period between 1990 and 2005. By 2010, total growth is expected to reach 32% (Ibid). This development has been dependent of the expansion of roads and development of the car industry. This has created a need. One could say that the production and supply of cars has been growing in step with the increasing demand of this artefact. Why is that? The reason for the increase must be seen in relation to the rest of the social development and have several possible explanations. In this paper we will not, however, discuss whether the car is a public enemy or not, but rather look at what mechanisms that are in use to cope with the increasing traffic problems.

How has Germany met the challenge of increasing pollution and congestion that follows modern vehicle mobility? The German solution seems to be to use telematics as a means to increase information available to drivers rather than through ecological taxes and/or pricing/restraint to meet the negative impacts of modern transport. Road pricing or pricing schemes is in Germany seems to be too politically controversial to be implemented. As we saw in relation to Trondheim were one of the main objectives behind introducing such road pricing systems to shift the modal split in favour of public transport (Holzwarth 1997). This was tried in southern part of Stuttgart region from 1994 to 1995. According to Jürgen Holzwarth this failed because the participants tended to seek behavioural alternatives with their car and only secondarily changed to other mode of transport. Holzwarth concluded in his report that "*The decision of road pricing must be embedded in an overall concept for integrated transport including all transport means*"[9] and that "(...) *road pricing can only be introduced if it is carefully prepared by politicians*". Further he argued that it would be difficult to introduce such a system in Stuttgart alone, because this would lead to a number of problems with occasional and foreign users: "*What is needed is a European or at least a national decision as to whether road pricing is to be introduced or not*".[10]

In a national context it is an outspoken goal to see: "*(...) the new information, communications and guidance technologies in transport (transport telematics) as a great potential to ensure the many different forms of mobility for industry and permanently, efficiently and in the environment-friendliest manner possible.*"[11] Another example of how they understand the technology is:

> "Transport telematics provides intelligent technical solutions for coping with high traffic volumes by connecting and interlinking the modes of transport more closely and thus making noticeably better use of the advantages especially of environment-friendly means of transport, for example by the formation of environmentally compatible transport and travel chains. The utilization of telematics increases the specific efficiency of the modes of transport and enhances traffic safety. The possibility of applying telematics to

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[9] Holzwarth, J. (1997): "*Experiences and consequences of Stuttgart MobilPASS field trial on urban road pricing*", paper presented at "Road Pricing Conference" in Brussels 22 September 1997. There are no page numbers to refer to.

[10] Ibid.

[11] http://www.baunetz.de/bmvbw/sprachen/englisch/10301c__.htm

improve the traffic flow, to avoid traffic in search of its destination and empty journeys and to shift traffic from the road to more environment-friendly modes of transport leads to a reduction of environmental strains caused by traffic".[12]

As we can see, there are three kinds of (policy) problems that the technology is meant to deal with: Congestion, environmental pollution and traffic accidents. The use of such technologies is expected to lead to a marked improvement in road safety and traffic fluidity, while at the same time helping to protect the environment by reducing the energy consumption and wastage with infrastructure congestion. As the quote above and also the project in Stuttgart illustrate, transport telematics is a tool that is supposed to move travel behaviour into more environmentally friendly ways. In this respect, the car industry has been criticising the kind of transport telematics that favours the interests of the public passenger transportation (local traffic). The interests of the motorised individual traffic are not dealt with as being equivalent, but subordinated which made it difficult for the car industry to fully and extensively engage in these projects (Prätorius and Lehrach 1998). It seems that the car industry is a crucial actor in the interpretation of this kind of technology in Germany. According to Höjer (1998) is this development also, among other thing, driven by industry and it has focused on finding markets for new functions and on solving specific tasks in the traffic system. The motivation for the research has been to find competitive IT products and functions for sale to the car industry and car owners (Ibid.). Important actors in Germanys telematics discourse are politician, IT industry and car industry. The drivers as an important actor seem to be neglected.

What about the German contribution in these aforementioned projects? To give a complete overview of the German participation in transport telematics application projects is not in our intention, but we will give a few examples. Actors in both PROMETHEUS and DRIVE seemed to realise that there was a need to contrast the emerging advanced traffic information and control systems developed within these projects with the urban and regional policies in the metropolitan areas. In light of this there was created a concept of a Co-operative Transport Management for the City and Region of Munich (Keller 1995). The basic idea behind this was to integrate all institutions and actors involved in traffic development in general and in traffic management in particular in order to develop an integral approach for all traffic areas. This was to happen through co-operation between public transport, private urban transport, and regional transport via advanced traffic control and communication technologies. The project was particularly aimed at applying up-to-date information and communication systems and results of traffic information and traffic guiding systems that had been obtained in the PROMETHEUS and DRIVE (I) programs (Ibid). The project in Munich became a starting point for other similar projects in Germany. Examples of these are STORM in Stuttgart (Stuttgart Transport Operation by Regional Management), VIKTORIA in Cologne (Verkehrs Informationsystem Köln-

[12] Ibid.

Technik, Organisation, Integrierende Andwendungen) and also MOVE in Hanover, which we will, as mentioned earlier, study in greater detail later in this paper.

In DRIVE II there were also several pilot projects with German participation. These projects concentrated on field trials of traffic control systems as parts of the process in which their systems were introduced in real transport as well as in the political, administrative, and financial environment of metropolitan areas and transport corridors. There were projects that studied integrated regional and/or urban transport management and integrated inter-urban transport management (Keller 1994). It was expected that the results of these projects were to contribute to the development of integrated trans-european services using information and communications technologies to improve the performance (safety and efficiency) of passengers and goods transport services, and at the same time, reduce the impact of transport on the environment.

7. Move – transport telematics in Hanover

Move existed as a project before the participation in CONCERT, and it was, according to Keller (1994), created out of a need to contrast the emerging advanced traffic information and control systems with the urban and regional policies in metropolitan areas. *Move* (an acronym for «MObilität und VErantwortung» which means mobility and responsibility) was formally founded as a development, infrastructure and service company in 1995. Before that it had originally been initiated as a project by Volkswagen in 1990, and that can in turn be seen as a seamless continuance of an earlier project named DAISY (Dual Automobile Information System). DAISY was designed to bring together both the data transmission system RDS-TMC and GSM in order to make a contribution to a sustainable regional and urban traffic management. The main concern in the DAISY-project was to improve the traffic process in the inner city by setting up a parking information and parking lot booking system. It should also improve the traffic development at the city limits by establishing flexible supplementing services (e.g., park & ride service stations and automated parking facilities in order to make public transport more attractive) (Prätorius and Lehrach 1998).

Various entrepreneurs (e.g. Siemens, Bosch, Volkswagen, Üstra, TransTec, Nds, MWTV and others) had been engaged in developing and introducing products towards improving mobility in the Lower Saxony region since around 1986. The most important premise of the project *Move* was that the predicted over-proportional increase in traffic volume along with the still persisting sector thinking and behaviour of all traffic carriers prompted the need for an urgent solution to these problems. Another important reason for initiating the Move project was that the EXPO world exhibition was to be held in Hanover in the year 2000. The predictions were that this would lead to a pressure on the infrastructure that had to be catered for. The first *Move* activities also coincided with B.I.E's (Bureau International des Expositions) decision to have the EXPO 2000 take place in Hanover. The basic idea behind *Move* was therefore that an effective overall traffic management through the co-operation of the public and private sector would solve the mobility problems the region was facing, rather than trying to solve the problems through building more and better roads. Not only did this mean that existing infrastructure would be used more to its potential, but it would also mean that new and innovative traffic system components would be developed and integrated into a sustainable overall traffic system. The initial Volkswagen initiative lead in its turn to the Lower Saxony MWTV's (Ministerium für Wirtschaft, Technologie und Verkehr – Ministry for Economy, Technology and Transportation) founding of a *project group* named Kooperatives Verkehrsmanagement Region Hanover (Co-operative traffic management for the Hanover region). Which in its turn lead to the founding of *the working association Move* (Ibid.).

There were participants from many different fields in the *working association Move*. The Lower Saxony MWTV, the district capital, Hanover, the district of Hanover, the Norddeutscher Rundfunk (NDR – a public radio for the northern states of Germany), Siemens AG, Bosch and Volkswagen (Ibid.). One of the most important activities of this working group was a feasibility analysis carried out by Heusch/Boesefeldt GmbH and TransTec Hanover, for the *Move* project in April 1993. What was investigated in this analysis was a concrete concept for co-operative traffic management in Greater Hanover. The concept included an assessment of the planned measures of traffic technology and planning against the special background of realising Move in the Hanover region. It also included a study of the marketability of products, systems and sub-systems in the field of mobility, and particularly traffic telematics applications and services were to be examined and assessed (Ibid.). There were set up seven different priorities, or political guidelines for the *Move* experiment:

1. Expansion in public transport supply;
2. An increase in the public transport share of passenger transportation by prioritising solution approaches;
3. An emphasis on short distances in city-/regionplanning;
4. Improvement in the division of labour between different modes of transport;
5. Improvement in the flow and steering of city traffic;
6. A creation of effective communication structures for traffic steering and traffic logistics;
7. Fostering ecological commercial traffic (ibid).

Move Entwicklungs- Infrastruktur- und Servicegesellschaft mbH (M*ove* development, infrastructure and service society, with legal status of a Ltd company) was, as mentioned earlier, founded in November 1995 (Ibid.). It formalised the relationship between the project partners within the *Move* working group and it was part of a joint effort towards ensuring a safer and more environmental-friendly personal mobility in the Hanover region. The company was set up as, and still is, a public-private partnership where the Lower Saxony State government, through the Greater Hanover District Association (KGH) owns 51% of the shares, while the private partner, TransTec investment and management mbH owns 49% of the shares.[13] The company is divided into six different areas: marketing and research, product development, customer service, operation of the Lower Saxony traffic management centre, complementary services and central services, press office.[14]

The CONCERT task of *Move's* operations was to see whether pre-trip information services would sway the public into using public transport instead of private cars. This was done as a part of the preparations towards EXPO 2000. The primary goal was to integrate all traffic information into one particular system, both administrative, physically and with joint technological solutions. The *Move* software system comprises the interfaces, applications, common databases and internal communications which integrate various media for managing road traffic, together with links to the EFA system which present alternative options for using public transport.[15] The architecture of the complete system contemplates on-trip information and traffic network regulation functions as well as pre-trip information services.

Besides providing a link between public and private transport, the Lower Saxony traffic management centre also carries out traffic control and incident management. Move is the first company in Germany that has taken over local authority duties. These are tasks that earlier has been the responsibility of government bodies, transport authorities or the police. Such as:

- Traffic situation overview
- Traffic information service
- Traffic control[16]

There are various practical activities that follows an integrated transport concept based on a technique of integrated traffic management. Amongst others:

- ***Pre-trip information.*** On Move's homepages you can find updated status reports on the conditions on the highways in Hanover. This is in order to give travellers an overview of the current traffic situation so that they can be helped in their choice of when and how to travel to their destination. As mentioned earlier this was the CONCERT part of Move. In addition to the Internet solution, Move is also operating a hotline to traffic information, which they call "TravelScout". This service is not only meant as a pre-trip information service, but also as a service to those already travelling either by car or by public transport.

[13] move homepage: http://www.move.hannover.de/englisch/start_frame_e.htm
[14] move homepage: http://www.move.hannover.de/englisch/1_2.htm
[15] CONCERT Project (TR 1013), Final Report Draft version, Transport Telematics & Transport RTD Programmes.
[16] http://www.move.hannover.de /englisch/2_1_1.htm

- ***Variable direction signs.*** If congestion is reported on a section of the motorway the system will automatically indicate a detour route within the motorway network. By gathering data through a data acquisition system installed on the motorways the current traffic load is calculated and graphically presented to the traffic manager. If a threshold level is exceeded the system will provide an alternative route through changes to the direction signs.
- ***Motorway traffic control systems.*** The current traffic load is calculated and graphically presented to the traffic manager. If the traffic load exceeds a threshold level the drivers will be advised of a speed limit by dynamic traffic signs. This leads to similar speed level, which in turn leads to a single stream of traffic and a build-up of congestion is avoided. The system also offers other types of information such as warnings of icy conditions or roadwork. A similar system is also installed on the expressway to Hanover's exhibition area. Drivers a picked up by the traffic control system and are guided by variable traffic and message signs to the most suitable traffic lane for their destination.
- ***Parking management systems.*** The traffic management centre operates a number of parking management systems on behalf of the systems' owners. The objective is to advice the drivers on where to find the nearest available parking space. There are systems both in connection with the EXPO grounds and Hanover's city centre.

In Move's opinion, these means will together ensure that everyone reaches their destination using the quickest and safest route.

There were several activities undertaken to assess the potential of integrated traveller information systems to promote public transport usage. The starting point for these assessments had to be the consideration of how travellers use different information media.[17] There were three surveys done in Hanover to assess the extent to which travellers used the electronic traffic information provided to change their travel behaviour. The results of the surveys must have been rather disappointing for the information providers. Less than 10% used the electronic information systems. As the CONCERT final report points out, one explanation of this result might be the low penetration of modems in the general public, without which it is hard to get on the Internet.[18] On the other side, those who used the systems seemed to be more than satisfied with it. The most popular choice amongst the system users seemed to be to switch from private car to public transport.

In view of the objectives of the CONCERT program perhaps the most important survey done in Hanover was the before- and after panel survey containing two representative samples. After the before study the experimental group of this survey got a modem sponsored by *Move* and a free Internet connection sponsored by Deutsche Telecom. This was done in order to

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[17] CONCERT Project (TR 1013), Final Report Draft version, Transport Telematics & Transport RTD Programmes.

[18] Ibid.

counteract the fact that there were a low percentage of Internet users in the region. The traffic planners in Hanover did, however, see the results of this survey as promising when thinking of a future where computers and an Internet connection will be more entrenched in the everyday life of German households. This will, in their opinion, lead to an increase in the need for electronic travel information. The penetration of computers and modems will lead to an increase in the potential for traveller information systems to act as mode-switching strategies.[19]

Hanover, along with Marseilles, were the only cities participating in CONCERT that worked solely with the third hypothesis concerning multi-modal Internet travel information. When looking at the project objectives and the three hypothesis outlined, we find this a bit peculiar considering that the main premise of the project was that price is the deciding factor for travellers when deciding upon mode of transport. Also the premise for the third hypothesis is not in coherence with what happened in Hanover: "[it] *relates to a longer-term vision of systems architecture where payment and access control systems provide inputs to mobility centres this and other data to generate multi-modal travel information services."*[20] Even though developing such a multi-modal information system was an important task in itself, the question still remains why this was not done in connection with a pricing/access control scheme.

9. Transport telematics as a paradox?

The transport telematics solutions chosen in Hanover are indeed, as all transport telematics, an attempt at ordering and controlling traffic so that an optimal usage of the existing infrastructure can be reached. This also means that the freedom connected with being mobile will be restricted, or at least so it may seem. By submitting to the technology the drivers do lose some of their freedom of choice. At the same time what is lost in terms freedom of choice, may be gained in time saved spent on congested highways. Thus, the implementation of a transport telematics solution has to be in coherence with the existing mobility regime, or alternatively the new technology can contribute to a change in the mobility regime. This does, however, mean that sufficiently strong actors have to be enrolled so that the regime can be changed. If we look to Trondheim, a city of about 10% of Hanover's population the solution chosen there is a pricing scheme through an automatic toll ring. This solution is much more radical in terms of how this may affect the behaviour of drivers and describes well the interpretative flexibility in this technology.

As we can see the concept of transport telematics will vary in time and especially in relation to existing policies on transport telematics technologies and which actors that try to define the technology. One possible reason for this

[19] Ibid.

[20] Ibid.: p 7

is that transport telematics is not a uniform technology, but has a great variety of appearances and applications, ranging e.g. from radio information to interactive route guidance. In our reading it therefore became clear that it does not exist a clear overall picture or interpretation of the concept. It has been claimed that the reason for the concept complexity is because: "*(...) there is no exchange of views between decision-makers, managers, technical staff and legal experts either at national level or within individual companies (or at any rate that no clear strategy would seem to be emerging from any possible debate)*".[21] This may be a result of the division into categories that may follow different interests in traffic related issues. Another reason might also be that both CONCERT and Move seem to be top-bottom oriented and do not take the users (and non-users) into sufficient account. It can therefore also be that behavioural responses are much more complex than originally thought. Drivers are not a uniform, homogenous group, but rather a heterogeneous group that seems to respond in different ways to the same information.

In terms of transport technology policy, this paper has identified a quite complex practice. Perhaps most striking is the role of local areas, mainly cities, as sites of quite autonomous experiments and efforts, with links to other such sites, nationally as well as internationally. The experiments are not local in a strict sense, since they to a considerable extent involve actors outside the local area, who may have great influence on the shaping process. However, what we observe is something different than the usual national-local hierarchy of decision-making.

On the other hand, the thinking behind transport telematics as we have described it in this paper, is definitely supply side driven. Transport telematics is perceived as a kind of technical fix, an application of technology to solve social problems related to transport. The interaction that has been identified, is basically interaction between supply side actors and public policy makers. However, we may see the process of shaping transport telematics as a process of translating between technological options and policy demands. This includes the observation that some applications, like road pricing, are deemed as politically impossible. Thus, the kind of optimisation process that was going on in Hanover was not just a local effort to optimise transport flow by the use of better information to drivers. It was also an effort to optimise the use of transport telematics, given quite severe political constraints.

[21] European Conference of Ministers of Transport (ECMT) (1995:5): "*Road Transport Informatics. Institutional and Legal issues*" Study drawn up for ECMT and ERTICO by Jean-Pierre Camus and Max Fortin, Paris, ECMT.

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