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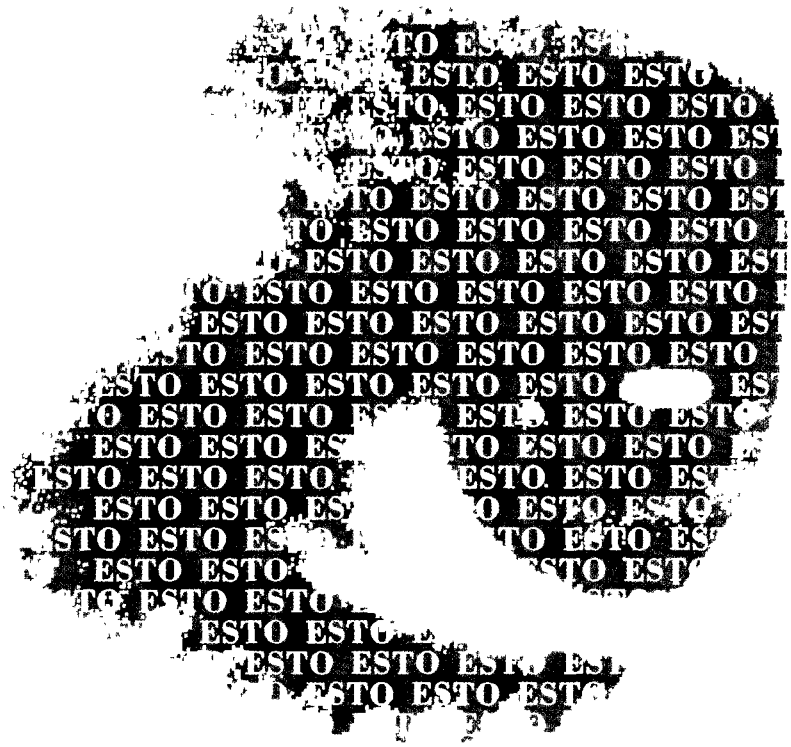

SPECIAL ISSUE: URBAN MOBILITY

EUROPEAN COMMISSION
Joint Research Centre

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A farewell in lieu of a prologue...

I was aware of the wisdom of this old Arab proverb even before I joined IPTS, and I am certain of it as I am leaving it. This is partly why I have striven to emphasise in our work at IPTS not predictions, but rather the projection of possible outcomes and their repercussions. The time devoted to carving out a niche for the IPTS, and securing it a voice, most evidently through the IPTS Report, in the context of the European decision-making environment, has been one of the most challenging and rewarding periods in my life. As I leave IPTS, sure of its solid foundations, I would like to express my gratitude to all those in academia, industry, the European parliament, as well as the Commission itself, who have honoured us with their support, patience and - always bona fide - criticism. I would also like to thank all the readers who have embraced the IPTS Report so warmly and helped establish it in such a short time. Finally my deepest gratitude goes to all my staff for their dedication. Einstein reportedly said that success is 98% perspiration and 2% inspiration. My staff has provided both in abundance; working with them has been a privilege.

HE who PREDICTS the FUTURE LIES EVEN if HE TELLS the TRUTH

IMPORTANT

Subscriptions to The IPTS report run for a calendar year. So, as The IPTS report is now in its second year all subscriptions will shortly expire. If you have found the report interesting and a valuable tool in your work and so would like to renew your subscription in order to receive all ten 1997 issues, please fill in the subscription form stapled in the centrefold and return it to us by February 28 at the latest.

Preface

Personal mobility has become an indisputable part of citizens rights in the latter part of the twentieth century. In the search for a balance between public and private transport reality shows that use of the private car predominates (75% of journeys are now made by private car). This situation is becoming increasingly problematic for cities and other built up areas; constant bottlenecks in city centres and on main arterial routes are having a negative impact on the quality of life, the environment and urban transport.

Improving urban transport systems and thus individual mobility must be founded on research into new technologies capable of developing effective non-conventional transport systems, in parallel with the development of 'intelligent' vehicles, which are clean, safe and offer adequate performance. However, the solution to the problem of mobility cannot be viewed in isolation from other aspects touching upon individuality; safety, respect for the environment, energy efficiency, and the competitiveness of the industrial sectors concerned.

Mobility is fundamental to economic activity. Among its indirect effects the example of freight transport, closely tied to all industrial activity, stands out. More directly, the car industry alone is one of the biggest sources of wealth. Car production accounts for 2% of the European Union's GDP, employs 1.8 million people in distribution and repairs as well as 1.8 million employed directly, accounting for 8.3% of manufacturing work.

The transport industry today depends upon its ability to produce quality at prices which can compete in the world market. It is vital that the European industry be encouraged so as not to fall behind Japan and the U.S., which are growing thanks to heavy investment in Re3D. The industry must face up to an immense challenge if it is to be able to respond with 'intelligent' and competitive solutions and/or reinforce its market competitiveness.

The European Commission is aware of the challenge facing the transport sector in particular and the European Union in particular; managing the interests of industry and transport, the environment, the energy sector and citizens' needs is far from easy.

In this context the Commission has set in motion actions to integrate perceptions of the subject from the stand point of different Directorate General (DG X II. JRC, DG VII, DG III, DG XIII and DG XI) with the aim of advancing research into solutions related to the problems of urban transport. The underlying strategy of the Commission for the qualitative improvement of urban mobility was set out in the "Citizen's Network" green paper; the importance of bringing together Re3D efforts in the transport domain and technology in the Fourth Framework Programme and the creation of Task Forces also needs to be highlighted. Those working on the "Car of Tomorrow" and "Intermodality" are particularly important for urban transport and aim to lead the different actors concerned toward a reconciliation of all the elements that are needed to configure "tomorrow's" urban transport.

The standardisation of transportation systems which may be used in all towns and encouraging joint research between different Member States, are two examples requiring action at European Union level. However, the European Commission always has the question of subsidiarity uppermost in its mind given that we are facing a problem for which local and national governments are mainly responsible.

This special issue of The IPTS Report on urban transport seeks to give an overview of the current situation and the ways open for new research in order to bring new elements to decision makers.

THE IPTS REPORT

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SPECIAL ISSUE

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EDITORIAL

Urban mobility in the cities of the future

Jochen Naegele and Matthias Weber

One of the essential characteristics of liveable cities is the mobility of individuals and goods. It enables access to persons, locations and services, and thereby fulfils an important social and economic function needed to sustain the quality of life. Mobility and transport are of crucial importance for the creation of wealth and employment in globally competitive industries. Moreover, they make leisure activities possible and play a key role in individual self-fulfilment .

In recent decades, a number of negative externalities and inefficiencies of our transport systems have become apparent. Particularly in larger cities and densely populated areas, congestion has turned into a widespread phenomenon. The extent of land use for transport purposes is approaching physical limits, and the consumption of energy resources to operate our present transport systems can hardly be maintained in the future. A number of negative environmental impacts, e.g. in terms of air pollution and noise, have raised concern about the sustainability of our present approach to providing mobility. This issue becomes even more obvious when taking into account the expected increase of mobility and resource needs in developing countries.

In the discussion of how our urban mobility systems should look like in the future, conflicting needs and interests become apparent. In recent policy documents such as the European Commission's Green Paper "The citizen's network", these conflicts have not only been highlighted, but also a number of recommendations have been given on how to move towards an economically, socially and environmentally more sustainable urban transport system. It is widely recognised that urban mobility is a highly complex issue and that there is no easy solution to the problems and conflicts at stake. In order to solve them, more than new transport technologies and vehicles are required. Also needed are changes of individual preferences, innovations in planning, coordination and management of different modes of traffic, and modifications of the structural distribution of activities across the city.

Moreover, cities in Europe are very different from one another and their current problems are the result of long historical processes characterised by different individual and political priorities than the ones which are set at present. While in the past it was regarded as desirable to segregate living and working areas, today this is increasingly perceived as an obstacle to the reduction of traffic. This example also indicates that it may be difficult to solve urban transport problems solely by improving the technical and infrastructural supply side. Though it is unclear whether and how a broader strategy to transform cities and their mobility systems could be implemented in a sustainable way.

Due to this complicated situation, there are different visions of and approaches to how mobility should and could be provided in the future. Some favour an incremental strategy to improve our present transport systems, complementing them by new innovations where sensible (e.g. by means of better vehicles or by using information and telecommunication technologies). Other approaches advocate a shift

from private to public transport, and also long-term strategies to change city structures and mobility requirements have been proposed.

The six articles which are collected in this special issue of the IPTS-Report on 'Urban Mobility' aim to shed some light on this spectrum of options for the future by looking at innnovative developments, both in the provision of new technologies and in the implementation of new mobility strategies in cities.

In the first article, by Christian Neuhaus, two different future models of the city are presented under the titles of 'Planned Urbanity' and 'Self-Regulation'. Within these two frameworks very different transport technologies can be expected to play a major role. Moreover, the article provides the scenario context for the five other articles.

The second contribution reflects some of the major R&D efforts taking place in the European automotive industry. It highlights how the improvement of car technology can contribute to ease the environmental and resource problems associated with urban transport.

Advanced Transport Telematics (ATT) technologies are regarded as one of the 'generic' technologies which are expected to play a major role for future mobility. It can be used to complement different transport modes and to facilitate their integration. The article by Fabiana Scapolo discusses some results of a recent in-house study at the IPTS dealing with the future prospects and impacts on congestion and traffic volume of ATT. It confirms the focus of recent Commission programmes to promote ATT, but also points to a number of critical issues such as standardisation and competition between different ATT systems.

John Whitelegg's article highlights some of the major external costs or our present mobility systems, which are essentially based on the widespread use of individual vehicles. He argues strongly in favour of the feasibility of a major re-orientation of our mobility patterns, shifting urban transport planning away from dependence on the private car

The fifth article, by Celia Greaves, goes a step further by analysing the options which exist at the local level to establish a pathway towards a sustainable mobility system. She underlines the importance of integrating a wide range of possible measures into a sound strategy, taking into account complementarities among individual measures and mechanisms for learning form experience.

In the final contribution, Roel ter Brugge and Wim Dunnewold develop an understanding of urban freight transport from the perspective of supply chain management. They identify private-commercial interests as the driving force towards lean supply chains, improved customer service and the reconfiguration of logistics chain partnerships. To gear these developments in a sustainable direction, they see a need for urban authorities to acquire in-depth knowledge of the differentiated logistics and freight concepts, and for the EU to act as an overall facilitator.

Despite their differences in subject matter and perspective, a number of shared arguments and insights can be identified in the six articles. First of all, they all share the conviction that something needs to be done in the field of urban mobility, and that the measures proposed at present are not sufficiently drastic to solve the problems of congestion, pollution and resource consumption. It is also repeatedly indicated that technological

innovations alone will not be enough. They will play an important, though auxiliary role within a wider strategy which takes organisational and structural changes in the provision of mobility into account. Information and telecommunication technologies are generally regarded to be of major importance because they enable several organisational changes for integrating transport systems. It is also indicated that only a broad set of activities as part of a mobility strategy can be expected to ease the present problems. Another feature which is shared among the majority of articles is that such types of integrating strategies and their success depend very much on local inititiatives and the understanding of the local context. However, a number of horizontal problems and barriers have been identified which ought to be addressed at national or European level. These include issues like information exchange, standardisation of certain technologies, or the provision of an orientation for industrial R&D efforts. Finally, arguments are formulated in favour of efforts which go beyond the improvement of existing transport systems and shifts between modes. Measures are also needed to re-structure our cities and our individual lifestyles in order to reduce the demand for physical mobility and transport.

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Mobility and Communication in the Agglomerations of Today and Tomorrow

Christian Neuhaus

Issue: Recent research has underlined the fact that the urban transport and traffic problems we are facing are not just a question of availability of infrastructures and means of transport, but need also to be addressed in a wider context of mobility needs and structural development of cities.

Relevance: Most research efforts to solve the problems associated with urban transport have gone into the development of new technical solutions. Without denying their importance, the question arises as to whether there are not more efficient options to address this problem area. City planning and urban policies seem to be more powerful and all-encompassing tools for achieving development towards sustainable traffic and transport able to provide the mobility and communication means needed by citizens.

A city needs traffic. It needs the quick and permanent movement of human beings, goods and information in order to be a city. But it also needs rest, air, space as well as community feeling in order to be a habitat. In this field of tension, urban policy is faced with an ever increasing amount of individual traffic, which not only impairs the quality of urban life, but also - to an increasing extent - affects the functional ability of a city as a whole. It is this that has become one of the most urgent problems of all imposed on cities.

Increasing amounts of individual traffic not only impairs the quality of urban life, but also increasingly affects the functional ability of a city as a whole

Traffic penetrates nearly all areas of life - from an economic as well as an ecological point of view, and as a social and psychological phenomenon, both culturally and technically determining and determined. For a long time, transportation policy was tantamount to extending capacities in reaction to bottlenecks and forecasts. Efforts to stem the - still increasing - flood have been in vain. The numerous interrelations can no longer be explored by a single branch of science alone, nor can they be handled adequately if departmental thinking prevails. In terms of science, these questions can only be treated in an interdisciplinary way, in terms of politics, planning and decision processes which must go beyond the borders of single departments. This situation was the starting point for an effort to comprehend the phenomenon of traffic in its variety of interactions and to introduce it into an interdisciplinary forum for discussion.

Transportation policy can only be treated in an interdisciplinary way, in terms of politics, planning and decision processes

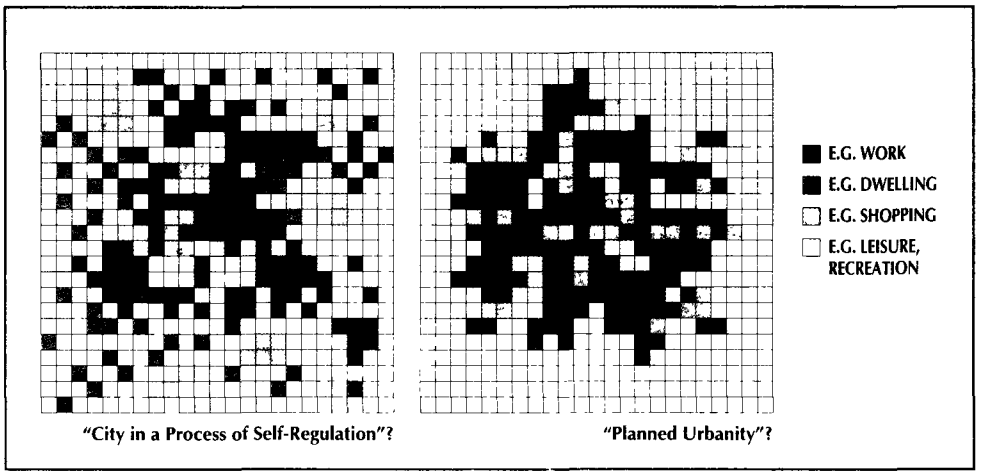
City and transportation researchers, sociologists and vehicle engineers, city planners and communication technologists of the Free University and the Technical University of Berlin, the German Institute of Urbanism, the Institute of Urban Research and Structural Policy and Daimler Benz Research have asked themselves the following questions: How do traffic and the

In the 'self-regulating' scenario the inner city will be reserved for business activities and people will travel long distances to work from their homes in the suburbs and countryside, making cars indispensable

The city with short travelling distances has been achieved, at the cost of a higher degree of regulation and planning - developing dense areas combining living, working and shopping

'Planned urbanity' - dense, closely-knit cities in which public transport plays an important role, will not be easy to achieve

Figure 1. Two scenarios for 2020



demand for traffic arise? What effects does traffic have and what is it that makes it a problem? What might the contributions of new communication and information technologies be? And above all: How are tomorrow's big cities likely to look?

Two Scenarios for 2020: 'Planned Urbanity' or 'Self-Regulation'?

The subprojects have dealt with the interactions between traffic and city development, between lifestyle and traffic conduct, between telematics and traffic. Trends in economic exchange and demographic development have been investigated and current approaches have been compiled. On this basis, conclusions for future action in politics and administration have been drawn. Two alternative scenarios show different possible developments of a city and describe agglomerations in the year 2020 (see figure 1). These scenarios are not forecasts, they do not describe what will happen, nor do they say what should happen. Their purpose is to stimulate reflection and discussion on topics such as: What could life be like in 30 years? What should life be like in 30 years? What is to be done?

Will there be cities of 'planned urbanity' in 2020, whose inhabitants will not have to go far to work, do their shopping, spend their leisure time and who will drive only small cars - if at all; where suburbs have been kept under control and where public transportation carries the main load of passenger traffic? For a city and its inhabitants this would not be an easy path to follow.

Or, will we live in a 'city in the process of self-regulation', as is illustrated in the second scenario? Those who can afford will live in the outskirts of a city, in a house with a garden. The inner city will to a large extent be reserved for office buildings, shopping will have to be done outside the cities in large supermarkets and shopping centres. This will be a city with long travelling distances, where cars remain indispensable.

The scenario of 'Planned Urbanity' is based on the notion of a traditional European city characterized by compactness, density and the combination of functions. It proceeds on the assumption that spatial structures are determined by urban planning activities. The city with short travelling distances has been achieved, however, at the cost of a higher degree of regulation and planning. This 'ecologically-social' city has required distinct traffic re-orientation measures as to distances (avoiding traffic), choice of mode

(relocating traffic) and negative consequences (compatible handling of traffic). The most important goal -ie., avoiding traffic- has only been achieved by the integration of traffic-related measures and spatial planning. In this context, the further development of dense (in terms of usage of space) areas of combined functions (living, working, supply) as well as guaranteeing an adequate quality of the inner-city environment have been major areas of action.

Measures of this kind can only be realized if the primacy of public planning is recognized in its considerable influential depth and changes are made to the overall legislative conditions. What would be required is at least an attempt at carrying out a tax reform, whose basis for assessment is location, size and energy consumption. At the same time, limiting the right to transfer property and the balancing of the benefits derived from planning would be necessary. Scepticism seems appropriate as to whether such incisive measures in terms of legislation and planning are likely to gain a political majority in the foreseeable future - not to mention at all their acceptance among the population. In addition, a change in the spatial structures will require a considerable investment of time and means.

The scenario of a 'City in the Process of Self-regulation', which rather continues along the lines of growth that our today's reality has taken, adheres to the principle of 'open pragmatism'. Urban development has been regarded as an open process that can only be manipulated to a limited extent. In a flexible, pluralistic and individualised society, the level of acceptance of regulation and administrative restrictions has been quite low. Greater emphasis has been placed on unregulated market processes and forms of individualised co-ordination and decision making. The political-administrative philosophy of planning and acting has been and continues to be that the important thing is not to find overarching, comprehensive solutions to a great number of problems, but to solve the actual, single problems in a specific and appropriate way. The basis for this approach is the trust in the development of understanding and reason created by participation and dialogue among the persons involved. Compared with the forces of the market, municipal and regional planning lose importance within this approach. In the centre of the agglomeration, strong economic and private interests are prevail; further suburbanization with the related infrastructural and traffic requirements has been the consequence; ecological relief has been acquired only to a limited extent.

The future is open. What the situation will be like depends on whether such long-term perspectives are discussed at all, whether common goals can be agreed upon and whether action in politics and administration will follow these goals.

Tax reform and limitations on planning benefits would be necessary if 'Planned Urbanity' is to be a reality and it is doubtful whether there would be a political will for this in the foreseeable future

Traffic Policy is Urban Policy - Urban Policy is Traffic Policy

The foremost result of the work done by the research association is that traffic policy is urban policy and urban policy is traffic policy. Both as an event and as an offer of infrastructure, traffic determines the development of a city, especially its settlement structure. Settlement structures, in turn, produce more or less traffic.

Infrastructure determines the settlement structure of a city, and levels of traffic depend on that settlement structure

A number of recommendations have been worked out for an urban policy that does not rely solely on the self-regulation of a city and its traffic:

- Traffic must be regarded as a consequence. Its growth does not follow the laws of nature but is the result of human decisions made under concrete circumstances. The design of these circumstances will influence transportation requirements.

From the point of view of self-regulation, municipal and regional planning lose importance compared with market forces

A change in spatial structures, reducing distances and improving short-distance attainability, is the only effective strategy to limit the occurrence of traffic

The loose settlements on the outskirts of cities would not be possible without cars, which thus pave the way for the dissolution of the city in its traditional, European sense Even in the U. S the call for a 'revival of the cities' is getting louder

- The car still holds a central position as embodiment of individuality and mobility. Imposing ceilings on use or attempting to completely abandon the use of cars will therefore be unsuccessful in the foreseeable future. It can not be expected of individuals that they stop driving cars but they can be expected to use them differently.
- Traffic policy can only be realized on a long-term basis. There is no panacea, no single action to be done that will always and be a remedy in all cases. Only a combination of diverse measures can yield viable solutions - direct interventions and overall conditions are mutually dependent on each other.
- All efforts to contain even the growth of traffic will lack a solid basis unless the city in its spatial aspect is kept in mind. Density with an increased quality of urban life and the combination of living and working, shopping and spending one's leisure time are the goals on the way to the reduction of traffic. To put it more explicitly: a change in spatial structures, reducing distances and improving short-distance attainability, is the only effective strategy to limit the occurrence of traffic. There is a strong tendency among inhabitants, commerce and industry to move into the surrounding areas; a tendency that feeds on itself from a certain point onwards.

In the final analysis, the goals and models to be followed can only be fixed in the realm of politics. On the one hand, traffic provides mobility and supply, on the other hand, in its present form, it impairs urban life by producing noise and exhaust fumes, reducing the available space and increasing the risk of accident. In this context, a careful consideration of all aspects involved is required - ultimately against a normative and ethical background. But traffic also has influence on the characteristic features of a city. The loose settlements on the outskirts of cities, ie., houses with gardens for a large number of people, would not be possible without cars, which, however, thus pave the way for the dissolution of the city in its traditional, European sense. A final decision whether to deplore or to welcome such a development is not possible. However, the number of people supporting the idea of a compact, combined city, improving traffic without restricting mobility, is growing not only in Europe, even in the U. S. -the mother country of the automobile society and suburbia- the call for a 'revival of the cities' is getting louder, not only for reasons of traffic or urbanity (which might seem slightly abstract), but also because of strong fiscal and social tensions between cities and their surroundings.

Keywords

City, traffic, scenarios of 2020, urban policy, traffic policy, habitat, urbanity, city development, interdisciplinarity, planning, mobility

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Christian Neuhaus graduated in Communications and in Business Administration (Diplom-Kommunikationswirt Diplom-Kaufmann) at Berlin university. From 1991–1994 he was project coordinator in the interdisciplinary research group 'Lebensraum Stadt' and co-editor of the 6-volume-documentation. Since 1994 he has been a member of the Daimler-Benz Society and Technology Research Group, Berlin & Palo Alto. His current main fields of activity include the methodology of futures studies on the business environment and the conditions of future mobility and city development.

12 Urban Mobility

European Approaches to Mobility in the City: New Vehicle Technologies

contributed by EUCAR

Issue: The establishment of the EUCAR Master Plan, through the co-operation of the European automotive manufacturers, is the first co-ordinated step towards developing technologies to provide high quality mobility while reducing the transport system's externalities. The complexity of the technologies and issues involved underline the need for further collaboration.

Relevance: It is vital to maintain the competitiveness of the European automotive industry in order to keep its social benefits, ie. employment, wealth generation and mobility. Because of the complex network of interconnections and impacts, social, economic and environmental sustainability has to be ensured by both industry and government. This requires comprehensive action, starting with research and development activities and assuring that knowledge is generated and retained in Europe, whatever may happen in the future with respect to globalisation of production. In this respect, joint European industrial efforts are essential to fulfil this goal and to balance competitiveness against US and Japan.

Introduction

The automobile has to adapt to contradictory demands resulting, in particular, from public requirements for more environmentally friendly transport and ever higher vehicle performance. In a long-term perspective, sustainable mobility and its preservation are key success factors in the world markets for the European automotive industry. Steadily growing transport demand in Europe and the resulting mass use of the automobile causes well-known collective problems such as exhaust gas and noise pollution, traffic congestion and increased land use. Ecological concerns are playing an increasingly important role for future traffic development in environment-conscious societies, not only in Europe and other industrialized countries, but also in developing countries with their growing markets for passenger cars and trucks. The significant share of road traffic in the total volume of transport in all European countries shows that the automobile is indeed an attractive means of transport for individual mobility.

The significant share of road traffic in the total volume of transport in all European countries shows that the automobile is indeed a popular means of transport for individual mobility

In this context, EUCAR has combined its partners' efforts to support the achievement of the highest efficiency, effectiveness and economy in research performance. A Master Plan has been established, based on a European and global framework, to provide a common basis for co-operative research and technological development (see Box 1).

Box 1. The EUCAR Master Plan

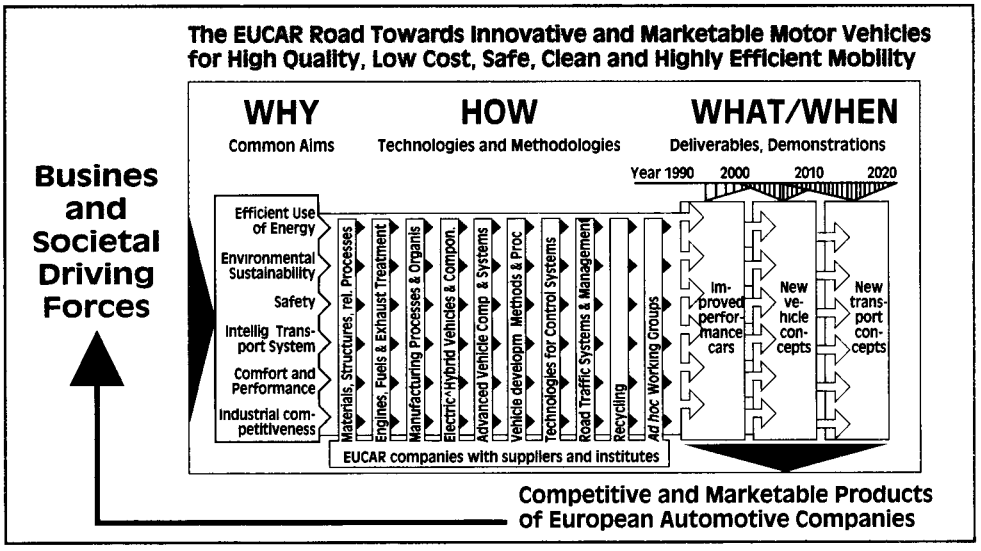
The purpose of the EUCAR Master Plan is to develop:

a) a platform of co-operation for sustainable mobility,

b) a framework for interdisciplinary co-operation, and

c) a guide for common strategic projects.

It addresses R&TD activities and industrial initiatives relevant to all road vehicles, combining the work of motor vehicle manufacturers, sub-system and component suppliers, tools and process equipment suppliers, material producers, industrial and academic research centres (EUCAR, 1996). As a means of co-operation the Master Plan proposes six common aims, ie. *efficient use of energy, environmental sustainability, safety, intelligent transport systems, comfort, performance and industrial competitiveness*. These aims have political as well as technological aspects. They can serve as a basis for co-operation between authorities and industries at a level which is both general enough for mutual communication and detailed enough for addressing the core problems of society and technology. An overview of the functionality of the Master Plan is illustrated in the figure below.



Source The EUCAR Master Plan

In the context of transport in urban and suburban centres, the effectiveness of the automobile involves two main issues. Firstly, the emission and energy efficiency levels of the vehicle per driven kilometre and secondly, underlying the congestion issue, the number of kilometres driven per vehicle and the number of vehicles in cities.

The former aspect depends exclusively on the vehicle itself and a key for its improvement depends on power source technologies. Some of the key features of the most likely driveline technologies are outlined in the next section. Regarding the latter, global aspect, this depends on the management of general transportation and individual mobility issues. Therefore the automobile has to be embedded in an intelligent transport systems as described later.

Main alternative power sources

Existing technologies based on the diesel and gasoline fuels still hold remarkable potential in terms of energy efficiency improvement and emission reduction and must be considered as

For urban and suburban transport vehicle effectiveness will depend upon emission and energy efficiency levels as well as the number of vehicles and kilometres driven

Ultra low emission standard vehicles are already on the market and further improvements are likely to emerge within the next few years

Natural gas offers potential for reduction in emissions to NZEV (Near Zero Emission Vehicle) or even EZEV (Equivalent-ZEV) levels

The first generation of emission-free electric vehicles are now in production

Hybrid vehicles, although more complex, allow emission-free electric operation in city centres to be combined with long distance travelling on diesel or gasoline fuels

Electric powered vehicles using fuel cells which produce electric current direct from chemical fuels, usually hydrogen, offer the potential of ZEVs with an increased operating range

'Moving Targets', since vehicles with fuel consumption approaching the 3.0 l/100 km will be on the market in the near future. Ultra low emission standard vehicles are already on the market and further improvements are likely to emerge within the next few years.

Alternative technologies are being developed to achieve new customer and society benefits. Within the framework of EUCAR a wide variety of R&D projects have been launched to work together within European, national- or individually funded programmes. The following paragraphs outline the characteristics and state of development of the alternative technologies at present under active study.

Natural Gas

Natural gas in compressed or later liquefied form offers potential for essential reduction in emissions to NZEV (Near Zero Emission Vehicle) or even EZEV (Equivalent-ZEV) levels defined by CARB (the Californian Resources Board). It can open a way to the introduction of hydrogen. This approach starts a step-by-step process of reduction from carbon-rich (diesel, gasoline) via carbon-poor (natural gas) to a carbon-free fuel (hydrogen)[1]. Besides the investigation on new fuel injection systems key efforts are set to develop high-efficiency, low weight tank systems at affordable costs and to establish a widespread infrastructure of refilling stations.

Electric Vehicle

With the use of electricity as an energy carrier for individual mobility in suburban areas emission-free vehicle operation becomes viable. Intensive development and testing of new drive train components, such as electric motors and high energy batteries, are under way using testing and evaluation procedures jointly established together with leading European research institutes.

First generation electric vehicles are now in series production in small numbers. Authorities and automotive manufacturers have undertaken actions for the diffusion and use of electric vehicles in large scale field trials addressed to the public. All agree to the advantages of electric vehicles in improving quality of life in city centres. However, it is likely that some form of support - national or EU-wide - will be necessary to increase the market for such vehicles. Such support might be aimed at reducing the incremental cost over a time period and building customer confidence.

These actions will create the guarantee of this market to permit the necessary investments. Further work is needed especially to sustain the early market. For example in the field of battery technology developments the work would involve improving battery performance and cost reduction, thus reducing the overall cost of the vehicle.

Hybrid Vehicles

Electric and chemical energy can provide a synergetic combination of the positive characteristics of both drive systems, and such vehicles are being investigated. The ability to operate in city centres with a limited driving range with emission-free electric propulsion can be combined with long distance travelling on diesel or gasoline fuels. This enables the power train to operate the combustion engine with new control strategies to improve fuel economy and emission levels. Hybrid electric vehicles are more complex than both battery-powered electric and pure internal combustion. Their chances of success depend on their capacity to obtain better emission levels for the same production and operation costs. Hybrid vehicles have considerable promise and could play a central role in creating a more sustainable transportation system. They can use electric refuelling infrastructure in the city and gasoline

station on interurban roads. The first prototypes are under investigation within a EUCAR project funded by the EC.

Fuel Cells

Fuel cells produce electric current direct from chemical fuels, preferably hydrogen. They offer the potential of powering vehicles with electric drive systems with an increased operating range, a high potential efficiency and the possibility of the classification as a ZEV, at least if hydrogen is carried on board.

Since there is no existing hydrogen infrastructure and the cost of providing it would be high, work is also being carried out on systems for generating hydrogen in the vehicle. These use fuels such as methanol which would not require fundamental changes to the infrastructure. The development of the necessary reformer systems for hydrogen production concentrates on its behaviour under start up and transient loads as well as energy efficiency, but must also take into account the by-products which are produced. The target is to be classified as EZEV, taking into account the necessary overall assessment of emissions for this classification.

Although fuel cell technology will probably be initially commercialized for stationary electrical power generation, it is interesting to note that it is now technically feasible to power passenger cars with fuel cells - albeit with certain restrictions. The most significant challenge faced by the automotive sector will be the reduction of mass, volume and cost.

However, the advances made with fuel cells should not obscure the fact that, at the present state of development, the same basic vehicle equipped with conventional technologies at relatively low cost can achieve roughly five times the power and therefore carry considerably higher payloads, whilst still remaining below emission levels set for the ULEV (Ultra Low Emission Vehicles).

The automobile as a part of an intelligent transport system

The major objectives of intelligent transport systems are an improvement in transport efficiency, including environmental aspects and improvements of traveller comfort and safety by new technologies and services. An open and intermodal system including private and public transport modes has to be considered as part of achieving these aims. The car will continue to be the optimal means for individual mobility. But with respect to the growing demand for mobility, the optimal use of each transport mode and the interactions between different means of transport will play an increasingly important role.

Important R&TD areas for improving transport efficiency and traveller comfort are traffic and demand management and travel or traffic information. This includes, for example, intermodal traffic optimisation and traffic guidance strategies. Urban public transport management and parking management are important further research areas. Real-time traffic and travel information offer the opportunity to provide each traffic user with up-to-the-minute information, taking into account specific and individual information requirements, and they are an important basis for efficient traffic management. Traffic data acquisition and its real-time processing are very ambitious tasks which need more research and investigation. Further R&TD areas are transport strategy and databases, road management and logistics, and fleet management.

Beyond the improvement of transport efficiency and traveller comfort, continuing research efforts are needed to improve active

To overcome the high cost of setting up a hydrogen supply infrastructure the use of on-board hydrogen generation from methanol is being studied

Ultra Low Emission Vehicles using conventional technology can still achieve five times the power of a similar vehicle using fuel cells

An open and intermodal system including private and public transport modes has to be considered as part of intelligent transport systems offering an improvement in transport efficiency, including environmental aspects and improvements of traveller comfort and safety

The uptake of these new technologies will depend upon overcoming introductory barriers such as costs, infrastructure and public acceptance

R&TD has to cover process-related as well as product-related technologies Innovative product concepts, technologies and new materials call for innovative and flexible processes in product development and manufacturing

Consumer acceptance is one of the major obstacles to the introduction of both alternative power sources and fuels

The new car must be within road-users' budgets, keep its value and be supported by the necessary infrastructure

safety. Research in this field deals with on-board vehicle control systems. By means of microelectronics, these control systems assist the driver in particular in dangerous driving conditions The whole issue of intelligent transport systems is addressed in detail by the EUCAR Master Plan (EUCAR 1996).

The broader perspective for the automobile

The effective implementation and diffusion of new vehicle technologies require a number of socio-economic and political conditions to be fulfilled. In particular, to overcome introductory barriers such as costs, infrastructure and public acceptance, and to avoid additional unwanted side effects. Apart of the aforementioned integration and optimisation of the car within the overall transportation system, it is necessary to better understand user needs and behaviour and to assess the required industrial change needed to manufacture the car of tomorrow. Therefore it is important to assess the implications and impacts in a socio-economic sense and it is necessary to take into account the general socio-economic trends. This is particularly relevant for the uptake of radically new technologies, to overcome introductory barriers such as costs, infrastructure and public acceptance (IPTS, 1996).

Industrial Competitiveness

Reduction of time to market, steady improvement of product quality and reliability, and continuous cost reduction are the main requirements for increasing industrial competitiveness. To meet the additional economic, environmental, legal and customer requirements, R&TD has to cover process-related as well as product-related technologies. Processes in the European automotive industry have to be flexible in adapting to changing requirements and have to be competitive with the USA and Japan. Consequently, it is crucial to take the prospects for new automotive technologies in the other world regions into account when defining new priority areas for transport technologies.

Additionally, innovative product concepts, technologies and new materials call for innovative and flexible processes in product development and manufacturing. Both product improvement and the increasingly important process improvement are strongly taken into account in EUCAR co-operations.

User implications

Consumer acceptance is one of the major obstacles to the introduction of both alternative power sources and fuels. The drivers of today must be convinced that either it is their duty to be 'green' or that their 'new' car will perform at least as well, if not better, than the one they already have. At least the buyers must be confident that they are buying something that they want and not something that is imposed. The criteria for a new understanding of 'performance' have to be present in the consumer's mind. In order to enhance the widespread uptake of such technologies, it is indispensable to implement effective stimulation measures, both economic and regulatory, and special information programmes. Overall cost is an important factor for the introduction of new technologies. For their widespread diffusion the cost of the vehicle, its subsequent fuelling and servicing must be within the budget of all road-users. Together with this, there may also be the need for guarantees that the new car will have a similar lifetime to the traditional one and that a market exists for its resale when it is no longer required. In terms of performance and everyday running, it is also very important that the

required infrastructure is in place. The driver should be reassured with good quality and quantity of refuelling, repair and general servicing facilities.

Conclusion

The EUCAR plan incorporates the experience gained from the previous European automotive initiatives such as PROMETHEUS, the "Environmental Friendly Vehicle", etc., as well as addressing, amongst other topics, R&TD needs of the Targeted Research Action of the EC Task Force 'Car of Tomorrow'. In addition it includes information on USCAR (the approximate equivalent of EUCAR in the USA) and the PNGV initiative in collaboration with the US Government.

The six common aims of efficient use of energy, environmental sustainability, safety, intelligent transport systems, comfort, performance and industrial competitiveness, which form the basis of the EUCAR cooperation, address the changes required by society and especially in the area of urban transport. These common aims have the advantage that they all have political as well as technological aspects, and are thus possible points of contact for co-operation between authorities and industries. They also integrate technologies for easier public perception and put pressure on developers to identify public needs and to present implementation scenarios of their research results.

Through this initiative, EUCAR intends to ease the co-operative process and fill the gap between the industrial bottom-up and authoritative top-down approaches, thus providing an opportunity to obtain a clear framework in which future vehicle technologies can be developed to respond to the problems of mobility in the city.

About the author

This article is adapted from the EUCAR R&TD Master Plan EUCAR is the European Council for Automotive R&D Its partners are BMW and Rover, Daimler-Benz and Mercedes-Benz, FIAT, Ford, Opel, Porsche, PSA, Peugeot, Citroen, Renault, Volkswagen and Volvo.

Keywords

New vehicle technologies, urban mobility, intelligent transport systems, vehicle emission standards, EZEV, ZEV, NZEV, ULEV

Notes

1- Natural gas has been appointed by the CARB to fulfil the EZEV requirements due to the benefit of the sealed fuelling system. To exploit the benefits of natural gas dual -fuel cars (gasoline, NG) have already been introduced to the market in the beginning of 1996.

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Transport Telematics to Improve Congested Urban Areas

Fabiana Scapolo

Issue: Research and pilot projects on transport telematics technologies have demonstrated that they have considerable potential to help overcome congestion problems, by making it possible to achieve substantial improvements in the utilisation of existing transport networks through the application of information technology and telecommunications.

Relevance: The level of congestion in urban areas is getting ever closer to saturation point. The widespread use of transport telematics technologies in European cities may alleviate congestion and its environmental impacts.

Introduction

In the last twenty or thirty years traffic speed in the city centres has not changed significantly. More and more vehicles have been squeezed into our cities and onto our highways. Greater sophistication in our traffic control systems and in traffic management techniques has in general helped to improve the situation, although in many European cities it is already clear that the process of increasing traffic volumes cannot continue much further. Traffic management is an area where advanced technology is having important effects and will continue to be vital for the management of our transport systems well into the next century.

Traffic management is an area where advanced technology is having important effects and will continue to be vital for the management of our transport systems well into the next century

Research shows that most of the drivers setting out on a journey do not have definite plan of the route they will follow, tending rather to depend on maps, signs, and the driver's own, sometimes sketchy, knowledge of the road network.

The role of transport telematics technologies

Road information is a public service, intended to provide the information needed to prepare trips, select routes, and choose the best time to travel. It makes it easier to complete the journey stage by stage under the best conditions by addressing the lack of knowledge mentioned above, thereby avoiding difficult situations -which are announced in advance or during the course of the trip- and so it increases both comfort and safety.

Advanced transport telematics (ATT) technologies can be divided in three main groups:

- technologies which are able to measure the current level of traffic in the network;
- technologies that adjust traffic signs on the basis of the existing traffic level to give priority for example to Public Transport vehicles;
- technologies that can assess the level of congestion in real-time and can communicate with the vehicle and for example re-route them.

The coupling of information technology and communications applied to the transport sector aims to improve road safety, maximize road transport efficiency and contribute to environmental improvements. Electronic systems in our vehicles are already contributing to the ease of driving, increasing travellers' comfort and convenience and to improving safety.

It has been generally recognised, as the data in the following table shows, that advanced transport telematics technologies are going to penetrate the market between now and 2050. However, it is interesting to try to forecast the level of use of these technologies in European cities in the future, what effects they are going to produce on levels of congestion and on volumes of traffic in urban areas, and also what factors that could act as constraint to their widespread use.

The European Commission started with DGXIII's DRIVE project in 1989 and later continued with the ATT Programme, which has developed pilot projects whose objective has been to carry out field trials of ATT applications in real-world environments. The main areas of operational interest are: demand management; travel and traffic information; integrated urban traffic management; driver assistance and co-operative driving (use of telematics technologies intended to assist drivers); freight and fleet transport; and public transport (CEC, 1993). The success of the DRIVE/ATT Programmes has proved the flexibility of telematics applications in assisting different transport policies and supplying new user services. The European Commission (EC, 1994) is aware that harmonisation and co-ordination in this sector are essential. In fact, the role of authorities at national, regional or local levels, all of which continue to exert their influence on the transport sector, could lead to the creation of technological islands if steps are not taken early on.

Prospective Study on the Future of ATT: The Approach

At present, the application of telematics technologies is restricted to a small part of the transport network. The challenge of these technologies lies in their application on a wide portion of the transport network.

In order to find what the prospects for wider penetration are, the Institute of Prospective Technological Studies (IPTS) undertook an in-house prospective study to forecast the level of use of a selection of ATT technologies in European cities by the year 2015. This forecasting has been performed by applying a two-round Delphi method process.

Advanced Telematics Technologies exist to measure traffic flow, adjust signals to alter flow, and assess congestion and perform re-routing

Harmonisation and coordination in this sector are essential if the creation of 'technological islands' of incompatible technologies is to be avoided

A two-round Delphi method process was undertaken by the IPTS in order to forecast the level of use of a selection of ATT technologies in Europe in 2015

Table 1. Years in which ATT Systems are projected to achieve 5% and 50% Market Penetration

SYSTEM	5%	50%
Real-time traffic information	1996	2007
Static information	2000	2011
Emergency call	1998	2010
Dynamic route guidance	2000	2020
Collision warning	2002	2013
Intelligent cruise control	2004	2015
Automatic backup braking	2008	2020
Autonomous lane braking	2012	2032

Source Catling

One of the most promising technologies is dual mode guidance, combining vehicular guidance, a traffic management centre and communication between them

Automatic Vehicle Location is expected to find major use for public transport in city centres

A major restricting factor in the widespread use of Advanced Transport Telematics (ATT) technologies is the high level of investment required, especially when infrastructure-based equipments are involved

The formation of 'technological islands' will not only push up costs, but the lack of interoperability will reduce the usefulness of these technologies, particularly for private users

The Delphi method

A Delphi sequence is carried out by interrogating a group of experts with a series of questionnaires. Each successive questionnaire is a round. The questionnaire not only asks questions, but also provides information to the group members about the degree of group consensus. It is the medium for the group interaction.

There are three quintessential attributes that distinguish it from conventional face-to-face group interaction: anonymity, iteration with controlled feedback, and statistical response handling. Delphi does permit an effective interaction between members of the panel, even though this interaction is highly filtered by the moderator's summarising of the arguments. (Martino, 1993).

The inquiry was conducted amongst more than 200 transport experts from different sectors, selected from a variety of European countries. The selection of the technologies on which we based our inquiry was done on the basis of ATT technologies piloted within the DRIVE/ATT Programme. The technologies selected have been tested for the urban transport sector, and are part of the three main groups described above.

The experts involved in the survey, besides giving their views on the level of use of these technologies in European cities in the year 2015, also had to forecast the direct effect of those technologies on two transport problems: congestion and passenger vehicle traffic volume. Finally, they had to assess the influence of social acceptance, economic viability, technological feasibility and the existence of European standards, compliance with which could act as a constraint on the widespread use of these technologies.

Examples of future impacts of ATT

A promising technology, in terms of a reduction in the level of congestion in urban areas, is dual mode guidance systems. This technology consists of three components: vehicular guidance equipment, a traffic management centre, and communication between these components. Communication interfaces facilitate the communication between these components. It has been forecasted that around 20% of European cities will adopt this technology by the year 2015. The main constraint is the level of investment necessary for its widespread development, due to the high costs of the components used in the infrastructure. However, if this technology were to use the already existing infrastructure for cellular phones (GSM), its market penetration could well be made much easier.

Furthermore, ATT systems are projected to have a significant impact on Public Transport, forecasts suggest that they are going to be present in 50% to 90% of European medium size cities. An example of ATT technology for Public transport use is that of Transponder based systems for Automatic Vehicle Location (AVL). These systems give priority to Public Transport vehicles through the adjustment of signal timings. The effect of these technologies are a decrease in the level congestion and in the volume of passenger vehicles. However, the operational costs for the management of these systems are fairly high, which means we can assume that they are unlikely to be implemented across whole urban areas, but only in city centres.

Investment barriers

There was a consensus among the experts involved in the Delphi study that the level of investment necessary to obtain a widespread use

of ATT technologies in European cities, is one of the major restricting factors, especially for those technologies which require infrastructure-based equipments. Thus, the level of investment for the dissemination of ATT technologies is also a matter of transport policy and/or strategies. In fact, experts believe that there are still a lot of differences in transport policies amongst European countries, which could hinder their harmonised dissemination across Europe.

The standardisation problem

It is important to highlight the fact that the lack of harmonisation and standards is still seen by transport experts as one of the major constraints related to urban transport, in fact, if local initiative in the field of ATT technologies becomes widespread without control in different European cities, there is the danger that a whole series of 'islands' could develop in Europe, each with its own ATT system. The incompatibility of these systems can increase the costs of production and installation on the road network. Experts have stressed the fact that action at European level is essential to ensure that, for example, a system such as driver information/route guidance, developed either nationally or locally within Member States, is compatible both technically and operationally. The first step in promoting the development of interoperable systems in Europe is to carefully consider the institutional framework in which these systems have to operate.

Intra-technology competition

There are some ATT systems which although based on different technologies could achieve the same purpose. In the case of such competing technologies two possible sub-optimal outcomes need to be borne in mind:

- if the first technology introduced proves to be a failure there could well be a resultant general loss of credibility of all systems of this type, although using different technologies, which may completely jeopardise the chances of competing systems; or in the second case
- if the first technology introduced on the market proves to be a success, it may pave the way for other competing technologies intended to meet the same requirements, thereby opening up the possibility of greater differentiation as the volume of the market grows.

The success or failure of the first technology to be applied could result either in rejection of all related technologies or the over-enthusiastic proliferation of different ones

The role of regional and local authorities and service companies

It is clear that there is a need for multilateral co-operation to allow ATT technologies to come into widespread use in European cities. This co-operation should include regional and local authorities, as well as service companies and industrial enterprises. In fact, the differences between the European countries regarding their legal and administrative structures could inhibit the setting-up of a framework for the development of these systems.

Legal and administrative differences between European countries could make it difficult to set up a suitable framework for the development of these systems

In general, the results of the Delphi inquiry show that the application of ATT technologies by themselves would have the direct effect of decreasing the level of congestion in urban areas. However, the application of telematics technologies without an adequate local transport policy which includes measures able to promote a modal shift towards the Public Transport sector, are not going to decrease the level of traffic volume. Moreover, there are some important drawbacks to consider. In fact, the increase in safety, comfort, trip planning and guidance for vehicles that telematics tools are going to provide, will probably initially contribute to a greater efficiency of passenger car traffic in urban areas. Nonetheless, these benefits could be outweighed in the medium term by the indirect effect of an increased

ATT technologies offer the possibility of reducing congestion by making more efficient use of existing infrastructures - but this will only give long term benefits if it forms part of a global strategy to reduce the number of vehicles using the transport network

number of vehicles on the transport network. So, if people are still making their own choice for the transport modes to undertake their trips (eg. home/work) the volume of traffic is not likely to decrease.

Conclusions

The area of telematics technologies is growing relatively quickly. The technologies piloted within the DRIVE/ATT Programme have demonstrated that they are feasible and effective. However, in order to improve the current traffic congestion situation a whole series of technologies should be applied in an urban area. Thus, that fact that there are contending technologies needs to betaken into account, and efforts should be targeted on the most promising ones which are feasible from a technological point of view and for which economic viability will not be a constraint.

The approach followed to forecast the future adoption of ATT technologies by European cities in the year 2015, and the specific assessment of the Delphi method, confirm policy decisions undertaken at Commission level. In addition, this approach can help to have a better idea about the obstacles to the widespread use of ATT technologies. However, it should be borne in mind that the interpretation of the results of a prospective study depends very much on the detailed understanding of the strengths and weaknesses of the methodology applied.

Keywords

Telematics, urban transport, technology forecasting

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Finding an Exit from the Mobility Maze: Non-conventional Approaches to Mobility in Urban Areas

John Whitelegg

Issue: Car ownership and use in Europe continues to grow at rates in excess of 3% per year, with higher than average growth rates in southern Europe and in eastern Europe. This dependency on private vehicles for journeys to work, shops and schools produces a number of well documented environmental impacts. Less well documented are the impacts on community life, neighbourhood congestion, land use patterns and public expenditures, all of which undermine efforts to create sustainable cities.

Relevance: The promotion and creation of sustainable cities is central to the overall objectives of sustainable development, to the attainment of fundamental solutions to environmental problems as required by the EU's 5th Environmental Action programme and to the protection of habitats, ecology and biodiversity in Europe's many undeveloped but threatened 'green' areas. Given the environmental impacts and constraints there is still scope for the delivery of improvements to local and large scale regional environmental quality through serious traffic restraint and the promotion of alternatives to motorised transport.

Finding the exit

Current developments in urban mobility show a fundamental mis-match between expectations and what is delivered. The car offers so much to its owner. Instant availability, instant access, safety and security, carrying capacity to deal with modern shopping habits and the extension of the number of employment opportunities within reasonable journey times (< 1 hour). This tempts us all further into the maze of auto dependency and frustration. The actual delivery is very different. Average speeds of vehicles in London and many other European cities are below 15 km/per hour. The very fact that so many other people have access to these vehicles means that all of us receive fewer benefits, ie. we are more likely to be subject to congestion and delays. The daily reality around the London's M25 orbital motorway is very similar to that experienced by those attempting to circumnavigate Milan or Madrid or drive from Dusseldorf to Dortmund in Germany. Roads that were built to improve economic performance, expedite goods and people, are now subject to massive delays and frustration, impeding the economics of efficient manufacturing and distribution.

The problem with urban mobility is that most transport land use interactions have powerful feedback tendencies. The advantages of better vehicles and faster roads are rapidly eroded by the

The availability of individual motorised transport to all has given rise to a discrepancy between the freedom and flexibility offered by the car and the reality of a congested road network

Experience has shown that rather than improve mobility and access, better vehicles and faster roads release latent demand, thus always reaching the same levels of congestion as before

The experience of some European cities has already shown that bicycle and pedestrian transport are viable alternatives

Travelling shorter distances to schools, shops and the workplace has a lower environmental impact, frees time for other activities and creates socially rich communities where neighbours know each other

More rapid and efficient transport does not reduce travel times but gives rise to more spatially diffuse lifestyles in which people live further away from work, etc

large latent demand for motorised transport and by the acute sensitivity of land uses to adapt to new possibilities and to restructure cities and regions in the image of the car and the lorry. If we had all continued to live, work, and shop in roughly the same locations that we had established in the 1960s, then we would find the road system of the 80s and 90s enormously liberating in terms of free flow and speed. Sadly we have all advanced further into the maze and taken a large number of wrong turns. We now live further away from where we work. Shopping habits are radically different in the 90s to what they were in the 60s. Shopping is almost entirely car dependent and in Britain particularly the journey to school which should be a strong preserve of the cyclist and the pedestrian is now largely motorised.

This is not the case throughout Europe. Dutch cities such as Delft and Groningen offer important models of successful bicycle and pedestrian transport. Copenhagen has an enviable record of support for the bicycle that could be translated to most other European cities of more than 500,000 population.

UK research published by the Standing Advisory Committee on Trunk Road Assessment (SACTRA) in 1994, showed very clearly how building new roads led to the generation of new traffic. The age old assumption that new roads simply reallocated existing traffic onto the additional road space, was disproved revealing the existence of feedback and the counter-productive effect of 40 years of large scale public investment in new road capacity.

Mobility is an expression of the relationship in urban areas between time and space. We can be very mobile over a large area with the assistance of vehicles and roads, but only at the cost of consuming fossil fuels, land for roads and car parking and producing large amounts of greenhouse gases and pollutants that damage respiratory health, particularly of children. We can be relatively immobile but at the same time accessibility rich and using buses, bicycles and feet to make contact with local shops, schools and workplaces. This relative immobility is very undemanding in its use of energy and in its production of pollutants. It is also vital for socially rich communities where neighbours know each other, children play in the streets and community activities are common. Those satisfying their daily needs for goods and services and employment in a relatively small geographical area will have more time to 'spend' on discretionary activities than those who spread out over a radius of up to 50 km in the search for shops, workplaces, schools and recreational centres. Both kinds of behavioural types (and all those in-between) are dependent on the land use planning system to make their worlds work. Generally, in the past 20 years in Europe's cities the tendencies have been in favour of a reduction in small scale urban facilities, and their replacement by large scale activities often on the edge of towns or in locations which are inconvenient for public transport. This process is well advanced in Britain but less advanced in southern Europe. It is a process that is fundamentally not sustainable and one that drives up the demand for distance, energy and the destruction of green spaces.

In spite of these large differences in life style with their large differences in environmental impact, many aspects of mobility are remarkably constant. Werner Brog of Socialdata (Munich) has shown that over a wide range of cities we are indulging in about the same number of activities per day (eg. work, education, shopping etc.) and the number of these activities is on average 1.8, the same amount of travel time per day (one hour), the same number of trips per day (ca. 3.2)

Table 1. International variations in Mobility

Per Person/day	Wismar	Delft	Zürich	Perth
ACTIVITIES	1.8	1.9	1.7	1.8
TRAVELTIME (Min)	69	62	64	62
TRIPS	3.1	3.5	2.9	3.2
DISTANCE (Km)	15	21	18	45

Source. Brog, W (1996)

but very different total distances travelled. This variation in distance travelled from 15 km per day in Wismar to 45 km per day in Perth (Western Australia) shows how deeply we have got into the mobility maze and the extent to which we are well and truly lost. The residents of Perth are paying (financially and environmentally) for a spatially diffuse lifestyle. They do not gain in time, they do not gain in number of activities but individually and collectively they have to pay for a life support system that can handle long distances.

Can we afford to stay in the maze?

Supporting large amounts of mobility is very expensive. According to the Automobile Association, one of Britain's main motoring organizations, the cost to the owner of using a 1600cc car is 23 pence per kilometre. Assuming 16,000 kilometres each year this will amount to £3700 each year or £71 each week (£10 each day). Car ownership and use is a very expensive item for the individual beneficiary but this is overshadowed by the cost to society as a whole. David Maddison and his colleagues in a 1996 report titled 'The true costs of road transport' put the total costs of road transport in 1993 in the range £45.9-£52.9 billion for the UK with a taxation return of £16.4 billion. This represents a massive subsidy to private motoring (and the lorry) and a substantial economic loss when there are many alternatives to car commuting and road freight.

Current levels of mobility are both unaffordable and non-sustainable. They contradict EU policy commitments in the Maastricht Treaty and the 5th Environmental Action programme to internalise external costs and implement fully the 'polluter pays principle'. They also damage the efficient functioning of the economy in more subtle ways. Cities clogged up with traffic are unattractive places and suffer from a fall in retailing revenue. A study by the German Institute for Urban Forecasting (DIFU) in 1990 noted that the cities with the highest levels of retail turnover per square metre of retail space were those with strong traffic restraint policies in place. Traffic restraint (reduced mobility by private car) is good for the economy. Traffic reductions are supportive of a strong local economy. Studies of public transport, traffic

Car ownership and use is costly for individuals and society. In the UK roads are estimated to be subsidised to the tune of £35bn a year

A recent study has noted that the cities with the highest levels of retail turnover per square metre of retail space were those with strong traffic restraint policies

Just-in-time transport cannot function effectively on the congested European motorway system and European executives are wasting valuable time in ever longer journey times, while their competitors spend more time doing productive work

While the UK's per capita GNP was 2.3 times higher in real terms in 1990 than in 1950, the quality of life measured by the ISEW index has been falling since the 1970s and is almost back to 1950s levels

Transport policies and urban mobility policies should take into account the fact that the costs of coping with increased mobility have been high and have not brought an adequate rate of return on the very large public investments that have supported them

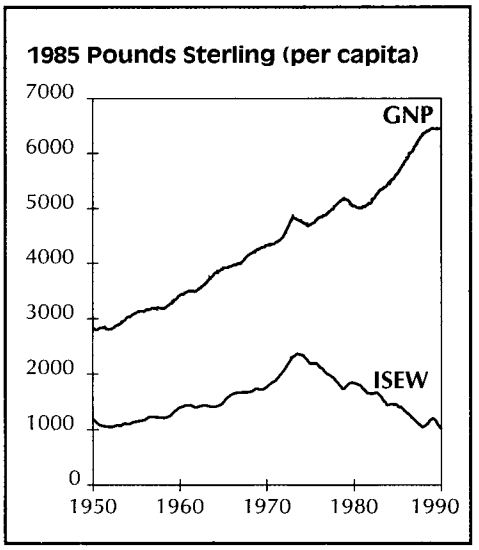
calming, walking and cycling strategies show that investment in these sustainable modes of transport delivers more employment per financial unit of investment and injects more of that investment into the local as opposed to the global economy.

There is a central paradox in the implied commitment to mobility in European transport policy. As more freight is carried by lorry and more passenger journeys are undertaken by car then the quality of the lorry or car journey for existing users falls. Just-in-time transport which is the mainstay of European logistics and freight transport systems, cannot maintain its time quality standards in the face of congestion on the European motorway system, particularly around large cities. Business travel by car is increasingly uncertain leading to longer periods of allocated time for the journey, more stress and less useful work carried out by the motorised executive. All these tendencies effect the international competitiveness of European business. If the Japanese executive and the Japanese freight trip are subject to less disruption and shorter time penalties then, this will work in favour of Japanese enterprise. The Japanese already drive fewer miles than their European counterparts. What are they doing with the time they save?

Saving time and saving money: the exit

Quality of life involves much more than quantitative indices of increases in GNP or per capita income. In 1970 in Britain 80% of all children walked or cycled independently to school with no need for an adult escort. In 1990 this percentage had dropped to 8%. This drop was associated with a huge increase in children being taken to school by car, more pollution and tens of millions of hours being 'spent' by adults (mainly women) in doing the work of escorting. Does this kind of change represent an increase or a decrease in quality of life? In an attempt to answer

Figure 1: Gross national Product and Index of Economic Welfare in the UK, 1950-90



Source. NEF

questions of this kind the Stockholm Environment Institute have produced the Index of Sustainable Economic Welfare (ISEW). Spending to offset social and environmental costs (defensive expenditures), is subtracted from consumer expenditure as are longer term estimates of environmental damage and the depreciation of 'natural capital'. This includes the costs of congestion and commuting though not the costs of escorting children to school. The result shows a more comprehensive measure of welfare which diverges from GNP. While the UK's per capita GNP was 2.3 times higher in real terms in 1990 than in 1950, ISEW has been falling since the mid 1970s and by 1990 was almost back to its 1950 level. This decline involves much more than traffic and congestion but it graphically illustrates how the presumed gains of higher mobility have been transformed into actual losses through congestion, time loss and the associated costs of pollution and poor health

All this points to a solution. Transport policies and urban mobility policies should be informed by the realities of the space-time restructuring of

the last 20 years. The personal, household and community costs of coping with increased mobility have been high and have not brought an adequate rate of return on the very large public investments that have supported them. Policies that widen choice -particularly those that favour the non-motorised modes- and offer more activities within smaller geographical areas and give time back to those who have lost most will serve both environmental and economic objectives. Detailed implementation of these policies will require an approach unlike any that have hitherto been applied. This approach will be characterized by the breakdown of differences between the public and private supply of transport, achieved by the full involvement of workplaces in altering the pattern of demand for transport of their commuters, and by the application of multiple strategies aimed at reducing car dependency for school trips and shopping expeditions.

Conclusions

The solution to mobility problems in urban areas requires a detailed understanding of the relationships between space, time and human behaviour that have been generated by the widespread availability of private motorised transport. A policy response would be necessary in order to address concerns about the environment, quality of life and economic performance. This would need to be able to establish new equilibria in which the density of facilities (shops, employment, schools etc.) is increased, ie. more of them in smaller geographical areas. Restricting car access to residential and city centre areas could also reduce the travel times for public transport and improve economic conditions for more essential business travel. Eliminating car commuter trips through high quality alternatives could help achieve greenhouse gas reduction targets and improve the health of urban populations through reductions in emissions.

At the European level these policies would require the right 'frame conditions' especially the full internalising of all external costs of transport and progress with deeper reforms of the taxation system. A taxation system that 'penalises' the use of green (undeveloped) land, whilst 'rewarding' the use of land that has already been used once for development of some kind, will ease the transition in cities towards land use patterns that generate less traffic and encourage more walking and cycling. Other 'frame' conditions include a strengthened Strategic Environmental Assessment procedure to discriminate between damaging and beneficial public investments in transport infrastructure and the incorporation of transport and traffic reduction issues in EU-wide market mechanisms such as EMAS (Environmental Management and Audit Scheme), and eco-labelling schemes. Companies and products that minimize their demands on transport (lorry-kilometres) are just as important as those that minimize their demands on energy for the production process itself.

A fresh approach is needed, breaking down the difference between public and private supply of transport, involving workplaces in altering the pattern of demand and employing a variety of strategies for reducing car dependency

Keywords
Mobility, car dependency, urban transport, sustainable city

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A Transition to Sustainable Mobility

Celia Greaves

Issue: The challenges generated by the growth in road traffic present urban authorities with an increasingly complex dilemma. With the recognition that a 'predict and provide' approach is unsustainable, emphasis is shifting away from efforts to meet demand towards the management of demand, mitigation of effects and reduction at source. There is also growing recognition that the achievement of such solutions requires a balance between transport, environment, health, community and local economic goals.

Relevance: In order to derive sustainable transport strategies, urban authorities need to consider carefully the full range of technical managerial and policy options, and the interactions between them. Optimal solutions require planners to adopt a holistic and rigorous approach which builds on experience elsewhere and reflects specific local circumstances.

Introduction

In recent years there has been a major change in the approach to transportation planning, with a shift towards the development of integrated local policies aimed at reducing reliance on the car and encouraging the use of other modes. This has generated a number of challenges for local authorities seeking to achieve sustainable solutions embracing the full range of local opportunities. These include:

- anticipating the local outcomes of specific measures;
- predicting the nature of interactions between individual measures,
- comparing policy options, with a view to identifying the most appropriate ones; and
- developing transport strategies which embrace the full range of local issues.

This Paper discusses recent developments and methods of optimising outcomes. To illustrate the complexity of the subject, a summary of the options available is also presented.

Measures for achieving sustainable mobility

Box 1 illustrates the wide range of options available to individual authorities. Further details of some of the measures listed below are provided in other articles in this issue. A key challenge for decision makers is to develop local strategies based around an optimal mix of measures.

Interactions between measures

An understanding of the interaction between individual measures is critical if unforeseen consequences are to be avoided in implementation.

In recent years there has been a shift in transportation planning aimed at reducing reliance on the car

Box 1: Measures for achieving sustainable mobility

Measure	Key characteristics
parking charges	- optimal prices will depend on the distribution of travel across different modes, the availability of parking and the accessibility of other modes.
reducing parking availability	- should form part of an overall parking strategy (see above)
access restrictions	- in the form of congestion charging, either area or route based
improvements to road networks	- small scale improvements may bring some local benefit, but are unlikely to be sufficient in isolation
traffic calming	- can help to reduce speeds on individual routes
transport telematics	- offer benefits in terms of both better traffic management (eg. through signal control) and transport information
	- options for control are limited in countries such as the UK - use of bus lanes and priority at crossings and junctions - can help towns and cities to accommodate growth by helping to limit future growth in congestion
light rail system	- combination of on- and off-street running possible. Less infrastructure intensive than heavy rail systems
heavy rail system	- key constraints to development are cost and infrastructure requirements
guided buses	- similar to conventional buses, but restricted in range to predefined routes
facilities to encourage cycling	- including segregated cycle ways, priority at junctions and crossings, speed restriction on roads used by cyclists and signing
facilities to encourage walking	- pedestrianisation and the provision of adequate and, in some cases, segregated footways, crossing facilities and signing, as well as suitably situated dedicated footpaths.
speed restrictions	- reduced vehicle speeds can support both cyclists and pedestrians

The interaction between measures needs to be understood in order to avoid unforeseen consequences

In this section, a selection of examples are presented to illustrate the need for individual measures to be integrated to form a cohesive whole

Parking restraint is a contentious issue for many authorities. There is often concern at the local level that the reduction of parking in central areas will deter shoppers, thus having an adverse impact on economic performance. Such concerns can be addressed through the introduction of compensatory measures, such as park and ride.

For park and ride schemes to be successful, they need to be introduced in parallel with other measures that support the use of buses, namely prioritisation schemes such as bus lanes and priority at traffic lights. Other measures to encourage public transport use include co-ordinated ticketing to allow transfer between companies.

Cities such as Delft (The Netherlands) and Freiburg (Germany) include cycle parking at their park and ride sites. This enables those who wish to cycle but live too far from the city centre to do so, to adopt a combination of cycle and bus for their journey. In Oxford, the extensive park and ride facilities, which impose no fees for parking, have been introduced in parallel with a steady increase in parking charges elsewhere, such that public parking now has the highest charges in the country. Here, the biggest constraint to future growth in the uptake of park and ride is recognized as being the availability of private non-residential parking spaces, provided by private operators who may undercut charges for public parking space and thereby reduce the effectiveness of parking charge increases as traffic limiting measures. These currently have a value of around 2300 ECU per year, tax free (Walker, 1996). In seeking to reduce the number of such spaces in the long term, Cambridge City Council has imposed a one-off payment on operators of around 2600 ECU for each new non-residential parking space created. Funds raised are used to support the operation of park and ride facilities.

As well as addressing formal parking provision (ie. car parks), local authorities often need to consider the availability of uncontrolled parking in residential areas adjacent to urban centres. Unless some form of restraint is introduced in these areas, drivers discouraged by high car park charges may migrate to peripheral areas where parking is free. Restraint typically takes the form of residential parking permits combined, where appropriate, with pay and display facilities. The charging structures at pay and display can be geared towards encouraging certain types of driver. An issue to be considered is whether it is preferable that the facilities be used on a long term basis, which could well attract a commuter, or on a short term basis, which could be associated with local trips.

Planners are often faced with spatial constraints in developing transport schemes, with the need for trade-offs between the requirements of cyclists, pedestrians, buses and cars. Thus, the introduction of bus lanes has a significant, and often intended, effect on car drivers, but limits the scope for cycle lanes. Experience across Europe suggests that increased cycle use can lead to reduced risk of accident, because cyclists are less easily overlooked and road layouts are increasingly designed to take account of their needs (Royal Commission on Environmental Pollution, 1994).

At a more general level, with all measures aimed at congestion relief, there is the risk that any eliminated journeys will be replaced by new journeys by other travellers. This highlights the need to involve local communities in efforts to achieve sustainable mobility, through a process of dialogue and consensus building.

Strategy development

Transport strategies are increasingly recognized as critical pre-requisites to the identification of appropriate local schemes and measures which will produce improvements in local transport conditions.

Key components of strategy development are likely to comprise the following:

- defining the objectives;
- understanding the detailed nature of the problem (ie. as defined by current local transport conditions, public perception thereof, and future plans);

Park and ride schemes have been combined with schemes promoting cycling and with increased parking fees to encourage their use

When increasing parking charges local authorities need to consider the possible effects on free uncontrolled parking in residential areas

Spatial constraints often impose the need for trade-offs between the requirements of cyclists, buses and cars

Ideally, consultation would be an important part of the process by which local authorities implement measures to improve local transport conditions

Typically, transport solutions will encompass a package of initiatives covering a range of restraint measures and public transport provision

- reviewing the options;
- assessing and evaluating options; and
- identifying the preferred strategy (Institute of Highways and Transportation, 1996).

An important underlying theme of the process is consultation, with local authorities ideally seeking to involve the full range of interested parties across all aspects of strategy development.

Strategy objectives need to be carefully defined if they are to provide an appropriate framework within which to identify problems and evaluate solutions. Objectives can embrace a whole raft of issues, as shown in box 2. Clearly, these objectives are not mutually exclusive and may act in synergy or, indeed, opposition.

Box 2: Strategy objectives

- reducing congestion
- improving safety for all transport users and pedestrians
- reducing transport pollution
- improving environmental quality
- providing opportunities for regeneration
- increasing opportunities for walking and cycling
- reducing the need to travel.
- providing an efficient public transport service
- encouraging the use of alternative modes to the public car
- ensuring economic efficiency
- facilitating economic regeneration

The timing and phasing of individual elements of a strategy can be critical to overall success

Although the use of targets, as a means of quantifying elements of the objectives, has yet to be embraced on a large scale, there are some interesting developments in this area. For example, the City of Edinburgh in Scotland has set a target of a 30% reduction in car use in central areas by 2010, and a 12% increase in the proportion of commuting trips by public transport, cycle or foot.

It is recognized that in the longer term, there is a need to address the interconnections between transport and land use planning

In developing the elements of the strategy, it is often helpful to consider the options in terms of a number of themes, such as restraint measures and improved public transport provision, as shown in Box 1. Although these themes provide a good starting point, it is unlikely that any one approach will provide the best way forward. Typically, the solution will encompass a package of initiatives covering most, or all, of the themes. Assessing the likely impact of a particular scheme or measure in the local context can be particularly difficult. Both modelling and experience from elsewhere can be useful, although, in the latter case, there is relatively little data. This can be attributed partly to the lack of long term experience and partly to the fact that, for value to be gained from others' experience, there needs to be careful monitoring of outcomes. In this context, the results of a project currently in progress in Oxford should provide valuable guidance for the future. The project, which is supported by the EU Life Programme, aims to monitor a range of parameters related to the implementation of various transport strategy elements over the next few years. The strategy includes bus prioritisation, enhancement of park and ride, improved facilities for cyclists and pedestrians, parking restraint and traffic calming, with impacts being assessed in terms of traffic levels, economic vitality, air quality, building erosion and public health (Oxfordshire County Council, 1996).

Once the impacts of scheme elements, both in isolation and combination, have been assessed, options can be compared with a view to defining the overall strategy. Issues to be examined include achievement of objectives, amelioration of identified problems and value for money (Institution of Highways and Transportation, 1996).

The timing and phasing of individual elements of a strategy can be critical to overall success. Oxford's current policy stresses the need for a step by step approach to implementation, with

measures aimed at reducing traffic pressures in the central area being introduced in advance of environmental improvements (Oxfordshire County Council, 1996). It is hoped that by encouraging a modal shift away from the car before the introduction of city centre access restrictions, the displacement of traffic pressures to surrounding areas can be avoided. Similarly, increased park and ride provision is scheduled to be introduced before city centre parking is reduced.

All of the above could be considered as short to medium term measures. It is recognized that in the longer term, there is a need to address the interconnections between transport and land use planning. Careful planning can help to ensure that whilst accessibility is maintained, the need to travel is reduced. A good example is the Netherlands, which has a policy of 'The Right Business in the Right Place' (known as ABC). This policy aims 'to ensure that businesses and services with a high potential of public transport utilisation by employees and visitors are sited on locations which are easily accessible, or can be made easily accessible, by public transport' (European Commission, 1996).

The introduction of an EU Directive on Strategic Environmental Assessment is currently under consideration. The Directive aims to strengthen existing assessment systems by extending them to land use planning issues such as transport. It could have an impact on local strategy development across Europe, encouraging more formalized and transparent decision making. Proponents of this approach cite better policy decisions, greater opportunity for public involvement and enhanced public legitimacy as some of the benefits (Sheate, 1995).

Learning mechanisms

The most important source of information for authorities planning local transport is generally government guidance, with conferences, site visits and professional journals and networks also playing a significant role.

As the earlier discussion has highlighted, the development of integrated strategies and policies requires a good understanding of the impacts of both individual measures and packages of measures acting together. At present, methods of developing this understanding, and learning from the experience of others remains largely uncoordinated, resulting in potentially inefficient decision making. Authorities would benefit from greater support in the identification and evaluation of options.

Conclusions

In seeking to achieve sustainable mobility, urban authorities have a wide range of measures at their disposal. The successful mix of different options in a given location will depend upon a number of local characteristics, including land use patterns and constraints and current transport patterns. Furthermore, there are trade-offs to be made between different types of measures.

Clearly, no single paradigm will provide the solution in every case. Nevertheless, it is becoming increasingly recognized that successful urban strategies require a combination of 'stick' (restraint) and 'carrot' (encouraging modal shift) measures, as indicated above. In addition, public engagement and acceptance is important if restraint measures are to succeed.

With the shift in focus away from 'predict and provide' there is a need for much greater assessment and monitoring of new approaches, so that future decision making can be optimised. Progress could also be enhanced through mechanisms which allow local

The EU Directive on Strategic Environmental Assessment aims to strengthen existing assessment systems by extending them to land use planning issues such as transport

At present, ways of understanding both individual measures and packages of measures acting together, and learning from the experience of others remain largely uncoordinated, resulting in potentially inefficient decision making

Successful urban strategies require a combination of 'stick' (restraint) and 'carrot' (encouraging modal shift) measures, moreover public engagement and acceptance is important

authorities to learn from each others experience more easily, both at the national and international level. European Commission recognition of the need for improved frameworks for sharing and spreading information is to be welcomed (European Commission, 1996).

Finally, there are currently a number of European transport projects and programmes focusing particularly on technology. Given the need for a holistic approach to transport planning in the future, a broad based European initiative aimed at encouraging integrated strategies, both locally and more widely, could make a valuable contribution.

Keywords

Sustainable mobility, learning mechanisms, transport strategy, decision making

About the author

Celia Greaves is a Project Leader at CEST She has over ten years experience in environmental and transport related work in both the public and private sector. Her current areas of research include aspects of both transport and the environment, particularly within the business context.

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Who will Decide on Optimal Urban Freight Transport?

Roel ter Brugge and Wim Dunnewold

Issue: In several European cities urban freight transport has become a major problem the last decade. Increasingly, society is becoming concerned about problems due to congestion, air pollution and noise related to transportation and delivery of goods into town centres. Given the needs of town centres for urban freight transportation the question is: to what extent is it possible to design and operate urban freight transport within both commercial and social constraints such as flexible operation of supply chains and sustainability?

Relevance: Today many innovative technical solutions for urban freight transport are emerging. For this reason it is essential to focus on the possibilities of placing urban freight transport high on the research agenda. However, an important part of the research agenda should be geared to support implementation strategies of public and private actors, based on a better understanding of long and short term impacts.

Background: Cities in Transition

Many European cities, in particular cities with historic town centres and populations in excess of 100,000 inhabitants, are struggling for space in their town centres. This is not surprising, especially when considering that in the past it had never been considered necessary to take the requirements of urban transport into account, at least not in the way we do now. Traditionally, town centres are the areas with the highest (commercial) values, attracting all kinds of commercial activities, such as offices, big department stores, restaurants, shops, etc. From the point of view of society there is no apparent desire to change this. (Imagine a town centre without any of these commercial and cultural activities).

Segregation tends to degrade town centres. Higher income groups move to the fringe of the cities or even into the countryside, working and shopping in centres at highway nodes outside the city. Teleworking and teleshopping may lead to further developments in which large groups no longer have any need to go into the town centres, not even for leisure shopping. After all, what enjoyment can they expect to derive from shopping in congested, polluted city centres, where they may even feel unsafe? In contrast to this negative scenario, most researchers in the field -and also most politicians- have come to the conclusion that a 'highly urbanised society' is a necessary component of long-term sustainable solutions, both from the point of view of social stability and in terms of utilising optimally the natural resources we have inherited.

Town centres are under considerable pressure for space as they are traditionally the areas with the highest (commercial) values, attracting all kinds of commercial activities, such as offices, big department stores, restaurants and shops

There is a consensus that a 'highly urbanised society' is a necessary component of long-term sustainable solutions - thus efforts need to be made to stem the movement of higher income groups out of the cities

Movement of goods in congested urban areas is potentially more expensive than elsewhere and it is not clear who will have to pay this additional cost

Local authority regulations are intended to balance market forces with other social objectives

Lean supply chains enable retailers to maintain only limited stocks, this saves them valuable floor-space in expensive city-centre locations

What does this imply for urban freight transport? Imagine most of the inhabitants with economic potential living at the fringe or even outside the cities. They can buy their commodities in the city centre or via access to other options such as malls or teleshopping facilities, which allows them to have the goods delivered directly to their home. What is not clear is whether they are ready to pay the extra cost to get their commodities transported in and out of the congested city area, for which a highly advanced and thus expensive, city logistics system[1] has been set up. Who else is prepared to bear these costs? The retailers, transport firms or shippers? They have to incorporate the additional costs in the prices charged to consumers. Moreover, the attitude of public authorities has to be taken into consideration. For example, whether they feel responsible for the high quality of the town centre, bearing in mind that ultimately, these politicians deal with the same group of consumers, as tax payers and as voters. Therefore, on the one hand the conclusion is that we are predominantly dealing with a public issue in which local authorities have a great responsibility, however the (financial) margins generated by introducing advanced and expensive solutions through innovation are small. This is certainly true when freight transport is a part of the overall supply chain, controlled by commercially operating private firms.

Urban Transport: Part of Supply-chain Management

Urban freight transport can be understood better by approaching it from the perspective of supply chain management. Organizing effective urban freight transport is complex, on account of the many actors involved. The actual requirements imposed on it depend very heavily on the point of view of the partners in logistic chains. The transport operators aim for cost effectiveness while optimising the quality of their services, shippers, ie. the suppliers, wholesale and retail firms, want the shortest possible time to market while minimising storage levels, resulting in requests for frequent deliveries. Inhabitants demand both ease of access to and within the town and quality of life. Local authorities have the power to make regulations, for instance, concerning urban freight transport. Their overall goals are to balance market forces with other social objectives.

Relating the concept of urban freight transport to a framework of goals and trends in the management and the operation of supply chains is therefore essential. Moreover, transportation issues in the inner city are not an isolated problem. In Western Europe urban fringe and inter-city transport has become a more serious problem. That is why logistic concepts and supply chain management is put forward here as an issue. Below we offer a summary of some of the trends and concepts.

Lean supply chains

Eliminating excess stock in the supply chain from production to consumption is an important objective of logistic control. This applies in particular to the stocks in shops in the city centres where floor space is very expensive

Improved levels of customer service

In order to remain successful, many companies are paying considerable attention to the service levels they provide in the delivery of their products to customers; competing on product price and quality is no longer sufficient. The logistic service has become a part of competitiveness. As a consequence companies are continually seeking to improve performance in the following areas:

- availability of items from stock
- order cycle time
- frequency of delivery
- on-schedule delivery
- reliability of delivery
- complete fulfilment of each order with no missing or damaged items.

Reconfiguring the chain partnerships

Many companies are in the process of a major drive to reconfigure their upstream relationships with suppliers and their downstream relationships with customers, primarily in order to reduce costs and improve quality. Economies of scale and scope lead to a reduction in the number of players, either in the area of service providers and/or shippers (manufacturers, wholesalers and retailers). Basically, supply chain partners are now being assessed on the basis of the value they can add to supply chain performance. In aiming to achieve logistic objectives (eg. improved customer service, lean supply chains) companies want to be able to share real-time information with supply chain partners, which has major implications for mutual investments in both hardware and software.

In what way can urban freight transport be responsive? To what extent can urban freight transport meet the current and future requirements of users and potential users? Will the frequent trips by small trucks with low load factors be the favourite solution in this frequent delivery pattern? This should not necessarily be the only way out. Innovative logistic concepts such as ECR [2] (Effective Consumer Response systems) have the potential to fulfil these requirements and also lead to sustainability in logistical operations if these changes in commercial operation occur in an environment where the societal goals are also made clear. The requirements of sustainable operation can be met quite simply by establishing high load factors and making use of environmental-friendly vehicles or even using other modes of transportation such as subterranean tubes. Here we enter the area of the strategies for urban policies.

The Strategic Component of Transport Policy for Urban Freight

Enhancing the quality of the scarce space in city centres

Improving the quality of the scarce space is an important characteristic of policies in cities. Optimally, this space would be utilized 24 hours a day. But there are restrictions, both technological (access to the stores, noise of vehicles and loading facilities), and social (noise and working conditions) which are difficult to overcome.

It also has to be asked in how far it is possible to integrate urban passenger transport with urban freight transport. There may be more scope than actually recognized for integrating both activities, using only one vehicle instead of two, and making use of the public transport corridors in the cities.

Technological developments

In the longer run, innovations in infrastructure may be feasible, such as underground freight transport. In the Dutch program for sustainable mobility, much research is being carried out in this area. The result, for the moment, is that many of those who look with scepticism at an increase in road-based freight transport are now convinced that these concepts have a fair chance in very densely populated areas such as the Netherlands. Prerequisites for such novel infrastructure techniques are technologies for nodes or terminals, ie. efficient transhipment facilities such as automatic warehouses and AGVs (automatic

Rapid and reliable delivery has become part of retailers' strategy to improve customer service

Companies are changing the way they relate to other companies in their supply chains, assessing partners on the value they can add to the performance of the chain

A responsive supply chain may demand frequent trips by small trucks with a low load factor whereas sustainable operation is best met by environmentally-friendly vehicles with high load factors

There may be scope for integrating passenger transport with urban freight transport

Developments in infrastructure such as underground transport or the use of automatic guided vehicles and automatic warehouses may be feasible in the longer term

It is incumbent on public authorities to set out a clear vision, define the constraints and introduce standards to achieve sufficient scale for solutions both in each city and across Europe

There is a lack of information on which to base decisions concerning the selection of companies for city logistics

It is not clear how to design and implement urban freight transport in a way that meets both the needs of the supply chain and the long-term goals of society

guided vehicles). These advanced technologies require sufficient scale. In this area, an enormous effort has been noted. However, the realisation and implementation of these options must be based on technologies in advanced Information and Communication Technology (ICT). ICT, or advanced transport telematics (ATT), is not necessarily considered as being the push behind the development, but it is at least a very strong enabler of it. Developments in this field are extremely rapid and have the potential to restructure and improve transport operations and traffic congestion in the short term.

Orchestrating the many actors

Both in logistics and in society, it may be difficult for the large number of parties involved to find the optimal collective solution for urban freight transport. The question that arises is: should one party be the director in urban transport, in other words, have the power to impose its ideas on other parties and carry them out? Because of the complexity, the highly sensitive political nature of the issue and the commercial interests involved, this does not seem wise. Nevertheless public authorities are obliged to set out a clear vision, define the constraints and introduce standards to achieve a sufficient scale for solutions in each city as well as across Europe.

The need to be aware of differentiation

There is a high degree differentiation in the nature of the goods and in the logistics concepts behind them. For instance, whether fresh, dirty and inconvenient goods may be transported through urban freight platforms[3], and if so, what kind of loading units -eg., pallets, containers, boxes etc.- would need to be used? At the moment, there is severe competition between the many trucking companies, sometimes operating in highly specialized markets. What methods and what selection criteria will be used to select a company which will be responsible for city logistics? Is the scale of every town sufficient for optimal distribution or should city logistics be implemented on a regional scale? Are regional freight platforms perhaps a better solution than local ones for only one city? Generally speaking, there is a lack of information on which to base such decisions, making the role of (local) authorities very difficult. Given this uncertain information and knowledge basis, the question is, whether authorities can exclude some types of transport and/or transport vehicles from having access to town centres? Or can information be given to the market in order to optimize itself through self-regulation?

Improved organization will be followed by advanced and innovative solutions

As has been illustrated, supply chains have to be increasingly responsive to different service requirements. Rigidly constructed supply chain systems cannot offer a flexible response and will become inappropriate. So will any legal or technological solutions which do not take account of the trends in the society as well as those of the commercial actors in the supply chains. The question is therefore if it is possible to design and operate urban freight transport in such a way that it can promote the flexible operation of supply chains on behalf of participating companies while simultaneously falling in line with the long-term goals of society in the areas of physical planning and sustainability.

Conclusion

Most of the technical and organizational solutions mentioned here for urban freight transport are known and in many European towns experiments have been undertaken, and attention given to it in European R&D programmes is

growing. However, success rates are modest, because of the ad hoc approach and especially because of the private-commercial nature of supply chains. This does not mean that authorities are unable to induce change, but neither that they should try to control freight transport strongly. Municipalities will have to design sustainable transport policies, which balance environmental, economic and social concerns, such as ease of access and quality of life. Elements of such transport policies should focus on:

- managing transport demand (avoiding and reducing traffic),
- the supply and control of infrastructure (managing traffic) and
- the type of vehicles used (reducing external effects of vehicle use).

This is a complex task which will intrude deeply into social issues such as where people live, work and take their leisure. Moreover, solutions have to be acceptable in a wider area than just the inner city. To be able to change the current situation, urban authorities require detailed knowledge and understanding of:

- the current situation and problems within their city with respect to freight transport;
- the underlying commercially based logistical structures;
- the frequently conflicting interests of the parties involved;
- potential measures and policy instruments and their effects.

Finding the answers to these questions will be the key to the required re-organization of urban freight transport. Some of the recommendations aimed to help find answers to these questions and develop successful strategies are:

- Take into account the high degree of differentiation between specialisations, sizes, shapes and quantities in urban freight transport.
- Transport organization is the key to the solution. An open and neutral approach is needed to incorporate the many small and medium-sized enterprises and to prevent monopolies.
- Local authorities should play an important role in achieving effective urban freight transport. They should take advantage of the public attention focused on urban issues, however they cannot simply exclude freight transport from town centres, given the overall objectives of an urban policy.
- There is an urgent need for better information and understanding. If the necessary information on supply, demand and impacts of transport is available, optimisation by either self regulation or external regulation will almost automatically follow.
- Finally, it is important to differentiate between short-term and long-term solutions. Information and communication technology contribute more than most of us expect to the short-term dynamics. This development however will be guided in the right direction if researchers are able to arrive at an overall reference model for urban transportation and if politicians provide the framework containing a clear political vision on goals and constraints of the desired future scenarios. For some of the major technological opportunities demanding large-scale implementation, it means that certain choices will have to be made, given that divergence of investments would be inefficient at macro level.

Municipalities will have to design sustainable transport policies, which balance environmental, economic and social concerns, such as ease of access and quality of life

But it also has to be attractive to the bigger actors in order for them to change their own supply chains which already in place

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Keywords

(Sustainable) urban freight transport, costs of urban freight transport, public-private organization, supply chain management, policy agenda and research agenda

Notes

1- A city logistics system is a highly organised way of distributing goods to retailer. This form of urban freight transport, although executed by private companies, is usually directed by a public-private organisation (local authorities).

2- ECR means keeping almost no stocks at retail outlets: shelves in the shop are more or less directly filled up by the daily delivery from the producers. A high degree of control by sophisticated telematics is crucial here, and this can also be used to optimise transport.

3- An urban freight platform is the (physical) place where shipments will be transhipped from one (usually larger) truck to a (usually smaller) which is better equipped and officially approved for urban freight transport.

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