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Transport and Sustainable Regional Development

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Abstract

Transport plays a pivotal role in the dynamics of our society, not only in economic terms but also in a spatial setting. New driving forces such as technological progress, privatisation and deregulation exert a structuring impact on transport systems and on their related consequences including environmental sustainability and urban form. The paper presents empirical results from a scenario experiment among Dutch transport experts, in which expected and desired spatial and environmental consequences of new transport systems up to the year 2030 are depicted. The paper shows that the probability of achieving the objective of sustainable mobility is rather low.

1. Transport: The Pivot of a New Europe

Interaction and communication are the essential conditions for the new edifice of Europe. All European countries, regions and cities are witnessing nowadays an unprecedented dynamics as a result of both integrating and widening forces which position also Nordic, Central- and Eastern-European as well as Mediterranean countries much more clearly on the European map. It hardly needs any argumentation that the socio-economic and (geo-)political restructuring in Europe will exert profound impacts in the next decades. Transport and communication will play a strategic structuring role as the backbone of new European developments ranging from local to transnational scales. European networks will form a connecting system between various regions in a heterogeneous European space, not only in a geographical but also in a socio-economic sense. Consequently, Europe will likely exhibit a variety of appearances as a result of driving forces and varied national and regional policies.

The new position of transport and communications in the European space-economy provokes also many intriguing policy and research questions. Is the transport sector able to fulfil its strategic economic role and is it able to overcome all institutional, financial and socio-political impediments? Is the drive towards more speed and accessibility in Europe a benefit for all regions and socio-economic groups or does it lead to new geographical discrimination and segmentation? Is the rapid increase in mobility of people and in flows of commodities compatible with environmental sustainability and security, or would the modern information society through advanced telematics and electronic highways offer a solution? Do the popular predictions regarding the potential offered by virtual reality provide new hope for a sustainable mobility? It is thus evident that transport in Europe is at the crossroads of strong but also antagonistic interests, which can be summarized under the following headings: **strategic economic growth, geographical accessibility and quality of life.** These issues will certainly become more visible and pronounced as of the beginning of the next century.

Thus transport and communication will be in the centre of many conflicting developments in Europe. Furthermore, any drastic change in mobility or modal

choice will have far reaching consequences for the - strategically important - European transport industry, such as the automobile industry and the road and rail construction sector, so that the actual manoevre space may be limited. Nevertheless, new policies instigated by equity, social cohesion and environmental interests may generate novel directions in the transport and communications industry and technology. Consequently, both policy and research in the transport sector need to be pro-active, coping with challenges from the present and creating new opportunities in the future, while respecting the abovementioned threefold objective for the European space-economy.

2. Transport: the Edge of European Progress

It should be recognized that a sophisticated network infrastructure is a sine qua non for the cohesion and integration of a widening Europe. The benefits of a mobile society have however, also many shadow sides. In the past years transport in Europe has continued to increase congestion and traffic insecurity, to produce disturbing levels of traffic noise, to use non-renewable energy sources, and to emit greenhouse gases. Extrapolation of current trends in Europe would in the future not only lead to the attainment of critical bottlenecks and high environmental decay, but likely also to increasing disparities in accessibility of European regions. In addition, knowledge about the complexity in transport problems is still limited which further restricts an efficient pro-active policy making. For example, policy implementation affecting travel behaviour requires fine tuning between goals, measures and social acceptance. This generally means that social and political approaches need to be recognised prior to - rather than after - the formulation of policy. There is still a shortage of good insights into the ways actors in transport respond to alternative policy measures, particularly cost measures. These developments underline the urgency of a new strategic approach to future solid research on transport.

Whereas much past research had a strong emphasis on engineering principles, there is no doubt that future research needs an interdisciplinary approach by rigorously including concepts from the social sciences and humanities, while it also

needs to address equally issues of policy implementation. Transport cannot properly be analyzed when isolated from its social context; on the contrary, the key forces of mobility and communications are a direct offspring of broader social, economic and political developments in Europe.

Transport fulfils thus a key role in modern society and economy. It enables households and companies to select their spatial organisation of activities, while it forms the backbone in the further integration of Europe with newly opened nations. Figure 1 underlines the integrative approach, by including in a comprehensive way major influences on mobility, with particular reference to the driving forces in the economic system, social organization and policy frameworks. This figure equally underlines the interaction of the spatial organisation and transport infrastructure and industry with mobility. Furthermore, it makes explicit reference to the natural environment, which is strongly influenced by land use, transport and mobility but has only weak reverse impacts. The same position is true for social cohesion (exclusion) in Europe on various spatial scales.

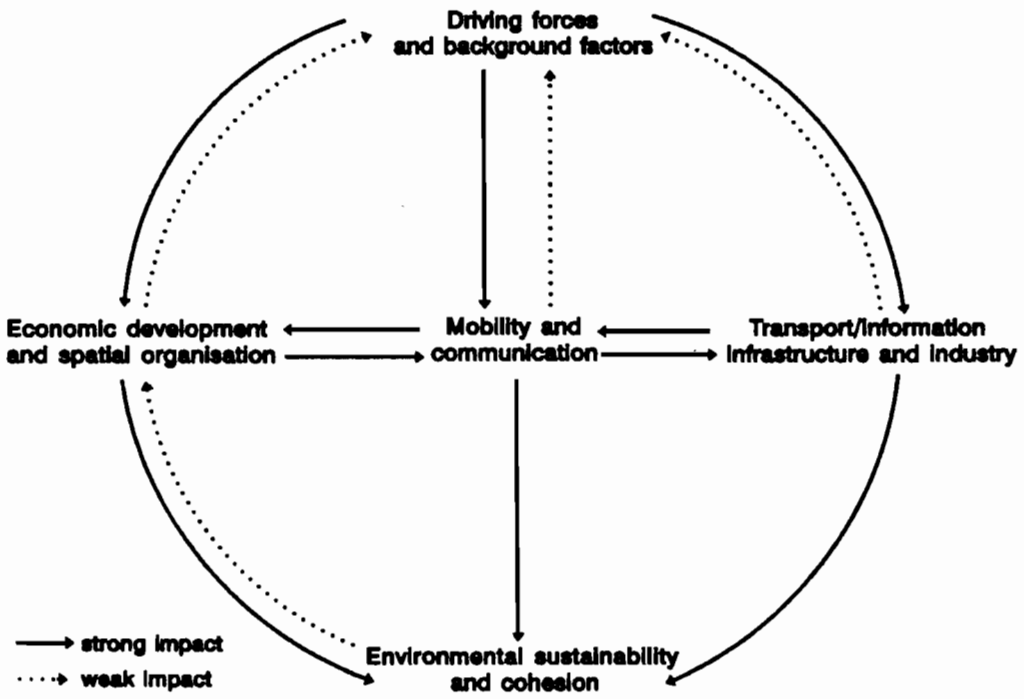

Figure 1. An integrative view on transport and mobility

Thus, transport is a central economic activity which also - because of its negative externalities - should respect the limits to European growth.

3. Transport: the Backbone of European Development

It is generally accepted that the strength of the new Europe is to be found in the synergy offered by its gradually evolving networks. Clearly, the emerging new European network society will in the next decades induce new forms of cooperation, communication, interaction and mobility. We will briefly sketch here some implications.

New logistics are increasingly being applied by firms impacting on the aggregate spatial pattern of physical movement. A major element in future logistics is recycling of products and waste materials. Far-reaching principles such as integrated product chain management will however, meet fierce resistance following the need for a new landscape of production, distribution, collection and treatment of waste materials and energy sources.

In production systems one can observe a rise of localized production networks (in particular, regions) as well as the emergence of expanding global networks. However, these phenomena seem to differ for different manufacturing sectors and segments within these sectors. At the same time, the relationship between manufacturers and suppliers is changing. There is a decrease of the number of suppliers per company and an increase of the interchangeability of the components involved. In addition, a persistently international division of labour implies that transport of mass produced goods will be over longer distances, and an increased product differentiation means that consumer goods are being transported in smaller quantities and more frequently. All developments mentioned tend however, to lead to more rather than less transport.

Driving forces such as individualization and urban sprawl are important in influencing increasing mobility of households and individuals. New lifestyles will inevitably emerge with concomitant new patterns of mobility. At one extreme is the mobile society, with fuller development of individual automobility. The other extreme is the homebound society with a focus on activities in and around the

home. Differences between the rich and the poor are also of interest here. Among the former, there is a persistent preference for living in suburban locations aside from a few respectable inner city quarters. High income groups and the well educated are usually more mobile than lower income groups (cf. Carley, 1992).

An issue of increasing concern in the coming years will be the growing constraints in physical infrastructure, mainly evident in road and air traffic congestion. Forces such as global competition, individualization, urban sprawl and persistent growth of large metropoles will inevitably lead to the collapse of major traffic routes and mainports. Solutions may be found in a combination of measures, such as increase of physical capacity, more efficient use of existing systems and support of new technologies.

A further issue is the linking of the European core with peripheral countries, including those of Eastern Europe. Missing infrastructure links are partly a reflection of the previous political geography of Europe. The speed at which the emerging deficiences will be removed in the new political situation depends on the importance attached to regional equity and group interests, as well as the availability of resources.

A quite new development is the growing demand for security in public transport systems other than air traffic. This follows on from the emergent vulnerability of underground (metro) systems for criminal attacks. But also systems like the High Speed Train seem to be easy 'victims'. Fear of violence may cause users of public transport to take private cars. Although much less harmful, strikes of employees in transport may equally distort public transport and bring numerous passengers into private cars.

Transport industries play an important role in the force field of transport, because they contribute considerably to employment in manufacturing and services. The automobile and aviation industry are often used as show-pieces of national governments. Nowadays, however, we see national-based industries becoming part of a larger globalization process. In more market-driven systems, producers prefer to locate footloose segments of their product chain there were costs are lowest, whereas governments react by trying to attract them to their countries.

The car and aircraft industries are also tied to other manufacturing sectors such as textiles, metal working and the machine industry. Furthermore, car use is closely connected with complementary services such as finance, insurance and fuelling. The production of transport hardware is also a field which often applies new technologies, such as new types of energy-conversion and storage systems, new light-weight construction materials, and advanced sensors. Subterranean transport is a field of application for new tunneling techniques, whereas Maglev may become an application of novel superconducting materials. In addition, the transport production industries have constituted a laboratory where innovative labour management systems and supply systems have developed and tested.

The speed to which new technologies will be introduced in transport in the coming years is strongly dependent on the type of driving forces at hand. New technologies for small (medium) scale public transport with a large public access seem important when principles such as eco-preservation and community values prevail. On the other hand, technologies which advance a fuller mobility of individuals will be popular when forces such as economic/technical efficiency and individualization dominate. Furthermore, it is difficult to predict the conditions which foster the uptake of new technologies by the market, such as socio-psychological, institutional and financial conditions. Side-effects of new technologies are not quite clear either. Before addressing the potential of new transport technologies, we will in the next section pay attention to the far reaching impacts of new actors in the European transport market.

4. Transport: the Seedbed of New Actors

Economic development and infrastructure development go apparently hand in hand. Therefore, the European economy will remain critically dependent on well functioning networks as catalysts for future development. There is nowadays however a growing awareness that the current European infrastructure network is becoming outdated, without being replaced by modern facilities which would position the European economies at a competitive edge. **Missing networks** emerge because transportation systems are developed in a segmented way, each country

seeking for its own solution for each transport mode without keeping an eye on the synergetic effects of a coordinated design and use of advanced infrastructures. Another reason for missing networks is the focus on hard ware and the neglect of soft ware and organizational aspects as well as financial and ecological implications. Cabotage, protection of national carriers, segmented European railway companies, and lack of multi-modal transport strategies are but a few examples of the emergence of missing networks. A European orientation of all transport modes is necessary to cope with the current problems of missing and competing networks at all geographical levels (ranging from local to transnational).

It is clear that the European integration will never come into being, if there is not an **efficiently operating network** connecting all nodes of the European network economy. A network is not just a sum of links and nodes, but an infrastructure configuration operated to provide services through one or several **operators**. A network is thus a value added configuration taking advantage of an essentially passive infrastructure. The positive impacts of infrastructure do not only derive from the mere creation of physical facilities, but from the services generated by operators. This evidence has sometimes been neglected because of the self-operated private car, but as far as freight road transport is concerned or any other mode the operator is a prerequisite to any value added network. This also means that infrastructure investment cannot create economic potential, but only develop it. Thus, a network employs passive infrastructure whose amount of added value is related to the efficiency of operators. Consequently, operators are the spiders in a network web.

Given the strategic importance of networks, it is also clear that the evaluation of investment programmes related to a network should not be based on individual projects, but on the **synergy** created by network operators in an interconnected infrastructure. This means that an infrastructure network is a cohesive set of links (edges) between concentrations of population or economic activity centres (the so-called nodes), which serve to provide all services (transportation, communication) that are necessary for an efficient transport of persons, goods or information between nodes. The assessment and the evaluation of a network should therefore

not only take account of the way such a network can be designed and developed but also **operated** in a business environment, with an increasing interest in global markets.

Internationalisation, reflected inter alia in global sourcing, has created inter-woven networks of international trading and industrial relations, in which firms in several countries produce different goods and service components of the same final product. In the last two decades, the globalisation and intensified competition in world trade has not only emerged from the liberalisation of trade policies in many countries, but also from major advances in communication, transport and storage technologies. The 'extended' firm - or the network firm - including formal and informal links (merging or partnership) is mainly economic oriented and follows prevailing market forces, but falls short in including and considering environmental effects and socio-cultural impacts. Therefore, it is also necessary to introduce sustainable development criteria at all territorial levels covered by a network (see Frybourg and Nijkamp, 1996).

Transportation planning is indeed often associated with physical movement, with infrastructure configurations and with regulations, but far less attention is paid to the way the transport market is organized, and how this organization uses and shapes transport modalities. Especially the transaction theory of firms has shed new light on the interesting link between firm behaviour and network development (e.g., hub and spokes systems). Even though transport systems exhibit fragmented networks, various operators (e.g., forwarding agencies, logistics suppliers) - through multi-modal shipping, integral logistics and neo-fordist customized delivery - are able to exploit transport networks for generating added value, not only in a local-regional but also in an international context. Globalisation of markets, new forms of competition, more client orientation, integration of production and warehousing, and transport innovations are shaping new opportunities for creative actors in the transport market reflected in joint ventures, 'filières', vertical integration etc. These new operators may to a large extent be considered as integrating actors in a spatial transport system which can be typified according to:

- the structure of the transport market (free competition, regulated market etc.)
- the type of mode (road, rail, waterways, air etc.)
- the geographical coverage (from local to global)
- the quality of service (including scale and scope), and the related tariff system
- the sophistication of transportation technology (e.g., logistic platforms, telematics, information systems)
- the structure of the network (e.g., hierarchy, hub and spokes etc.)
- the territorial and modal policy competence on networks
- the barriers to a full performance of networks (e.g., regulations, conflict of competence etc.)
- the integration with telecommunication (EDI, e.g.).

It is noteworthy that the transport function is increasingly shifting away from a purely physical shipment of goods and persons to a **value added process** through which in each step of the chain new services and economic values are added (for instance, assembly in nodal points, service delivery to train passengers in railway stations). This often implies also a transformation into goods or services of a higher market value. An illustrative example is the modern component assembly industry, where components are produced in low wage or cheap resource countries (primary production) and where the final product is assembled - after many transport activities - as close as possible to the final market (secundary production). It is foreseen that value added logistics will increasingly become a major feature of a modern post-fordist industrial nation. Consequently, in particular **central nodes** of a transport system tend to become places of strategic importance. As a result, the **quality** of the organization of transport as a material and immaterial process chain through links and nodes is becoming the new competitive feature of modes in a transport system. This also poses a formidable challenge to Europe.

The recently developed Common European transport policy has three main objectives. In the first place, the development of Trans European Networks should be stimulated, a policy which should also favour the development of peripheral regions. Second, the transport markets should be liberalized to the maximum extent possible; market regulations should be equal in each member state and product

markets would have to be opened for agents of each country. Finally, the transport sector should also aim at achieving sustainable mobility. Fusing the economic needs with ecological constraints may be fraught with many difficulties, though. Transport causes several externalities, like noise, bad odor and visual annoyance, segmentation of landscapes, local and global air pollution etc., which ought to be coped with in transport and land use policy.

5. Transport: the User of Land

In general, the need for transport emerges where functionally dependent human activities are separated in space. In the 1960s and 1970s, when economic prosperity increased, the spatial separation of working and living was enlarged to an unprecedented degree. This suburbanization was primarily residential and caused therefore, a focussed pattern of long-distance commuting from suburbs and outer areas to central cities. Later developments were considerably more complex because the sprawl of living quarters was coupled with a substantial suburbanization of employment. This new development has increased cross-commuting as well as relatively short-distance intra-suburban commuting trips. Aside from living and working, also a separation of living and recreation took place in the past decades. This holds for outdoor recreation and summer and winter holidays. Whereas the separation of (daily) activities in space has increased, the number of hours in the day remained the same. Consequently, much effort has been put in increasing the speed of transport in the past decades in order to increase the action radius (cf. Whitelegg, 1993).

Land use can to a large degree be influenced by spatial planning. The role of spatial planning is generally limited to changing or reversing ongoing trends, due to the following circumstances:

- a large technical inertia in the built environment (spatial inertia)
- a large institutional inertia regarding new frameworks of reference among politicians and planners
- a large variety of (often contradictory) aims of spatial planning, and a small effectiveness of spatial policy in reaching aims.

Regarding spatial planning for a reduction of transport towards sustainable mobility levels, it should be emphasized that there is still a lack of knowledge of the underlying principles (Banister and Watson, 1994; Wood et al., 1994). Much research in recent years has focused on the relationship between urban form and passenger transport. Urban form in this context means size and density, and one of the major conclusions so far is that larger dense cities are associated with a high use of public transport and with a low gasoline consumption (Newman and Kenworthy, 1989). What however, also matters is where the interdependent workplaces, service centers and houses are located within the metropolitan area, particularly where populations with different life styles are living. In other words the socio-economic composition of the city is a crucial element (cf. Banister and Watson, 1994).

One particular planning concept is important here, namely the 'compact' city. Such a city is suggested to provide high-density housing and a concentration of employment in the central city-area and subcentres (Van Wee, 1993; Breheny, 1992). In a decentralized city based upon an unlimited suburbanization, jobs and houses tend to disperse further in and beyond the metropolitan area, a process named counter-urbanization (Breheny, 1995). The compact city is currently adopted in Europe as a leading principle in urban planning (cf. CEC, 1992). This concept generally assumes two major merits in terms of sustainable transport, namely short private journey lengths and good prospects for public transport. In contrast to this, the decentralized city is usually associated with large amounts of traffic. Various decentralized cities in Australia and the United States however, seem to undergo a very interesting development, namely a 'spontaneous' relocation of jobs and houses leading to shorter commuting distances (Brotchie et al, 1995; Gordon et al., 1991). The major question marks on the relationship between urban planning concepts and sustainable transport can be summarized as follows:

- The relationship is very complex and difficult to understand, because other factors are also at work, such as lifestyles, travel behaviour and travel cost (Owens, 1992).
- There is a lack of specification in concrete terms, i.e. more understanding is

required of the range of appropriate forms and thresholds under which a reduction (stabilization) of transport can be achieved (Banister and Watson, 1994).

- There is a shortage of integrated planning, i.e. of land use planning and transport planning, also including behavioural policies (Owens and Rickaby, 1992).

In the light of the above discussion it is questionable whether there is sufficient ground to adopt the concept of a compact city as a leading planning principle which would ensure sustainable mobility.

6. Transport: the Challenge of Sustainability

The position of transport in Europe is not undisputed, as this sector forms the heart of European integration policies. It addresses issues like cohesion, access, efficiency, environmental quality, and urban and regional development. The widely accepted policy objective of sustainable development is however at odds with the increasing mobility and speed (e.g. more trips and longer distances), changes in industrial structure (e.g. post-fordist developments), liberalisation and deregulation in the transport sector, and new institutional frameworks (e.g. management and financing of infrastructure). The pace of mobility growth in various European countries is mapped out in Figure 2.

As a result of many forces in a complex spatial and transport force field, private forms of transport have become the winners in a competitive game (see Figure 3), although it has to be added that the modal choice is strongly influenced by trip motives (see Figure 4). In any case, the environmental consequences of the transport sector (measured e.g. in CO_2 emission) have become increasingly severe (see Figure 5).

In order to depict and explore alternative futures for transport systems, a scenario experiment has been organized among a large group of Dutch transport researchers and planners with the aim to design and evaluate alternative transport

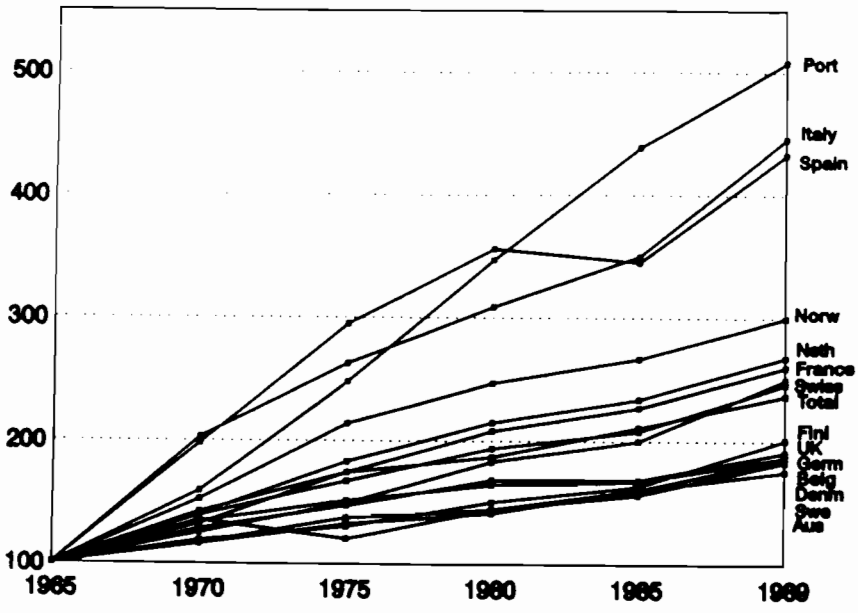

Figure 2. Mobility growth in land transport in Western-Europe [1,2] (index mln passenger kilometres, 1965 = 100)

Source: Own calculations based on ECMT, 1993.

Notes

1) Western-Europe excluding Luxembourg, Greece and Ireland (because of lack of data).
2) Only passenger kilometres by private car, rail and bus are taken into account.

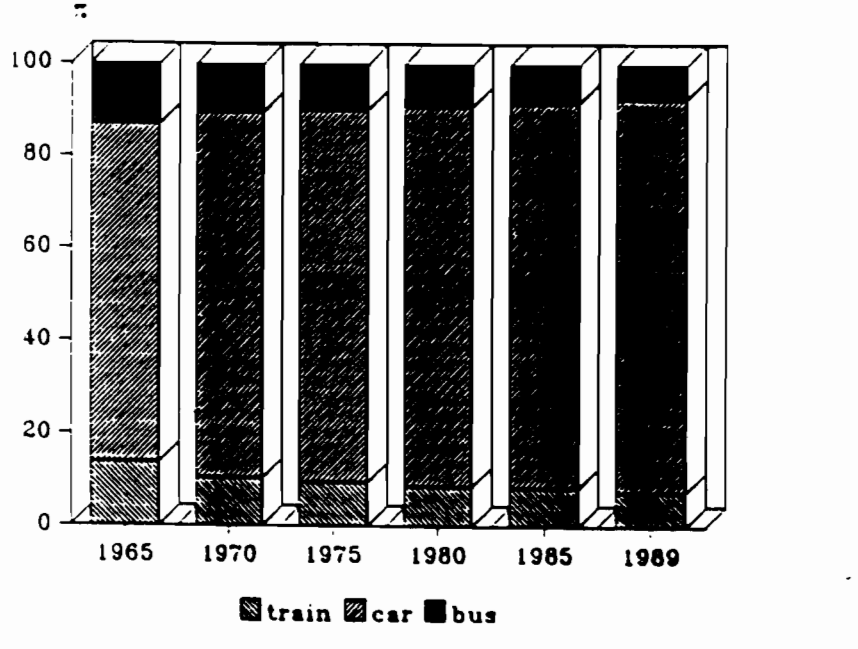

Figure 3. Modal split over land in Western-Europe

Source: Own calculations based on ECMT, 1993

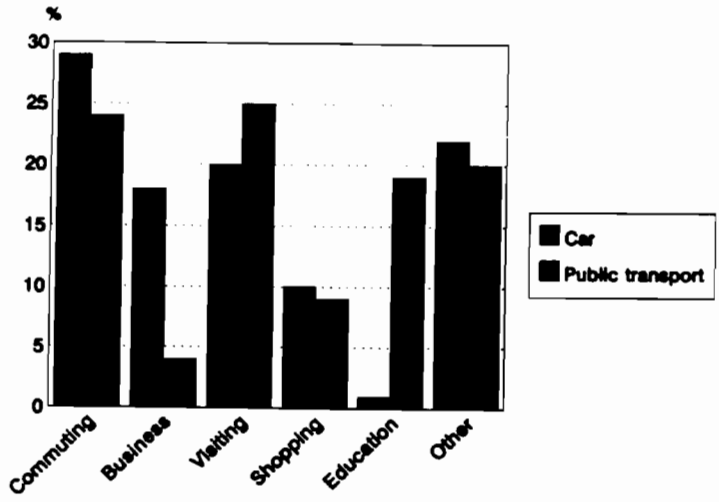

Figure 4. Travel motives of Dutch car and public transport travellers (1992, %)

Source: Own calculations based on CBS, 1992.

Note: Car: drivers only

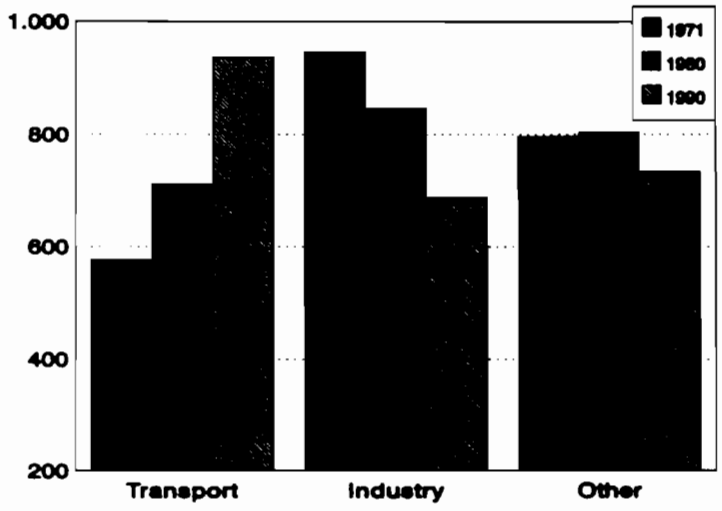

Figure 5. CO_2 emissions in European OECD-countries by sector (mln tonnes)

Source: OECD, 1993

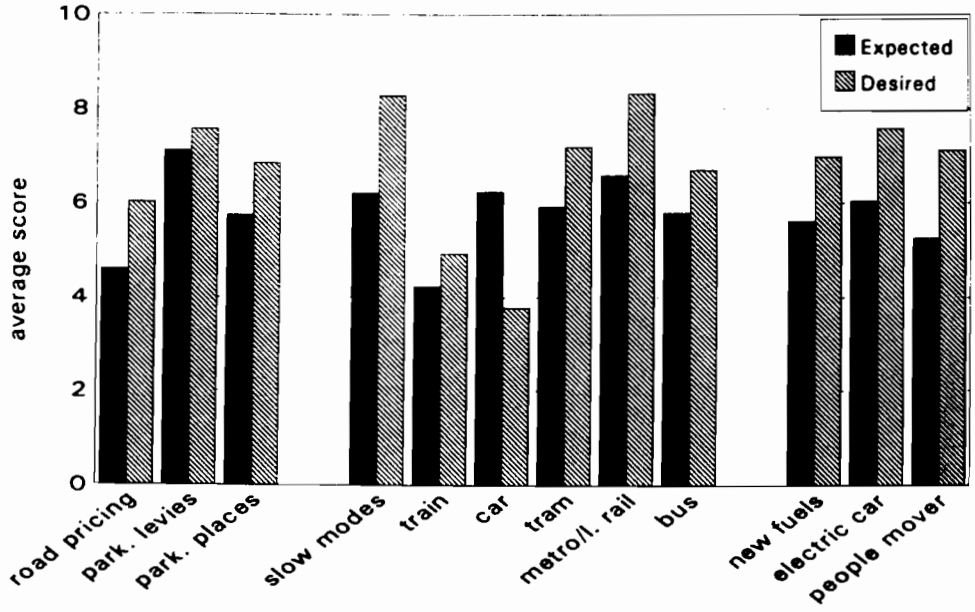

Figure 6. Short distance transport expectations and desires of Dutch experts

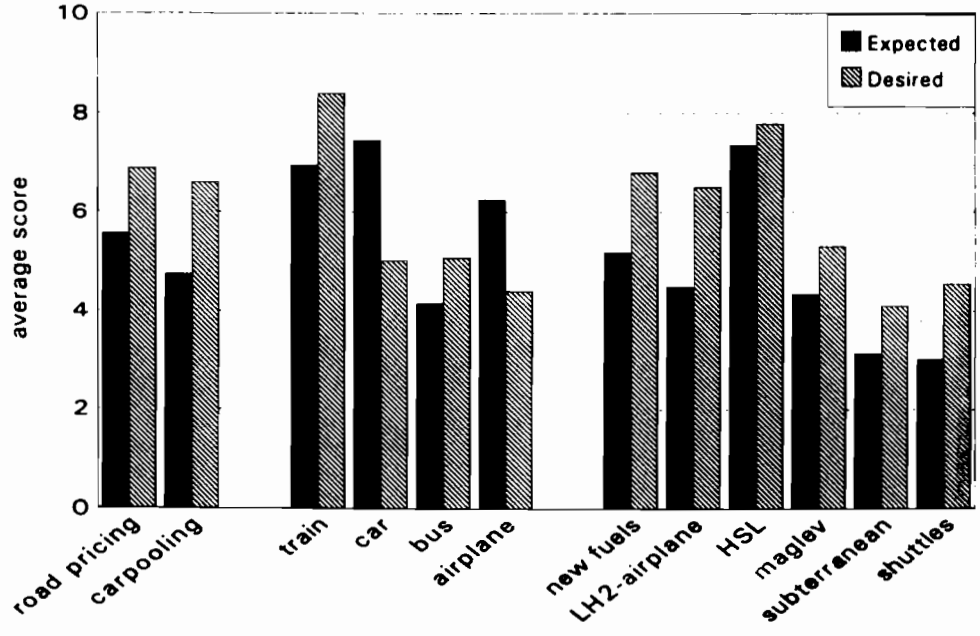

Figure 7. Long distance transport expectations and desires of Dutch experts

configurations in the long run. The main emphasis has been placed on the key forces of a complex dynamic spatial systems governed by critical spatial, socio-psychological, economic and institutional conditions. The information comprising detailed data on backgrounds, bottlenecks, driving forces, spatial configurations and environmental implications of future transport systems use was collected from an extensive survey questionnaire.

The questions underlying the various scenarios were consistently subdivided into 'expected' and 'desired' answers, in order to separate factual information and subjective value statements of the experts. This will allow us to identify the tension between reality and wish (leading to both a descriptive and a normative scenario approach). Rather than describing the statistical results of this scenario experiment, we will depict here the resulting spatial, societal and transport patterns in the future by way of interpretative analysis. Figures 6 and 7 give some information on the expectations and desires of Dutch transport exports regarding the development of transport systems and policies at short and long distances, respectively.

Many driving factors are important for the future of transport systems. For our analysis we classified them into four groups, viz. spatial, institutional, economic and social/psychological aspects. In the scenarios designed here the future transport system is supposed to be the result of forces and developments in these four force fields.

For each of the four above-mentioned relevant scientific fields considered in our study, two characteristic features are distinguished. These features can be qualitatively depicted by means of axes drawn in the spider, which represent the most important factors influencing the future of transport and the transportation technologies used (see Figure 8). They will now concisely be described.

The first quadrant contains the **spatial** aspects influencing transport systems. On the first axis, possible developments in the future *spatial organisation* are mapped out. At the one extreme (interior) side of this axis we find the so-called chains and zones model in contrast to the specialisation and concentration model depicted at the exterior side. The chains and zones model refers to uncontrolled land use and many criss-cross mobility patterns, whereas the specialisation and

concentration model represents mainly large-scale concentration (RPD, 1991). The second axis concerning the spatial aspects is mainly concerned with *urban patterns*; it describes two contrast patterns, viz. the diffuse and the compact city (as a result of explicit urban policy efforts).

In the **institutional** part (axes 3 and 4) we investigate the control and managerial systems for sustainable mobility. On the third axis the degree of *government intervention* is depicted; the opposing extreme modes here are regulation versus market-based measures. The *management* of transport modes and infrastructure is found on the next axis, where the two extreme ways in which this may be organized - public versus private - are presented. In this context, public transport means that the ownership as well as the operation of the transport companies are the sole responsibility of the government (or governmental agencies).

Another important driving force stems from the **economic** field in terms of efficiency and financing. The fifth axis concerns the *feasibility* of transport, as the required profitability of the system is an important factor for the future of transport. The main question in this case is whether the government wants to subsidise transport or whether transport modes should be operated on a commercial basis; in this way also private financing of infrastructure may be attractive. The next extremes - to be found on axis 6 - are the introduction of *market* principles in the economy versus coordination by the government (which may be achieved by some form of a centralised government). This consideration is important for future economic growth, regional development, the construction of infrastructure towards peripheral regions etc.

Finally, **socio-psychological** factors are considered. On the seventh axis *equity* is confronted with inequity. Non-intervention may favour inequity in society (for example, an uneven income distribution, or uneven chances for individuals, in terms of e.g. travelling and education), while on the other hand much public governance may emphasize equity measures (social security, discounts on travelling costs etc.). The eighth and final axis reflects *individualisation* versus social cohesion, including related social behaviourial developments (e.g., demographic, educational), which may have again consequences for transport (see for an elabor-

ation of these factors Nijkamp et al., 1996).

Scenarios can now be constructed by combining the eight points on the successive axes, based on views of experts who were asked to give scores on issues relevant to each of these eight dimensions. Some additional remarks are in order here regarding the interpretation of these axes.

The order of items on each of the eight axes is such that the interior points may be associated with non-intervention strategies, or laissez-fair policy (e.g., market forces; conservative attitudes etc.), which may lead to a transport system which is dominated by individual modes (e.g., powered by alternative fuels; a market-based scenario). The exterior points reflect the result of policy interventions (e.g., land use planning, control strategies, regulatory measures etc.), in which the transport system is dominated by collective modes (a regulatory scenario). Both may serve as reference scenarios for the expert-based design approaches (for a more detailed description see Nijkamp et al., 1996).

As mentioned above, the scenarios designed in our study were based on views expressed by transportation experts. On the basis of the answers given by these experts it is now possible to design both an expected and a desired average scenario. Both of them are depicted in Figure 8.

When the *expected scenario* is analyzed, it appears that the trends and underlying factors will to a large extent not change in the future. For example, no large scale mobility changes are expected for individual citizens, who are not expected to change their behaviour significantly in order to reduce the externalities caused by transport. The same holds for the government, whose policy is not expected to be sufficiently sustainable; only spatial policy may be rather successfully implemented. New transport modes and technologies, like new fuels (e.g., hydrogen) or collective modes, will neither be introduced to a large extent. In conclusion therefore, the transport system and society may more or less resemble today's pattern. Also the mobility growth will largely continue. It may be doubtful whether large scale reductions of externalities may be achieved in this scenario, because when sustainability criteria are to be achieved, a much larger scale improvement of current modes (car and airplane) should occur than is expected nowadays.

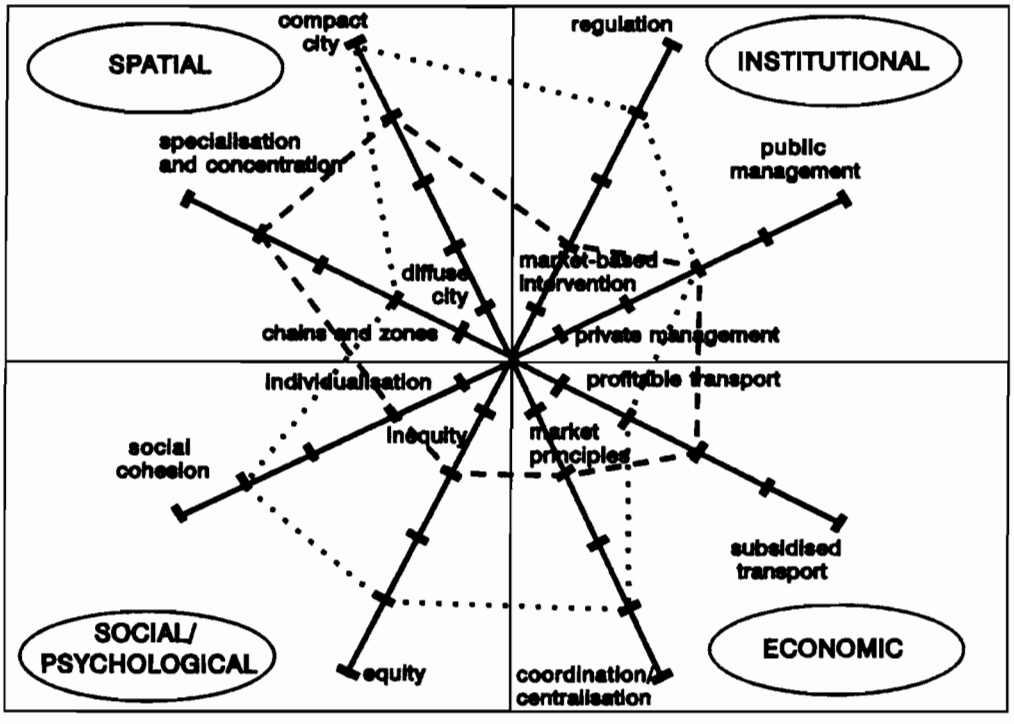

Figure 8. The expert based scenarios
Legend: ---- expected developments
..... desired developments

In the *desired scenario* a clear choice is made for a collective transport system. Therefore, far reaching changes are necessary in the behaviour of individuals, as well as in the institutional and economic environment. At the same time, the government should largely invest in public transport infrastructure and take drastic measures to reduce car use in order to make that mobility growth will largely slow down. It may be clear that it will be very hard for the government and for society to let this scenario become reality (in this respect, it is interesting to note that more than 80% of the respondents answered 'maybe' or 'no' to the question whether the transport system will be sustainable in 2030). One of the most pronounced practical problems that will emerge is free riding. For example, the (pure) compact city concept may be preferred by many residents, but this means that some landscape lovers will profit most from the deserted countryside. This may explain why in general the desired scenario (which is normative) is more

public-oriented than the expected scenario (which tends to be more descriptive).

The final question is now whether the expected or the desired scenario is more in more in agreement with recently accepted CO_2 reduction measures. Based on an extensive modelling exercise - from spatial configurations, transport technology, modal choices and life styles to energy use and CO_2 emissions - the resulting sustainability implications have been assessed (see for details Nijkamp et al., 1996). The results can be found in Tables 1 and 2.

Table 1 *Energy consumption and CO_2 emissions in the desired scenario (2030; index: 1989 =100)*

Final energy consumption	Primary energy consumption	Use fossil energy	CO_2 emissions
55	70	18	19

Table 2 *Energy consumption and CO_2 emissions in the desired scenario (2030; index: 1989 =100)*

Final energy consumption	Primary energy consumption	Use fossil energy	CO_2 emissions
55	70	18	19

The conclusion from this analysis is clear. The desired scenario results in the target levels of CO_2 emissions for the year 2030, whereas the expected scenario does not. Given that the scenarios are constructed with a view on reaching a state of sustainable transport (for which these target emission levels are representative), it seems plausible that sustainable behaviourial changes and technological progress are needed for the realisation of a sustainable transport system.

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