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Long-term options and forecasts for transport in Europe: summary report

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Commission of the European Communities

**science and
technology policy**

FAST series No 8

**Long-term options and forecasts
for transport in Europe**

Summary report

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of science and technology

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MAIN REPORT* (270 pages)

- Chapter 1 : Study Methodology
- Chapter 2 : The Scenarios
- Chapter 3 : Transport in a Socio-economic Context
- Chapter 4 : R&D Options and Priorities within the Transport Sector
- Chapter 5 : The Organisation of Strategic Transport Research

* Published in a separate volume, not included in this publication. The Main report is available from the FAST-team, Brussels (FAST Occasional Paper No. 25)

PREFACE

The paradox in international transport in Europe : The evidence of very important future risks and opportunities, but to be reacted upon by whom?

It was with some uneasiness that FAST in January 1980 made a call for offers on this project "Long term options and forecasts on transport in Europe". We feared that the field of international transport in Europe was so much in its infancy as regards research and long term analysis that no significant progress could be made for the limited resources made available for the study.

Unfortunately, one might say, our hypothesis about the lack of research and of long term analyses, in particular on the demand side has been confirmed by this study. On the other hand this document shows that the research team from the Institute for Transport Studies, the Universities of Leeds, has made significant progress in the identification firstly of future risks and opportunities which international transport in Europe is facing and secondly of the R&D requirements derived herefrom.

Let us here try to distill some of the findings of the study which are of particular interest to the Commission of the European Communities.

1. The European transport system in general and international transport in particular are in a very vulnerable situation, partly due to the lack of long term strategic planning. The authors argue that where future developments can lead to profound structural change the time-scale adaption of technology, public attitudes, living styles and locational patterns demand long term planning if major and potentially damaging discontinuities in the economic and social development of Europe are to be avoided (p. 24-25). The paper has identified several possible future developments such as high energy prices, energy shortages, increased transport demand on certain market segments, application of the new information technology by the railways etc., leading to very different futures with marked different implications for the transport sector in general and even more for particular modes as illustrated on p.11. For several reasons (demand p.11-12), and energy (p.27)) the future developments are particularly uncertain for road and air transport. The authors do not hesitate to conclude (p.25) that European transport is facing a future of perhaps unprecented uncertainty (or at least in our awareness of its existence).

Facing such an uncertain future makes us immediately refuse the two

* The study was carried out by the University of Leeds (see acknowledgements p.IV). The study was financed by the Commission of the European Community and by the University of Leeds. The conclusions of the study do not commit any of the two institutions.

'extreme' approaches to planning : 'end state planning' and 'incremental planning' (p.24-25). 'End state planning' is out for obvious reasons because it corresponds more or less to one specific future, while 'incremental planning' is founded on the myth that the sum of a large number of small improvements will necessarily result in a large improvement. We have to adopt an approach we might call 'keep options open' planning - we must look for those solutions which can solve or alleviate problems on the short and medium term and also make sense towards those possible distant problems and opportunities we are aware of. If we ignore the latter in the decisions we take today we will take the wrong decisions leading to missed opportunities and more aggravated crises than otherwise. Therefore we now turn to what are the future long term opportunities and constraints which are likely to characterize the transport over the coming years.

2. Two issues are of dominant importance for European transport, energy and new information technology.

Energy (p.12). There are two clear future trends : Firstly real energy prices will continue to increase and secondly, while oil has dominated the transport sector for many years, this will be superseded by coal and in the very long term by electricity. The two trends will continuously be making obsolete the infrastructure and rolling stock constructed in eras of lower energy prices.

R&D on substitute fuels are strongly concentrated into the synthesis of petrol (and gas) and two thirds of the R&D investments are now taking place within North America. Given the possible difficulties of importing coal, or other base material, and equipment for the synthesis and given the very long lead times in the energy sector due to political, environmental and technological factors, European states cannot rely on syncrude being available at the right time.

New information technology (p.15) will impact both demand and supply of transport.

Demand : the rapid 'geographical collapse' of the cost of communications may - to the extent it is reflected in tariffs! - significantly augment the demand for long distance travelling. On the shorter distances the issue of new communication technology does not pose itself simply in terms of substitution between telecommunication and transport, it is the individual's and society's use and organisation of time and space which will be affected. At present we can only hypothesise about future impacts but as their actual outcome will depend strongly on two issues in public policy, tariffs and promotion of new services, we must look further into the question.

Supply : new information technology offers opportunities to the operation of transport systems to all modes but in particular to railways (p.28) and to a lesser extent to airports (p.24). Railways, the only guided form of transport, are ideally suited to automation of train operation and the new information technology can increase the potential passengers 'psychological access' to the railways. But will the railways, given the conservative tradition of their administration, know to seize these far-reaching opportunities in time (p.28)?

The authors also underline another issue which they consider very important from a transport point of view: trade with Eastern Europe (p.18). For political and other reasons the times involved in changing east-west infrastructures are very long. Any major changes in demand at the turn of the century will have to be prepared now and the authors have on page 19 argued convincingly that at least the technical factors constraining east - west trade are likely to diminish in importance. Thus, even without detente, problems of infrastructure capacity are likely before the end of the century.

3. Present organisation of transport research at Community level is inadequate at three levels :

- i) No adequate procedure for relating research efforts of the member states to the research needs and efforts of other member states.
- ii) Little co-ordinated action to set priorities and set up inter-Directorate programmes of research within the Commission.
- iii) No explicit transport research responsibility within the Commission

The authors of the report suggest two guiding principles for the definition of an appropriate EEC-response to this shortcoming :

- a. EEC should not duplicate the activities of other international organisations (V.I.C. for rail transport; I.A.T.A., I.C.A.O., and E.C.A.C. for air transport, E.C.M.T., E.C.E. and O.E.C.D. etc.), unless it is clear that the E.E.C effort will be more effective than that of the other bodies.
- b. Stimulation rather than rigid co-ordination is preferable. The boundary between an enhancing co-ordination and stultifying stereotyping of research is so hard to define.

This leads to the following proposals for research at Community level.

4. There is an unfilled need for a systematic, long term policy oriented, review of the transport research needs of the Community.

In particular the following fields seem appropriate for action at the Community level :

- a. Transport and energy
- b. Interaction between transport and telecommunication
- c. Examine trends in international movement
- d. International transport systems, in particular rail and air transport.

While a and b have been selected for achieving economics of scale in the research, c and d call for Community action because the research requirement is essentially a matter of Community rather than national interest.

Furthermore a number of more specific fields for R&D such as alternative fuels and new information technology and railways operation, most of them relating to the key issues mentioned in point 2 above, are proposed in appendix A to the Summary Volume.

FAST

August 1982

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and by officers of the European Commission, in particular

Mr. O. Holst Directorate General XII
Mr. J.H. Rees Directorate General VII.

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1. INTRODUCTION

1.1 Objectives

The European Commission, through the FAST programme (Forecasting and Assessment in Science and Technology), is seeking to look to the medium and long term, to identify the key challenges for European societies over the coming decades and thereby to establish how research and development resources should be directed, and the Commission's role in such research - to open up new opportunities, to mitigate future problems or to reduce uncertainties in the future. This set of initiatives arose from a decision of the Council of Ministers in 1978, and reflects a perceived need to look beyond the more immediate policy issues which have characterised much of the work of the Commission in recent times.

Within the FAST programme are three sub-programmes, each geared to a different time horizon and based on a unifying theme which is considered to have a dominant influence over the period in question. This study is part of the second sub-programme called Information Society, which focusses on the period to the end of the century or thereabouts and which concerns the impact of new technology (that is, the combination of telecommunications, microelectronics and computing) on European societies.

At the outset we would emphasise that whilst this was the genesis for this particular transport contract, the importance of new technology to the European transport sector was not assumed in our approach to the study. Rather, an objective assessment was made of all influences on the transport sector, from which conclusions were drawn. We will see, however, that new technology is found to be one of the two key influences on the sector - the other, the energy future, was interestingly not considered as a unifying theme - but only because 'energy issues are already the object of numerous other long term research activities'.

The broad objective of the study is simply stated as:

'to advise the Commission of the need for long term transport research'

The study is limited by the Terms of Reference to long distance transport (typically journeys or hauls exceeding 50 kilometres); otherwise it encompasses all modes of passenger and freight transport and recognises the close links between transport and many related areas of Community policy.

There are four types of recommendations for research, with the following specific objectives:

- recommendations to better understand the impact of external influences on the transport sector;
- recommendations within the transport sector to develop transport options (for example policy or technological options);
- recommendations to improve the techniques of transport planning (for example improving methods of forecasting), and
- recommendations to improve the organisation and content of transport research within the Commission.

1.2 The Report

In this report we attempt to focus attention on the main conclusions of the study. For the study conclusions to be correctly interpreted however, it is first desirable that both the Commission's role in existing research and the key assumptions underlying the conclusions are appreciated, and these are described in Section 2.

We then examine the realistic futures facing the Community, by means of scenarios, and identify the key issues facing the transport sector and the nature of the problems they pose. We draw conclusions about the importance and appropriate role of long term transport planning and research.

Section 4 describes how the opportunities and constraints an action within the transport sector can be used positively to further the Community's transport, energy, regional, social and environmental policies.

Then, in Section 5, we present the study recommendations, firstly focussing on the content, priority and rationale for EEC involvement in research.

Finally, we contrast the present organisation and content of long term transport research in the Community against the identified future needs and draw conclusions for the role, organisation and content of research by the Commission which will best equip it to meet the identified challenges confronting the European transport sector.

1.3 Supporting Papers

Twelve supporting technical papers have been produced during the study. The most important are shortly to be published by the Commission in a single main volume and the remainder will be available from the Commission.

<u>Technical paper</u>	<u>Incorporated in Study main volume</u>
1. Framework for the Study	N/A (superseded)
2. First Interim Report	no
3. Study methodology	N/A (superseded)
4. The scenarios	yes
5. The demand for freight transport	no
6. The demand for passenger transport	no
7. Second Interim Report	yes
8. R & D options and priorities within the transport sector	yes
9. Research towards a better understanding of demand; and the impact of alternative scenarios on the transport sector	no
10. Research to improve capabilities for forecasting long distance traffic	no
11. Research to incorporate uncertainty in transport planning procedures	no
12. The organisation of strategic transport research.	yes

2. APPROACH

2.1 The Commission's Existing Role in Transport Research

With the exception of this study, all transport research in the Commission is executed by the Transport Commission (Directorate General VII), which is organised into three Directorates. Directorate A which is responsible for administration of policy and for air and sea transport has had little research involvement though its relatively recent acquisition of air and sea responsibilities may change this. Directorate B, which is responsible for the transport markets policy is involved in market observation and short term forecasting but no long term or strategic research. Directorate C, which is responsible for infrastructure policy, has the most apparent long term interests arising from the requirements of investment appraisal. It also appears to have had the most extensive commitment to research over the years, not only in its association with the COST studies 33 and 33b (long term demand forecasting exercises for the European passenger and freight sectors respectively) but also in analysis of track costs associated with infrastructure pricing initiatives.

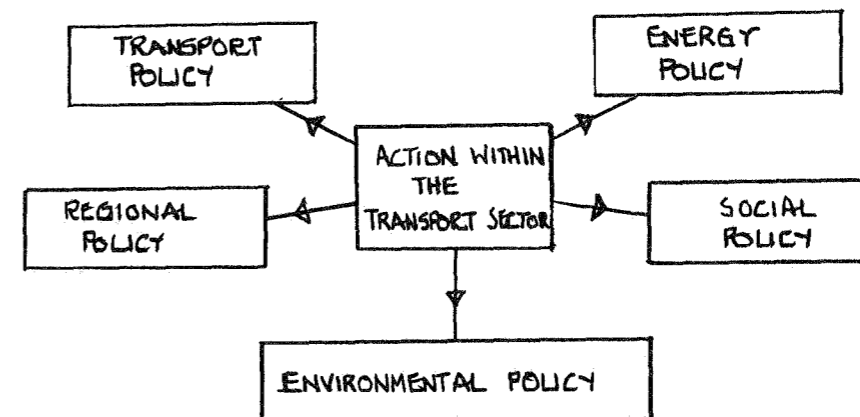
Thus the current research effort of D.G. VII is relatively modest. Much of it, like the work on market observation, is very short term and limited in scope. Some, like the work on the Community interest in investment projects, is essentially concerned with procedures. The major long term demand forecasting exercises COST 33 and 33b have been completed and appear likely to be viewed as once-for-all exercises which provide some background for the consideration of current policy issues. More recent COST initiatives (collaborative actions by EEC and member states) have been much more technical in content, more concerned with exchange of information, and hence less globally strategic in their intent.

The picture of the research objectives of the Transport Commission seems fairly clear. In the short term very modest policy aspirations are accompanied by very modest direct research activities. The COST action is seen as a good instrument for co-ordinating national research efforts, and for securing international co-operation where necessary. But there is neither budget, nor formal procedure, nor institutional organisation for a concentrated Community level long term and strategic research effort in transport.

It is against this background that, in the remainder of this report, we examine the need for the Commission to become involved in strategic transport research and recommend how such a role can be most effectively realised.

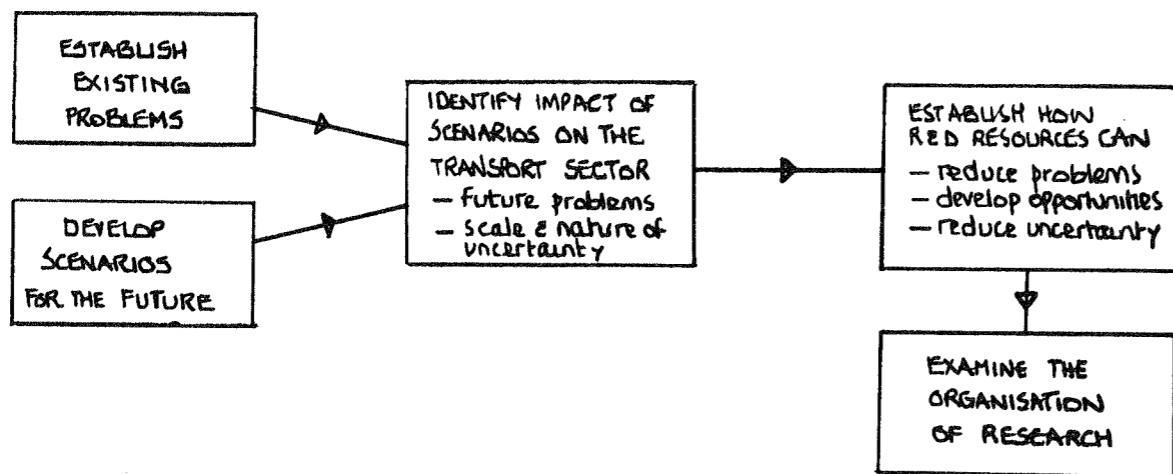
2.2 Technical Approach

We commence by asking what bounds we can place upon what is necessarily a wide-ranging study. Clearly we cannot simply be bound by the current policy concerns of the Commission because there is considerable uncertainty about the content of future policy. A more promising approach is to proceed from the general framework of Community policy as it affects, and is affected by, the transport sector:



As transport is rarely an end in itself, but usually a means to an end, we find that action within the transport sector can raise important issues of economic efficiency (via transport and energy policy), equity (via regional and social policy) and the environment (environmental policy). It has been our objective to identify 'problems', and develop recommendations for research under each of these five policy areas, thus demonstrating how research within the transport sector can contribute to wider policy objectives. This links our recommendations for action naturally to the institutions of the Community.

Having thus bounded the study, our second step was to employ the following analytical sequence:



This recognises that, even in a speculative study of this nature, it is essential to base an examination of the future on a sound understanding of the present - that is to say an understanding of the characteristics and determinants of existing transport, and an appreciation of existing problems in each of the five policy areas.

In looking ahead to the end of the century, we have simplified the analysis by separating external influences on the transport sector, over which we have absolutely no control, from actions within the transport sector. There are various ways of dealing with external influences (such as changes in gross domestic product or energy prices) but the most suitable for our purposes is to develop a series of distinctly different, but realistically possible, futures or 'scenarios' and to use these to investigate how, if no action is taken within the transport sector, existing problems are likely to develop into future problems. A very important output of this analysis is an understanding of the significance for the transport sector of uncertainty outside it as well as within it.

We next ask how research within the transport sector can achieve its objectives of mitigating future problems, reducing future uncertainty and developing new opportunities. There are two distinct and complementary dimensions to this task - the first concerned with the development of transport options (policies, technologies, etc.) and the second with improving the techniques used for transport planning.

What is required in the first respect is a systematic examination of all (policy/technology etc.) options within the transport sector showing how research may be cost effective in contributing to the five policy areas. To achieve this we have interviewed a wide range of experts in government, private companies and universities in order to inform ourselves of their knowledge of current research and their views about possible future developments; and in parallel we have undertaken a systematic analysis of each sector (road, rail, air etc.) and policy area to ensure the output is balanced and comprehensive insofar as this is possible.

As regards the second aspect, the rationale for research action is that limitations in the techniques of transport planning are themselves an important contributory factor which limit us in developing transport options for the future. Moreover, these same limitations have, arguably, been a major factor leading to the current disenchantment with longer term planning. We shall argue strongly that the appropriate response is not, as it has become fashionable to argue in some quarters, a negation of the need for longer term planning, but rather improved planning techniques which both seek to reduce the level of uncertainty in the future, but probably more importantly can deal with the inevitable uncertainty which remains in a systematic way. We have therefore analysed the deficiencies in the transport planning process as a whole and in its constituent elements, against identified future needs, and have established where research opportunities can be effective in removing these.

Finally, having identified promising areas for research, we have to ask how that research is likely to be most cost effectively executed, and in particular what are the implications for the Commission. This is difficult because of the limitation of our own information on the research activities both within the Community institutions and in the Member states. What we have sought to do is to identify those areas where the Commission clearly needs to undertake the research (in the sense that the subject area is important and no other organisation is involved) together with others where the Commission may have a role to play.

3. ALTERNATIVE FUTURES

3.1 The Interfutures Scenarios

'The evolution of the world economy (to which that of Europe is inextricably linked) over the next twenty years will profoundly alter the conditions for the transport sector's development. In many cases the trends which characterised the sector ... 1950-1975 will either shift or be reversed, and this applies equally to national, continental and international transport, passenger travel and goods transport. In this context all modes of transport will have to adapt, and those that compete with others will see the conditions of that competition change significantly.'

This quotation from the OECD Interfutures Study¹ raises a central theme of this work. Whilst it is a truism to state that the future is uncertain, an understanding of the nature and range of that uncertainty is a necessary basis for planning. Yet it is very rare to find uncertainty explicitly confronted in this way in current transport planning practice. Our first requirement then is to seek to enhance this understanding, by defining a set of alternative futures (or scenarios) which are distinct, which incorporate the main influences on the transport sector, and which bound the area of reasonable uncertainty.

The Interfutures scenarios provide an authoritative basis for this, and are - with one important omission to which we return, and subject to some modification - suitable for our purposes. Each scenario represents a complete possible state of the world insofar as it influences the transport sector - extending to political, economic, social and cultural factors, and not surprisingly we find (table on the following page) a complex picture which is difficult to summarise adequately. But each of the five scenarios are regarded as realistically possible - thus the next twenty years may bring a renewal of high growth (characterised by free market trade policies and strong multinationals); or it may bring two very different types of moderate growth - a development of recent experience where pressures for change in society have confronted structural rigidities creating deep seated conflicts, or a new form of growth resulting from a

¹ 'Interfutures - Facing the Future, Mastering the Probable and Managing the Unpredictable', OECD, 1979.

ALTERNATIVE FUTURES CONFRONTING THE EEC TRANSPORT SECTOR

External influences on the transport sector	High Growth Scenario open Europe lead by international commerce	New Moderate Growth Scenario government lead	Traditional Moderate Growth Scenario difficulties in structural adjustment	Low Growth Scenario protectionism	Zero Growth Scenario prolonged crisis with OPEC and developing countries
1. Global political/economic relations with Eastern Europe	detente	rapid detente	slow detente	status quo	rapid detente
- other areas	strong growth in economic exchanges	strong growth in economic exchanges	slow change in int'l economic order	limited economic exchanges	rapid reorientation of markets
2. Evolution of EEC	strong	strong	status quo	weak	strong
3. Economic growth 1980-2000	4%pa	3%pa	3%pa	1 1/2%pa	0%pa
4. New technology	decentralised, narrow and wide band networks, large impact	centralised, narrow band, quite large impact	limited decentralised, narrow band, moderate impact	centralised - applied to public services, narrow band, limited impact	decentralised, narrow band, moderate impact
5. Energy prices oil, 1980-2000	+100%	+150%	+100%	+35%	+200%
6. Demographic factors unemployment 2000	low	low	moderate	high	very high
7. Characteristics of consumers	current trends	accelerated trend to leisure	current trends	current trends	status quo
- hours worked	+4%pa	+1%pa	+2%pa	+0%pa	-1%pa
- expenditure on transport 1980-2000	low	high	low/moderate	low	low/moderate
- growth in counter cultures	rapid structural adjustments	rapid structural adjustments	forced adjustment in traditional industries	slow adjustment in traditional industries	rapid structural adjustments
8. Production characteristics	rapid concentration of power flexibility in organisation	new technology provides flexibility	concentration of power, flexibility in organisation	little change	rapid concentration of power flexibility in organisation
- structure	concentration	strong regional policy, some decentralisation	current trends	slow concentration	concentration
- organisation/ownership					
- location					

quite rapid change in societal values leading to a consensus for change. Alternatively protectionist policies may become widespread and growth very limited; or severe and continuing confrontations with OPEC and some developing countries may preclude economic growth over this period. Any of these futures (or something intermediate between them) might happen resulting in powerful forces on the transport sector which are completely external to the sector.

Many of the issues raised, whilst being interesting, are not important for our purposes. What we are concerned with is firstly an understanding of the extent and nature of uncertainty the European transport sector is facing; secondly an appreciation of the key issues confronting the transport sector - to which research resources should be directed; and finally an understanding of the implications of the scenarios for community transport, energy, regional, social and environmental policies. Only on such a basis can we draw sensible conclusions on research strategy and priorities.

3.2 The Extent of Uncertainty

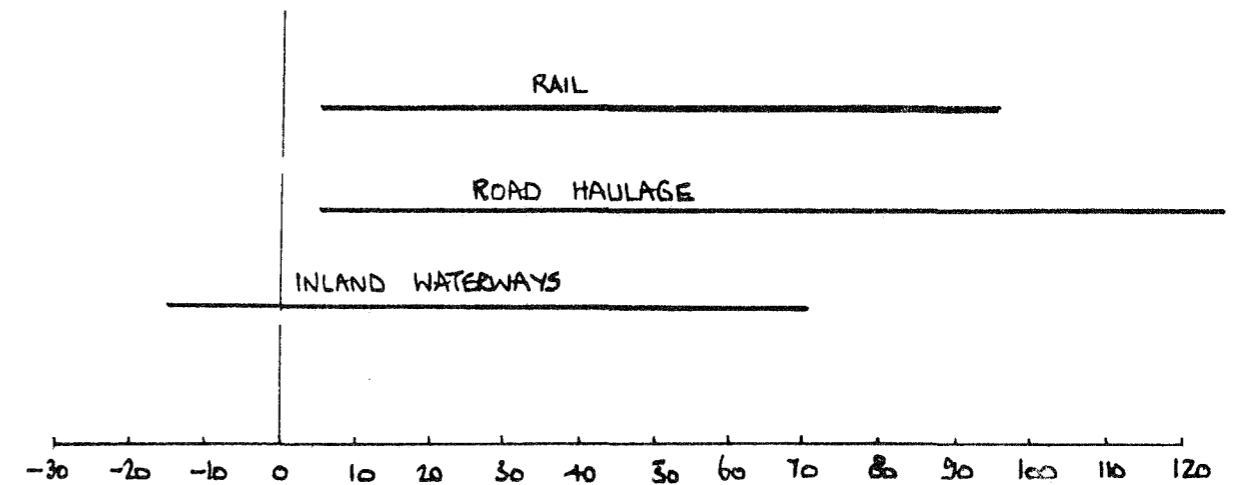
We have identified the complexity of the external influences on the transport sector - there are many factors, some completely new (notably the advent of the Information Society) and many are inter-related. Thus even for a single scenario we should recognise our limited ability to translate these external influences to changes in the transport sector.

But there is not a known future, or scenario. We have concluded on the basis of work by OECD and others that there is a very wide range of scenarios - any of which might happen. At the simplest level European gross product may more than double over the next two decades, or it may not change at all. At more sophisticated levels there are different feasible distributions of growth, both between social groups and spatially; and different orientations of growth reflecting trade, energy and other policies.

These differences have markedly different implications for the transport sector, and have much more severe impacts on some modes than

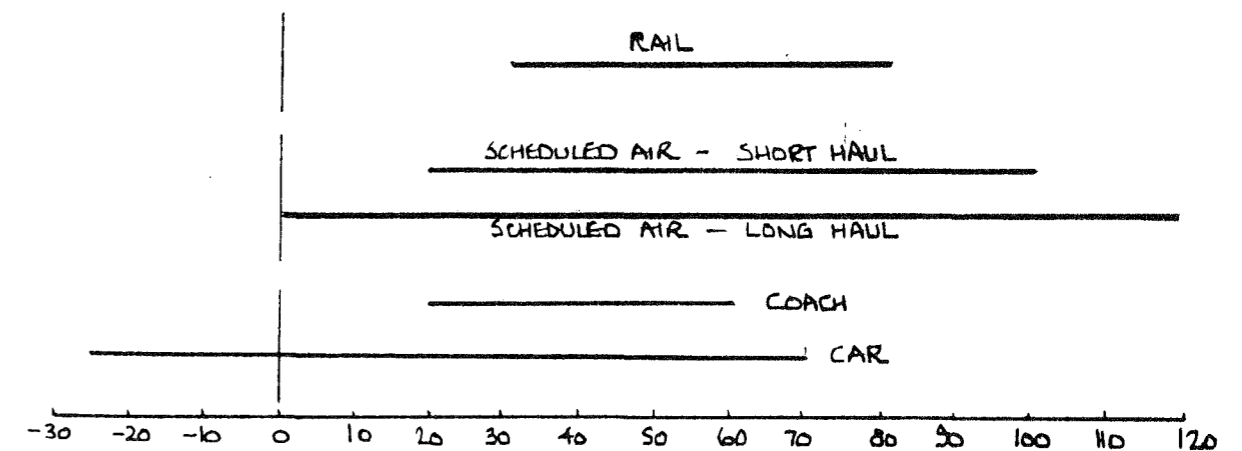
others. For example, we have estimated the change in the amount of passenger and freight transport for each scenario - and hence identified how uncertain the forecasts are even at this global level:

% change in passenger travel 1980-2000
(solely due to the different scenarios)



The two conclusions which stand out are that growth is extremely likely for all modes, and that the range of uncertainty about future passenger levels is large for all modes, but particularly for air transport and car traffic. Similar conclusions about the likelihood of growth and the extent of uncertainty apply to freight transport:

% change in freight transport 1980-2000
(solely due to the different scenarios)



3.3 Key Issues Confronting the Transport Sector

Having carefully considered this range of scenarios we conclude that external events pose three main issues for the transport sector - the adaptation to a future of high energy prices, the impact of new technology on transport markets and transport systems, and the influence of detente with Eastern Europe; and of these the first two issues, energy and new technology, are of dominant importance. We will seek to establish why these three issues are important

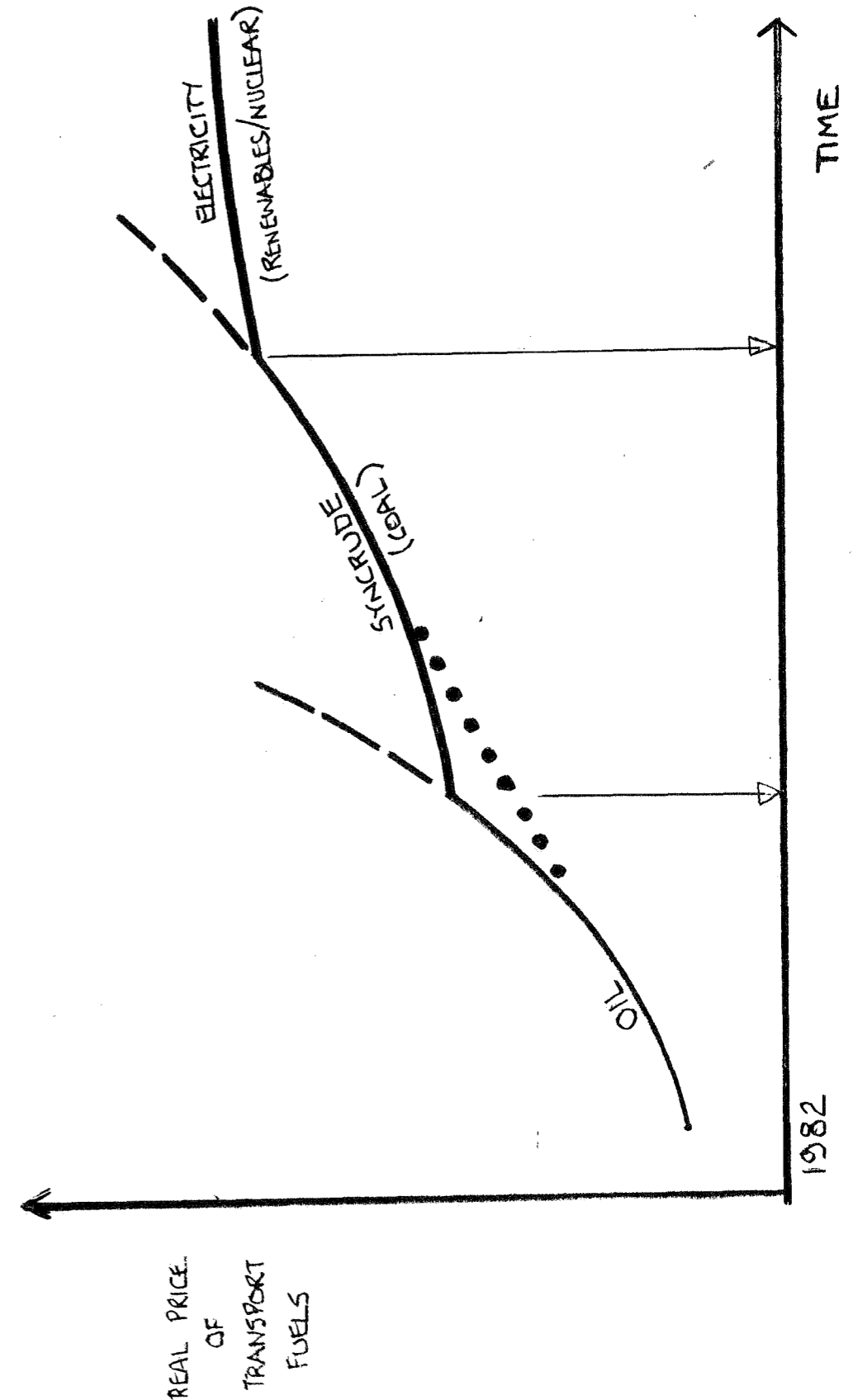
3.3.1 Adaptation to a Future of High Energy Prices

The 'energy problem' is basically the adaptation to energy prices (see the following diagram) - which will increase in real terms whichever (exhaustable) source of energy is considered. Transport is particularly affected both because it is a large consumer of petroleum products and because it is by no means easy to substitute other fuels for many transport users.

It seems clear that while oil has dominated the transport sector for many years, this will be superseded by coal and in the very long term by electricity generated by nuclear and renewable sources; other energy sources are unlikely to be significant except in localised circumstances. The timing of transition will be dictated by price - when coal based fuels are produced and marketed at the same price as oil, then the transition will occur (oil resources will become economically exhausted) and thereafter the price of transport fuel will be related to considerations affecting coal production and synthesis into liquid fuels or combustion into electricity; and while there are many uncertainties about when this transition should take place, it could be as early as the late 1990's. This outlook poses serious problems for most EEC countries which do not have large coal reserves, and in particular for their transport sectors.

An important point, and one not always understood, is that as this transition occurs it is likely that real energy prices will continue to increase - continuously making obsolescent the infrastructure and rolling stock constructed in eras of lower energy prices.

OUTLOOK FOR TRANSPORT FUELS



For many years the mainly American oil majors have dominated energy markets, and the evidence is that this dominance will continue. It is therefore important to recognise that their research and development efforts into substitute fuels are strongly concentrated into the synthesis of petrol (and gas) from coal, tar sands and shale oil. This strategic emphasis recognises on the one hand the vast domestic (secure) reserves of coal, tar sands and shale potentially available to the oil majors and on the other their enormous historical investment in liquid transport fuels and perhaps a scepticism of the potential of other fuels (electricity) to substitute for these in the medium term. It is estimated that nearly two thirds of the majors' R and D investments are now taking place within North America itself.

So will syncrude be available at the right time and price on world markets as oil is today; and can European States rest content to purchase the product and, to the extent that they wish to produce domestically, the technology from the oil majors? The answer is surrounded by much uncertainty which could presage a global energy crisis of a new kind - one which some would argue is the probable scenario and which would have particularly serious consequences for Europe, and particularly serious consequences for its transport sector; how then could it come about?

The production of syncrude requires considerable inputs of coal - for example if syncrude was to be produced domestically the output of the UK coal industry would need to be increased by 60-70% to satisfy existing surface transport energy demand. Recent experience suggests that the environmental implications of the mines and the syncrude plants seriously question the feasibility of such a programme, and as we have already noted EEC coal reserves are in any case limited. But if syncrude is to be imported this raises two issues - the impact on the country's balance of payments, and the source of the fuel. While it is highly desirable that this should be a committed friendly nation (North America or Australia for example), will these countries be prepared to do more than satisfy their domestic demands given their own environmental problems, which could be more severe, often involving strip mining? Alternatively will the oil majors be prepared to risk the enormous investments in syncrude plants

in (less stable) developing countries; or will coal from these countries be imported to western syncrude plants both substantially increasing the cost of syncrude and incurring environmental problems of the plants?

Even if these problems can be overcome however, will syncrude be available at the right time in quantities at prices consumers can afford - that is, will the exploitation of syncrude permit a continuing steady rise in the price of transport fuels (shown on the diagram). Given the very long lead times in this sector due to political and environmental factors as well as technological factors this must be seriously questioned - certainly without massive investment over the next 10-20 years into R and D and subsequently into the exploitation of syncrude there is the threat (and some argue this is the probable scenario) of a global energy crisis resulting in global recession lasting 10-20 years during which oil prices increase rapidly and the availability of the substitute fuel (syncrude) is gradually increased until supply again meets demand.

In summary, it seems clear that European states cannot rely on syncrude being available at the 'right time', and that an energy crisis of the type described is a real possibility (and quite distinct from crisis resulting from precipitate political action, incorporated in the Zero Growth scenario); this appears to be an omission from the Interfutures Study.

3.3.2 The impact of new technology

The convergence of microelectronics, telecommunications and computers into a powerful 'new technology' poses a peculiar and far-reaching challenge to European societies, which has been likened in importance to the industrial revolution. To understand why this should be so we need to recognise the increasing importance of information in all walks of life - information is, in many ways, power and lack of information is disadvantage. Because transport has historically been one of the main means of conveying information, we should expect that major improvements in the means of conveying information electronically will impact on the transport sector, and it is to this restricted area of application that we shall confine our comments (other areas are investigated in parallel research contracts).

New technology will impact on society, and it will do so for two main reasons, because it reduces the cost of communications (which is closely linked to physical transport) or because it provides products which allow us to do new things at prices consumers are willing to pay. There is little doubt that new technology will do both these things - real communications costs will continue to fall rapidly (for example due to fibre optics and satellite communications) and new products will become available at prices progressively affordable by consumers (for example audio conferencing or videotex in the office and home). The critical questions concerning the nature and scale of this impact appear to be how fast the cost of communications and of new products will fall as real incomes change, and how these changes are likely to impact on a transport sector where real costs will be increasing; and the answers to these questions will be shown to depend upon policy as much as commercial considerations. A further factor is of potentially great importance for long distance transport, this is the rapid 'geographical collapse' of the cost of communications. Satellite technology in particular, and fibre optic cables to a lesser extent have substantially removed the link between geographical distances and cost, so that for example the cost of contacting Paris from London is little different to contacting Athens or Riyadh from London. However the extent to which this geographical collapse in costs is reflected in the tariffs we pay (and it is these which determine the impact on society) depends on matters of public policy.

So what is the nature of such impacts likely to be - how can they change our lives? The first point to note is that they will be dynamic - that is to say they will change society's use and organisation of time. It would be as misleading to conceive of the impact on the transport sector for example as a simple substitution of physical travel as it would to assume there will be no impact - the technology should thus be seen as an 'enabling mechanism', offering choice to individuals, organisations and government alike. There are likely to be two main types of impact, resulting from the intensive application of the technology in the workplace and the extensive application of the technology throughout society (e.g. in peoples' homes). For the long distance transport

sector it is the intensive applications which are important, both through their direct impacts on business travel and through less direct impacts on organisational, ownership and locational patterns which affect business travel and freight transport.

All we can do at present is largely to hypothesise about future impacts. It is our view that, as real communications costs decrease, perhaps dramatically for very long distance travel, the demand for communication will increase and the geographical area of individuals'/organisations' contacts will extend, resulting over time in the generation of long and very long distance travel; secondly that as new products diffuse the business world permitting 'electronic meetings' to be effective in some circumstances, then some travel will be substituted but this may not be as important as is often imagined - long distance travel while potentially most suitable for substitution (providing a high saving in time and money cost) also tends to be for purposes which are least suitable for such substitution. The resulting impact on the transport sector is not clearcut - it will be apparent that we generally subscribe to the view that transport and communications are complements rather than substitutes and it may be that very large increases in long and very long distance travel would result from the intensive application of the technology in the workplace - this would have far-reaching implications for air transport in particular.

But as we have suggested, these changes will not be the inevitable result of private sector technology - public policy will be central in at least two respects which may have far reaching implications for regional and social policy.

The European communications sector is strongly controlled and as a result costs and tariffs do not need to (and do not) match each other in different markets - for example international tariffs cross subsidise domestic, trunk tariffs cross subsidise those in peripheral areas, business users cross subsidise residential users, and so on. The present framework thus provides a delicate balance between different interest groups, a balance which is inevitably upset by policies to deregulate

the industry, with potentially very important implications. This path is being pursued in the UK and as competition is introduced on the high density routes, it seems clear that tariffs will need to match costs in individual markets resulting in higher communications costs in peripheral regions and for residential users, with lower costs for business and existing centres of concentration - trends which oppose Community and national regional policy objectives.

Of more general concern is public policy in planning for the extensive application of new technology (and here videotex, the linking of computers to television screens via a telephone and console is the key) into public places and homes. Two contrasting approaches are those of the UK government - a passive role relying on the market, where 14,000 videotex 'Prestel' sets have been installed to date, nearly all in commercial applications, and the French government - an active role, with plans to instal 'Teletel' videotex sets in 20 million homes by 1990. The impact on ordinary people will clearly be massively different, with the danger in the former case that the technology will exacerbate existing inequalities in society and lead to 'information elitism'; but moreover this could severely limit the productivity gains which intensive application of the technology is designed to achieve. This is a theme to which we return when identifying such opportunities within the transport sector.

3.3.3 Detente with Eastern Europe (including USSR)

The post second world war political division between Eastern and Western Europe has inhibited some traditional and "natural" transport flows, and forced instead a more north-south orientation. This poses the prospect of important structural pressures in the transport sector if detente develops.

Of course we cannot know whether detente will happen; there is considerable uncertainty about the development of east-west flows. It is also the case that for political reasons the times involved in planning, financing and constructing east-west infrastructures is very long - and that action would be needed now to meet major changes in demand at the turn of the century. It is clearly the case that if such needs exist this issue should be of direct concern to the Community. The only relevant study

carried out so far, by the Geneva based United Nations Economic Commission for Europe, concluded that there would indeed be infrastructure capacity problems at the east-west border even under low growth assumptions, and we can relate our views, formed after discussion with them.

Historically three technical factors have constrained east-west trade, the non convertibility of eastern bloc currencies, the east's inability to produce goods the west wishes to buy, and Comecon's trade policy.

Currency restrictions have resulted in almost primitive nation to nation bartering but already there is discussion of easing these restrictions in the case of Romania and Hungary.

The east's inability to produce goods the west wishes to buy could also be eased, in two important respects. The first is the possible increase in Western Europe's purchase of energy materials, the Siberian gas pipeline project being particularly pertinent, which would provide the east with very substantial foreign exchange earnings which would be available to purchase grain, manufactures etc. from the west. The second opportunity would result from a much increased role of the multinationals in the east. They would combine low cost labour in generally stable countries with their own imported technology to produce high quality manufactures which would be purchased by their own western subsidiaries for sale in the west, again generating foreign exchange to increase imports from the west; arguably this is beginning to happen. Finally, Comecon's trade policy has always sought self sufficiency so that imports from the west have often resulted from unpredictable imbalances of domestic demand and supply producing irregular trade flows.

More recently, the foreign exchange debts of several eastern bloc countries have threatened to constrain trade, although paradoxically they may have the opposite effect. Our main thesis however is that given a movement towards detente, many or all of these restrictions on trade would probably be removed, and that substantial increases in east-west trade, and hence transport flows, could result. This is particularly important when we realise that many of the flows are of low or medium value

bulk goods (grain, coal, ores, semi-manufactures etc.) which have major transport requirements, and which appear to conflict with the north-south orientation of today's networks.

Thus the issue is clear - if the opportunities which may be offered by detente are to be taken, it appears that action will be required to ensure that the transport system does not place an impediment in the path towards increasing economic exchanges. Indeed, even without detente, as the EEC Study showed, problems of infrastructure capacity are likely before the end of the century.

3.4 Implications for Community Policy

We now turn to the implications of the scenarios for those Community policies (transport, energy, regional, social and environment) related to transport. We deal with each policy area in turn, and conclude that in addition to transport policy, the priority areas for Community action are, in decreasing importance, energy, regional and environmental and social policy. But as we shall see, the potential for action in the transport sector to influence these policy areas varies widely.

Transport Policy - Within the transport sector we have identified the changes in overall transport flows associated with differences in the scenarios. We have then asked what the implications of these flows are for congestion, and hence the need to reduce the flows or increase network capacity.

For the road network where reliable information about existing levels of congestion exists, it appears that (notwithstanding the global basis of the forecasts) considerable problems of congestion will occur by the end of the century under higher growth scenarios in the absence of major new construction.

In the case of railways we have not had access to similarly reliable information about the existing situation but clearly there are major problems today in parts of the network, such as the Alps. Looking ahead, our main conclusion - that there is an underlying growth in both passenger

and freight traffic - is important and may ease the railways financial problems, but it may also lead to increased capacity problems. It may be argued that, given their ability to control both demand and capacity, such problems are perhaps less likely - but against this we recognise that railways are often prevented from making such rational decisions by the constraints imposed upon them. Overall it appears probable that the more serious problems cannot be avoided by low cost measures.

Thus for both roads and railways pressures are likely to increase for investment in increased capacity. The major policy question is how to approach such pressures given the link between the justification of major investments and the future scenario and the long lead times involved in planning and constructing infrastructure. As regards inland waterways, it appears, on the basis of very limited evidence, that significant problems of capacity are unlikely.

Energy Policy - as early as 1962 the European institutions defined the scope of an energy policy and over the intervening years, notably stimulated by the 'oil crisis' of 1973, when Western Europe was shown to be extremely vulnerable to external events, this has steadily been developed. The perhaps unspectacular progress which has been achieved is as much as anything recognition of the diversity of energy situations in member states and of the prerogatives they jealously guard.

The Community transport sector, and in particular road and air transport, is overwhelmingly dependant on oil and thus demonstrably vulnerable to oil price variations. The major factors that could improve this situation are improved international relations between consumers and producers, strong policy measures to conserve oil (assumed in all scenarios to a greater or lesser extent) and high funding for R and D and the subsequent exploitation of substitute technologies and fuels. But from our examination of the scenarios it appears that international relations are as likely to deteriorate as improve, that conservation and substitution policies vary considerably in their effectiveness and that it is by no means clear that total R and D/ investment resources will avoid the onset of what we have termed an 'energy crisis'. It is clear that the Community energy problem demands very strong research action within the transport sector.

Regional Policy - regional disparities within the Community, after contracting slightly during the 1960's, widened in the 1970's resulting in low levels of incomes and productive efficiencies in most regions of Italy, the whole of Ireland, and parts of the UK and Belgium. Regional objectives are not well served by the laissez faire policies which characterise the high growth scenario or by low growth/high unemployment scenarios where migration to urban areas is restricted as are the possibilities for major regional initiatives. Only in the case of what we have termed 'new moderate growth' where substantial growth is linked to strong regional policies does a significant improvement in regional disparities appear likely.

The tentative conclusion then is that if importance is indeed attached to the stated regional objectives of the Community, then they will be achieved only by strong and coordinated action against a background which is tending to widen disparities.

However, the nature of regional problems is very complex, and in countries where a basic level of accessibility exists - and this includes most of Europe - the role of transport in remedying such problems appears limited. Moreover, action in the transport sector alone is unlikely to have much impact at all, and it is only by coordinated action involving many other sectors that progress is likely to be achieved. Finally, the complexity of regional problems differs markedly from region to region and transport initiatives, insensitively designed, may compound regional problems, by opening up regional markets and exposing protected domestic industry to outside competition. For all these reasons it is by no means straightforward to use transport as a tool of regional policy.

Social Policy has until recently had a specific Community meaning concerned with ensuring fair competition between member states and encouraging geographical and occupational mobility of workers rather than being a fully fledged social policy, but there are signs that this may be changing. The main links with transport concerns the conditions of work within the transport industry - a major employer within the Community, and concern to provide mobility for disadvantaged groups within society such as the disabled and elderly.

The scenarios suggest that for those working within the transport industry improvements in working conditions - that is to say wages, hours of work and comfort - are likely, while for disadvantaged groups improvements in mobility are less likely. Thus while not a major priority, research directed to selective action appears desirable.

Environmental Policy - since 1973, when the policy was established, it has advanced through an initial harmonising phase to ensure fair competition between member states by focussing on pollution control measures towards a much more positive role improving the environment in its wider sense. The undesirable side effects of transport (noise, air pollution, and accidents for example) together with the positive role transport can play in shaping communities and regions provide the direct link to the transport sector.

Of course some action has been taken over recent years towards achieving environmental policies, but this has probably been more effective in changing planning procedures than in mitigating existing perceived problems; although in some cases, such as aircraft noise, past actions have yet to work through the system to provide benefits.

Having said this, the challenge posed by the scenarios is considerable, notably in connection with road traffic where noise, emissions and accidents all threaten to become more serious. Furthermore as European society becomes more affluent (and while not assumed, this is likely) it is, if the past is a good indicator of the future, likely to find such problems progressively less acceptable. For both these reasons further action is likely to be required within the transport sector.

3.5 The Importance of Long Term Planning and Research

It may seem surprising that we consider it necessary to address this issue - yet in recent years it has become a concern that focussing on the long term is unproductive.

Transport planning passes through different phases. In the 1960's and in some member states later, the focus was what we might call 'end state' planning - an optimal master plan was formulated for some distant

year, and the more immediate second-order issue was how to phase its implementation.

1973 was a turning point for transport planning, when the oil crisis seriously disrupted the conventional planning assumptions on fuel supply and thereby undermined previous forecasts. One result was disillusionment with long term planning and a rapid change to what we might call 'incremental planning'. The philosophy was that we could not plan longer term - this had been clearly shown, but more than this, that it was not necessary. Finding problems here and now was not difficult and what was needed was short term action to meet clearly identified problems thus making sure and steady progress. In any event available resources were suddenly at lower levels than had previously been the case, and this reinforced the emphasis on 'making the best of what we have now' by short term policies.

But this did not tell us what decisions we should be making now which have implications twenty or thirty years ahead - which means decisions about all transport infrastructure and much rolling stock. Much more importantly, however, the approach was founded on a myth - that the sum of a large number of small improvements will necessarily result in a large improvement. The transport sector witnesses many examples of short term actions which appeared beneficial in isolation but which in later years proved to be counterproductive - for example faced with major change, a number of incremental projects may prove notably inferior to the construction of a completely new road, railway, airport etc. It was paradoxical to resolve this problem that strategic transport planning had originally been justified.

In the context of this study long term planning is imperative. Fundamentally, where future developments are likely to lead to profound structural change, the timescale for adaptation (of technology, public attitudes and living styles and locational patterns) demand long term planning if major and potentially damaging discontinuities in the economic and social development of Europe are to be avoided; the three issues we have identified as critical for the transport sector are obvious cases in point. If for example we ignore the possibility of an energy crisis in twenty or thirty years the decisions we take today will be the wrong

decisions and the impact of the crisis will be much more pervasive than it need be. If over the next ten years we fail to undertake the necessary research into new technology, we shall not be in a position to take advantage of its real potential at the end of the century; and if research is not undertaken soon, the transport system may restrict our ability to take full advantage of detente with Eastern Europe, should this occur.

3.6 The Emphasis of Research

What does our analysis of alternative futures tell us about the type of research which should be undertaken within the transport sector over the coming years? The answer to this question (which is the justification for examining alternative futures) appears surprisingly clear, and has three components.

Firstly we have concluded firmly that European transport is facing a future of perhaps unprecedented uncertainty (or at least in our awareness of its existence). This means that research action should both seek to introduce flexibility into the transport system and develop transport planning techniques so that they sensibly deal with the existence of uncertainty.

Secondly, our examination of alternative futures has shown that two issues are of dominant importance for European transport, energy and new technology closely followed by a third, detente with Eastern Europe. It follows directly that these should be priority areas for research.

Thirdly, the analysis suggests that severe problems may face three areas of Community policy - transport, energy and regional balance, with less severe, but still important problems facing the Community's social and environmental policies.

In the remainder of the report we shall be attempting to translate these general conclusions into more specific recommendations for research. Of course, this will depend in no small part on the opportunities and constraints which are likely to characterise the transport and related areas over the coming years. It is to these that we now turn.

4. OPPORTUNITIES AND CONSTRAINTS

We shall now seek to explain how opportunities and constraints on action within the transport sector can be used positively to further Community transport, energy, regional, social and environmental policies. We consider in turn road, rail and air transport but are not on the basis of our analysis able to provide similar coverage for inland waterways. Finally, we examine how improvements to the methods of transport planning can contribute to the overall objective.

4.1 Transport Policy

4.1.1 Road Transport - the two major challenges facing Community road transport are how to plan for future traffic levels given the very high cost of new roads and the distinct possibility that increases in traffic may not materialise; and how to reduce vulnerability to unstable energy prices, whilst recognising that an energy crisis may occur. We have looked at the main components of road transport, the vehicles, how they are used, and the infrastructure.

Having discussed the matter widely we do not envisage any revolutionary change in the conventional car. Under pressures for energy efficiency and to a lesser extent environmental improvement, evolutionary change is likely towards smaller, more fuel efficient and environmentally clean cars which cost more to purchase, run and maintain. These changes raise few issues of public policy, but leave at least one question unanswered- are there any ways of significantly increasing the usefulness of the car to offset the cost increase. Two opportunities appear to exist, the expansion of combined road/rail transport, where the car is carried on the train for the line haul part of long journeys; and the increased use of the car as an office, in communication with the outside world and with direct access to computer data banks. The first of these offers considerable promise, and would be particularly important in the event of an energy crisis; it could also offer a bridgehead to overcome the problem of limited range for the electrically powered car. In comparison, the limited size of the market, cost effectiveness and driver attitudes towards being in constant communication with the outside world makes the second option more problematic.

Turning to the truck we find less unexploited potential for improvement, as the pressures of competition already militate towards high levels of technical efficiency. Increasing labour and energy prices will continue the pressures by hauliers for larger trucks and for the Community the question of truck weights and dimensions will not go away, indeed this is perhaps the major issue of public policy. Many improvements in the efficiency of operations will be enabled by new technology and while individually these will be small, when we also consider its wider applications in manufacturing, wholesale and retail industry we may expect substantial change in freight distribution networks.

New technology offers two opportunities for improving the way the main road network is used - by improving the information available to drivers, both before their journey ('which is the best route from A to B' for example) and en route (how to avoid congestion, bad weather, accidents); and by automatically controlling vehicles on the trunk motorway network, substantially increasing road capacity.

Information could be provided in printed form prior to journeys by means of videotex sets in public places (garages, libraries etc.) and en route by electronic signs, car radio or by more fully automated in-vehicle systems; and the main issues appear to be 'who provides what information' for dissemination, and how to detect incidents quickly and reliably. The main question-marks over the automatic guidance (by buried cables in the road) of closely following vehicles at high speed are the costs and benefits in the light of technological advances over the last ten years (when the original work demonstrating feasibility was carried out).

Of these opportunities the first already offers considerable promise, while automated guidance is much more problematic. Both clearly require European co-operation.

It is clear that Europe's trunk road network at the end of the century will, whatever future actually occurs, be mainly today's network; what is not always understood is the very high, and increasing, expenditure on maintaining that network. The question we pose is whether this expenditure is cost-effective. It appears that because the mechanisms of pavement failure and the properties of different maintenance strategies are imperfectly understood, we cannot presently say with any confidence that expenditure is cost-effective. In view of the magnitude of the costs involved, concerns about the safety of roadworks on heavily trafficked roads, and the direct link to Community truck weight regulations, this is clearly a very unsatisfactory situation.

4.1.2. Rail Transport

The railway systems of the Community exhibit great complexities of analysis, planning and management. Given the conservative traditions of railway administrations, and the financial and regulatory constraints under which they operate, there is a real danger that railways will not take up the far-reaching options that new technology and other developments offer. We have sought to establish how research can best play its part in ensuring such options are developed and applied.

The member states are committed to various extents and in various ways to maintaining the railway network. These differences in objectives frustrate long term planning and in particular cause problems in international operations. But in assessing the role the railways should play in Community policy we would emphasise that of safeguarding options against a very uncertain future. The major uncertainties to which we refer are the energy scenario, changing social attitudes towards the environment and large unexpected changes in the flows of bulk freight.

The railways have a potentially crucial role in all three areas: as a substitute for road transport in the case of either an energy crisis or environmental constraints on increasing road network or airport capacity, and as the mode often most suited to carrying large bulk flows (of coal, ores, grain etc) economically. The implications of this argument are that a basic railway network of trunk routes should be regarded as essential, that spare capacity on these routes should be planned for, and that where these are not already electrified, proposals are examined in the light of the future energy scenarios.

There are two major opportunities facing the railways, the development and application of new technology, and the achievement of more effective international scales of operation. In principle railways, the only guided form of transport, are ideally suited to automation - for example it is conceivable that the existence and identification of all trains on the network is constantly known, that computers are used to optimise their schedules and that instructions are communicated directly to the trains, which are driven automatically. This is not to say this is likely to be cost effective, it is probably not, but parts of this 'package' are likely to be, leading towards progressive automation. Again, new technology can increase the potential passengers' 'psychological access' to the railways by means of better information and pre-booking (for example from videotex

sets in public places), simpler and automated ticket issuing and checking, and better information for the passenger en route; and finally new technology can provide the operator with increased marketing flexibility allowing him to respond quickly and effectively to market conditions.

Some of the problems facing railways on international operations are common to other modes - for example the delays encountered at borders due to customs procedures and the requirements for collection of statistics are also problems at some ports. It is not clear why this happens (it does not with air cargo for example) but there is reason to suspect that considerable improvements are achievable. Other problems are more specific to the railways, and of these it is inadequacies in international marketing - the services offered, pricing policy compared to competing modes and the quality of marketing effort which appear particularly important.

These two opportunities may not appear to the customer to result in very dramatic changes (compared for example with the discussion of magnetic levitation and tracked hovercraft in the era of cheap energy and high growth) but they are fundamentally important in improving the financial performance and competitive position of the railways. In addition some new products offer promise, for example the development of road/rail passenger services, already described, and improved forms of road/rail freight services for unitised traffics.

4.1.3. Air Transport

Four factors appear likely to dominate the future development of air transport, namely technology, energy prices, economic growth and political factors. Of these, technology may be the least important, for while it would be rash to suggest that all the major breakthroughs here have been made, it seems clear that the industry is facing evolutionary technological change (a conclusion we have reached for all transport modes). Energy prices are important to air transport both because it is a more intensive user of energy than other transport modes (this currently represents about one third of all costs) and therefore will be under increasingly strong competition; and because in the event of an energy crisis, there would probably need to be drastic changes in policy, which would severely reduce air passengers and cargo. Economic growth affects the customer's ability to afford air transport and also the airlines' ability to invest in new, more efficient aircraft - and hence to respond quickly to technological opportunities.

Finally, the political factor recognises that most large airlines and the great majority of airports are effectively government owned, and follow objectives which are often disparate and usually at odds with the commercial criteria of independent airlines. This conflict of objectives creates considerable problems in policy formulation for the Community, problems which are becoming more severe.

Together these factors emphasise the particularly wide area of uncertainty which faces the 'industry', an industry which comprises manufacturers, airports, airlines and governments. It is to each of these that we now turn.

Manufacturers - looking to the future there appears little opportunity of substantially increasing the attractiveness of air transport - its basic characteristics will remain and change will be evolutionary. The major option much discussed a decade ago was VTOL (vertical take off and landing aircraft operating between city centres) which offered a substantial improvement in accessibility to air transport, but the reasons for this form of operation not being pursued at that time are more persuasive today. The one option currently requiring evaluation is the airship, a technology more or less discarded after the Hindenburg disaster of 1937 but now once again in production and showing some promise for shorter distance passenger and for freight applications.

Thus, it is not difficult to describe the types of aircraft which will be flying at the turn of the century, they will be many of the aircraft flying today together with those just entering service; and perhaps one or two new craft (a stretched Jumbo possibly) on high density long haul routes. Many of the craft will be the new generation of fuel efficient, noise-certificated, quiet jets designed to fly at mach. 0.7-0.8, and designed to be very flexible as regards the proportions of passenger and freight payload carried.

Airports - the 1970's have witnessed an increasing tendency for airports to be constituted as semi-autonomous public bodies, often with commercial objectives. During this decade, the problem of uncertainty facing air transport as a whole has focussed in particular on airports - in many Community countries the difficulties of expanding airport capacity have become intractable, and necessarily attention has focussed on increasing the capacity of existing terminals (now generally considered to be the bottlenecks at airports) and runways. At the same time there have been pressures to increase airport revenues and reduce costs. Both these problems are expected to continue into the future.

The main opportunity in both these cases is promised by the application of new technology so that the process of ticket purchase, passenger and baggage check-in and baggage reclaim is progressively automatéd, changing the organisation of space within terminals, (which may increase airport capacity) and reducing staff numbers and hence costs. The technology to achieve these objectives is now becoming available and is expected to be applied extensively over the coming decade.

The Provision of Air Services - the future of air travel within Europe is dominated by the conflicting requirements of the consumer and some airlines for low price services and those of the business traveller to maintain as wide a network of services as possible, and sufficient spare capacity to ensure availability at short notice. The latter objective has traditionally been satisfied by internal cross subsidy with the network operated by state airlines, implemented through a monopoly or restricted franchise procedure. The potential to satisfy the former is increasingly being demonstrated by the development of low cost 'no frills' services by a new breed of private sector airlines.

The main impacts to date of these changes have been outside Europe, but already there have been moves within Europe leading to change, but this has been slow. Indeed within Europe there appears no likelihood of a compromise acceptable to both groups being achieved, and the only factor which may significantly change the status quo is a ruling by the European Court of Justice expected in 1982, on whether price agreements between governments are in practice price agreements between companies (their state airlines) and thus illegal under EEC rules. This would open the door to progressive deregulation, although probably not the massive deregulation experienced in USA. There is much uncertainty about the impact of such policies on the passenger, the airlines and national and Community interests, and in the event of such a ruling the Commission clearly wishes to explore and encourage outcomes rather less at the extremes of the range of possibility than the traditional system has generated.

Apart from scheduled airlines, we have considered the possibility that 'general aviation' may pose problems or offer opportunities to the Community. There seem to us to be good reasons why general aviation will not develop in Europe to the extent that it has in the U.S.A. Nevertheless changes in the international organisation of commerce and industry suggest that this could become a growth sector with implications for runway and airspace capacity, scheduled operations and the environment, and that a Community policy towards general aviation should address these issues.

4.2 Energy Policy

We have concluded that the energy scenario is very uncertain and could have a profound effect on the global economy. We have also noted Europe's particular vulnerability and the crucial importance of energy to its transport sector, and in particular to road and air transport.

Governments, by their fiscal policy, determine the prices (as opposed to costs) of different energy sources, and these provide signals to the private sector. Clearly these signals are being effective in reducing unit energy consumption and it is expected that energy efficiency will increase over the next twenty years by about 50% and 15% for new cars and trucks respectively, and by 50% for air transport, averaged over the fleet. These changes are largely the reactions to market forces.

Faced with this energy outlook, action appears necessary in three main fields - conservation by increasing the energy efficiency of existing transport fuels and technologies (mainly oil based fuels and the internal combustion engine); development of substitute fuels and technologies; and planning for the possibility of an energy crisis. The private sector has concentrated its research resources almost exclusively on the first of these fields, while issues of public policy concern all three. Furthermore, while individual EEC countries have very different energy resources, which will necessarily result in different national strategies, there are many common interests and in some cases common requirements for European action. Perhaps the most obvious is the need for road transport fuel and technology compatibility, for example in the context of electric vehicles or liquid substitute fuels, where the absence of such cross-frontier harmonisation would threaten the international free movement of cars and trucks. We ask how public policy within the transport sector can seek to further energy policy in these three fields.

Conservation - Public policy has two main roles here, an educational role seeking to influence the public's behaviour towards rational decisions, better driving behaviour etc., and a transport role, devising policies for example influencing the competitive position of different modes taking account of their energy efficiency.

Substitute fuels and technologies - The rationale for pursuing substitutes not being developed by the private sector is mainly to provide an 'insurance policy' and the best insurance is likely to be the use of electricity for car and light truck propulsion, a fuel which

can be generated from many primary energy sources. The major requirement for the realisation of this is major advance in battery technology, but, a decade after such breakthroughs were first imminently expected, the only battery reasonably certain to be an important step forward is the advanced, lighter version of the 'lead acid battery' which offers prospects of a 150 kilometre range. Heavy trucks and air transport seem likely however to remain heavily dependent on liquid oil/coal based fuels for the foreseeable future.

For many uses these range and capacity limits are acceptable, and it is the comparative cost of conventional and electric vehicle propulsion which is important. Electric vehicles have to date been more expensive to buy, and cheaper to run, but in overall costs invariably more expensive than their conventional equivalent (although differential fuel taxes have not always made this apparent). But for most long distance transport, such limitations on range between recharging or battery exchange would be severe and here various options exist, including the use of the train for the line-haul part of journeys to increase the effective vehicle range.

Planning for the eventuality of energy crisis - In the sense that supplies are not going to be terminated sharply and immediately it is sometimes argued that there is no energy crisis as such. Indeed there could be the gradual adaptation to changing energy sources and prices, which we have discussed above. But this depends on a wide range of private and public decisions. Many of these are of a long gestation period and require considerable foresight. If, either because of an interim political crisis in the oil supplying countries or because of some inherent myopia of the private or public sector, the rate of adaptation to new sources is not well matched to the decline of old sources, then rather sharp and destabilising changes in price, activity levels and structures could occur. This underlines the importance of issues we have raised before - standby capacity on the railways, the potential of telecommunications, the need to replace competitive policies by strong regulation, and the priorities for scarce oil resources. What is needed is an overall coherent policy linking these different factors.

4.3 Regional Policy

To recognise, as we have done, that the regional disparities of the Community are of major concern does not necessarily suggest that this should be a priority area for research. The reasons for such problems are often complex and specific to individual regions and while it is clear that action in the transport sector can, suitably linked to other sectoral actions, contribute to solutions, the importance of such transport action is likely to be limited and no general policy prescriptions are possible. The role of general research is therefore elusive.

4.4 Social Policy

We have argued that the main ways that action in the transport sector can advance social policy is by improving working conditions in the transport industry and by improving the possibilities of travel for disadvantaged groups. In the transport industry the main opportunity for improvement concerns the community drivers' hours legislation. Long distance truck driving is a very onerous task, and regulations governing drivers hours necessarily need to reconcile two conflicting objectives: drivers' fatigue and safety (where it is difficult to obtain evidence of the linkage between hours legislation and accident rates) and productivity (where it is much easier to demonstrate the benefits of long hours). It appears that the existing EEC legislation is both deficient in principle, and largely ignored in practice. Thus many drivers are regularly working excessive hours, inevitably under fatigue which affects safety. However the economic effects - for example the extent of harmonisation between states and the implications for competing transport modes - are unknown. A longer term problem threatening jobs in the transport industry has been recognised by the Economic and Social Committee of the Community, namely the incursion of hauliers from Eastern Europe into western markets. We raise this problem because since their 1978 report which recommended comprehensive action, we have been unable to establish what has been achieved, or how serious the problem is now regarded. For the millions of disabled people in the Community, recognition of their special problems was given by designating 1981 'The Year of the Disabled'. While we are unaware of whether their needs have been met in the context of long distance transport modes, this question should not be left unanswered.

4.5 Environmental policy

Most of the scenarios anticipate increasing wealth within member states, and in the past this has gone hand in hand with increases in transport on the one hand, and increasing perceptions of the problems caused by transport on the other. This prospect of increasing conflict is expected to continue, and while much has been achieved by regulation in the 1970's, we should anticipate that much more will be demanded in the coming decades. Whether such demands result in further regulation should depend on an assessment of the costs they may entail (for example increased energy consumption) as well as the benefits, an approach which the Community, in road traffic noise and air pollution, is moving towards. For such assessments to be plausible, it is necessary to understand the nature of environmental disturbance and in several areas this does not exist. Given a better understanding of how people value improvements, it appears likely that the main opportunities will be in further regulation of road transport noise, emissions (affecting health, causing annoyance, harming amenity, and adversely affecting buildings and crops) and safety, focussing on the heavy truck, together with monitoring how the introduction of Environmental Impact Analysis into planning procedures can provide a more positive aspect to transport infrastructure planning.

As regards air transport, the latest generation of noise-certificated new technology jets will bring substantial improvements in noise emissions. It may be that if there is considerable growth in general aviation, it is to this area that environmental policy should be directed.

4.6 The Method of Transport Planning

If we are unable to forecast ahead, we are unable to evaluate the consequences of external impacts on the transport sector, or of possible opportunities within the sector. Forecasting is thus a prerequisite to longer term action and without it problems will not be foreseen and opportunities will not be developed.

Yet we have argued that it is past failures in this important area which have been partly responsible for the misconceived disenchantment with longer term planning per se. We have sought to identify why this has occurred and to suggest how progress can be made, recognising that in some respects the future will be qualitatively different from the past.

We have examined the question in two stages, firstly focussing on the planning process as a whole (that is all the activities from setting objectives and data collection through to evaluation producing outputs for decision makers) and asking what requirements should be placed on it and what the implications are of these; and then looking in more detail at the individual activities within the planning process. This distinction recognises the close linkages between the component parts of the planning process - for example unless we commence by understanding how new technology may impact on transport, the data collected may exclude information on communications, it will be impossible to calibrate an appropriately specified model, transport forecasts will be in error and the information provided to decision makers possibly misleading.

While the following comments are directed to long distance transport much of what is said has a more general application.

4.6.1 The Planning Process

The main requirements for the planning process is that it should deal realistically with future uncertainty; it should provide answers to questions being posed by decision makers, at the time they are required; it should provide the decision maker with that information necessary for him to make a rational decision; and it should be cost effective. Against these criteria, we can be in little doubt that the planning process as used to date has, with very few exceptions, been severely deficient.

The major defect of the process has been its failure to allow for the very considerable uncertainty which confronts us. This has happened partly because of a lack of understanding of the extent of uncertainty

and partly because there has been a confusion of strategic and more detailed objectives which has resulted in strategic planning procedures which have been excessively time consuming and costly to apply, and have therefore been inflexibly applied. Progress will come by the explicit recognition of the main components of uncertainty (probably based on the form of scenario analysis we have used) and the development of strategic planning procedures which are fast and cheap to use.

A corollary to this way forward is that the criteria used for evaluating transport options should change and that more emphasis should be given to the quality of information given to decision makers. Thus instead of seeking to optimise economic returns, subject to environmental and other constraints based on a single, central view of the future and a few sensitivity analyses (the conventional approach, widely used today), we should be seeking to devise strategies which are flexible and robust across the range of alternative futures and give the decision maker the opportunity to base his decision on an understanding of the uncertainty involved. Thus he can decide whether to implement a high risk/high returns strategy or one which has a lower risk but lower returns.

4.6.2 Individual Activities

Assuming that the objectives of a strategic transport planning process are reasonably clear (and do not, for example, confuse strategic and more detailed issues), what are the main challenges facing us?

Data - it has become clear during the course of the study that the level of understanding of the determinants of long distance transport is very deficient, notably in the case of freight transport. Yet only with such understanding and knowledge can we realistically expect to forecast with confidence.

It is fortunate that for freight, a small number of commodities (such as coal, ores/steels, minerals, foods and finished products) account for a high proportion of the total for most modes and most countries. For example, more than half of all British rail freight is either coal/coke or iron ore/steel products, controlled by two public bodies each with their statistics and strategic planning departments. This concentrated expert knowledge of industrial needs and trends is a very promising basis for forecasting, which could be more effectively used.

More generally, there are two approaches for collecting information and increasing understanding which offer promise, namely the use of time series information (that is, information which has been collected

repetitively over a period of time) and the collection of what has been termed 'soft' data. In forecasting what we are really interested in is the responses of individuals, families, corporate bodies etc. to change, and this understanding gains much from collecting time series information; but because this is rarely done we have usually had to rely on information collected at one time, usually the time of a particular study.

Conventionally, attention has focussed on what people are observed to do (hard data) rather than what they say they would do under hypothetical futures (soft data). While this has to date been understandable, techniques are becoming available which should provide considerable advances in the use of soft data.

Scenarios - unless strategic planning moves away from one or two best estimates of the future, it is unlikely to be relevant to what actually might happen. It seems essential that a suitable set of scenarios is developed, and in Community terms this - by no means straightforward task would appear to fall naturally to the Commission, ensuring relevancy and co-ordination of all strategic planning carried out under the Community's auspices.

Analysis - there has been a growing awareness that the techniques of analysis must adapt to the challenge of forecasting and appraisal under uncertainty, and several theoretical advances have been made both in transport and other areas, the private and public sectors. These desirable aims will be met only when the whole planning process adapts, and practical experience is gained of practical applications.

The conventional approach to long distance transport modelling has been developed from the urban models of the 1960's and 70's and comprises a number of sub models, each based on simplistic behavioural assumptions; the accuracy of the forecasts is almost invariably unknown.

Against this background, several themes have emerged promising new developments. Recognising that there is no one 'right' model, and that approaches to date have been rather stereotyped, new forms of model have been formulated offering improvements in analysis - what is now needed is the opportunity to gain experience in understanding which applications different classes of model are suited to.

Secondly there has been a move towards applying more rigorous statistical testing in transport planning. It would seem apparent that an understanding of the errors in the planning process (in data, model specification and scenario variables) should be related to the required accuracy of the outputs (such as economic returns from transport

strategies); but this is not possible with our present state of knowledge. Yet without such developments we cannot rationally know how best to improve the efficiency of the planning process - whether to invest in obtaining better data, or to develop better models, or to seek to improve scenario inputs.

Thirdly, there has been a recognition that if models are to serve the requirements of the strategic planning process as we have described them, they must be relatively fast and cheap to apply. Various approaches have been made to increasing model efficiency, usually involving a coarser level of analysis (in zoning and networks), but many questions remain to be resolved.

Finally, there has been recognition that the complexity and amount of information resulting from the planning process poses considerable problems of assimilation and interpretation for the decision makers. This is partly a reflection of the complexity of the issues under consideration, but partly a matter of display techniques. If progress is possible here, and if the techniques of analysis can be made more responsive to the decision makers requirements, the outputs of planning will correspondingly be more useful.

5. RECOMMENDATIONS FOR RESEARCH

5.1 Content

The following table summarises the main recommendations, which are described in more detail in the Annex to this report. It includes only research where prima facie there is a public sector, and in particular an EEC role.

While there are no cut and dried thresholds which separate the role of the Commission from that of other national and supranational bodies in the field of research, there appears to be a prima facie case for their involvement in four cases:

1. Where research is essential to Community transport or other sectoral policies.
2. Where there are such economies of scale in research that the optimal scale of effort is beyond the capability of individual states, especially where research risk is high.
3. Where coordination to exchange information and avoid duplication in non-commercial research would allow a wider range of issues to be confronted to mutual advantage.
4. Where the issues themselves are of such a kind that the benefits would accrue widely throughout the Community, and where recognition of these benefits would result in the research being accorded a higher priority at the Community level than at the national level.

The nature of their involvement thus ranges from international collaboration in research (concerted action) to joint or sole funding of research (usually by means of indirect action).

Not surprisingly, different issues imply very different resource commitments - in some cases all that is needed is coordination of national efforts, in others a specific study is needed, while in others

PRIORITIES FOR STRATEGIC TRANSPORT RESEARCH BY THE COMMUNITY

Subject of Research	Priority for research	Involvement by EEC priority	EEC main reason	Overall Priority	Resource implications
<u>A. To further TRANSPORT POLICY</u>					
<u>A1 GENERAL (affecting several or all modes)</u>					
Detente with Eastern Europe	HIGH	HIGH	4	*	LOW
Impedance to international transport	HIGH	HIGH	1/4	*	LOW
Information systems for transport	HIGH	HIGH	4	*	LOW
Impact of new technology on transport demand	HIGH	HIGH	1/3/4	*	LOW/MOD
Motorail services	MOD/HIGH	HIGH	1/4	*	LOW
Freight distribution systems	MOD/HIGH	MOD/HIGH	1/4	*	LOW/MOD
<u>A2 ROAD TRANSPORT</u>					
Truck weights and dimensions	HIGH	HIGH	1	*	LOW/MOD
Information systems for drivers	HIGH	HIGH	3/4	*	LOW/MOD
Controlling congestion on trunk roads	MODERATE	MODERATE	3/4		LOW
Automated guidance of vehicles	MODERATE	MODERATE	3/4		LOW/MOD
Road maintenance	MOD/HIGH	LOW	3		MOD/HIGH
<u>A3 RAIL TRANSPORT</u>					
Plan for flexibility in network capacity	HIGH	HIGH	1/4	*	LOW/MOD
New technology and train control	HIGH	LOW	3		MOD/HIGH
New technology and the passenger interface	HIGH	LOW	3		LOW/MOD
Cost effectiveness of safety standards	MOD/HIGH	MODERATE	3	*	LOW/MOD
Track maintenance	MODERATE	LOW	3		MODERATE
<u>A4 AIR TRANSPORT</u>					
New technology and airports	HIGH	HIGH	3/4	*	LOW/MOD
Deregulation (continuation of existing research)	HIGH	HIGH	1	*	LOW
Policy for general aviation	LOW/MOD	HIGH	1		LOW
Airship feasibility	LOW/MOD	LOW/MOD	2/4		MODERATE
<u>B. To further ENERGY POLICY</u>					
Electric vehicles	HIGH	HIGH	3/4	*	MOD/HIGH
Aircraft energy efficiency	HIGH	N/A	2/3		N/A
Planning for an energy crisis	HIGH	HIGH	1/4	*	LOW/MOD
<u>C. To further REGIONAL POLICY</u>					
(no recommendations)					
<u>D. To further SOCIAL POLICY</u>					
Drivers hours regulations	HIGH	HIGH	1	*	MODERATE
Impact of Eastern European freight operators	N/A	HIGH	1		N/A
Long distance transport and the disadvantaged	N/A	MODERATE	4		N/A
<u>E. To further ENVIRONMENTAL POLICY</u>					
Perception of environmental problems	MODERATE	LOW/MOD	3		LOW/MOD
<u>F. THE METHOD OF TRANSPORT PLANNING</u>					
Commodity flow studies	HIGH	HIGH	1/4	*	LOW/MOD
Passenger demand studies	MOD/HIGH	HIGH	1/4	*	LOW/MOD
Set up panels	MODERATE	MODERATE	4		LOW
Review the need for statistics	HIGH	HIGH	1	*	LOW
Define and monitor scenarios	HIGH	HIGH	1	*	LOW/MOD
Accuracy requirements and characteristics	MODERATE	LOW/MOD	3		LOW/MOD
Case studies for treatment of uncertainty	HIGH	HIGH	1/3	*	LOW/MOD
Development of efficient strategic models	HIGH	MOD/HIGH	1/3	*	LOW/MOD

a major programme of research over several years is required; and we have indicated what level of activities we consider appropriate. Research which is known to be in hand is excluded. Finally, where the issue is both of high technical priority and of high priority to the EEC we have asterisked it.

5.2 Organisation

We commenced this paper by recognising (in Section 2.1) that, at present, there is neither budget, nor formal procedure, nor institutional organisation for a concentrated Community level strategic research effort in transport. In stark contrast with this, our study has identified substantial areas where such an effort would be justified. It is therefore a matter of great concern to us that, at the very least, the small initiative taken in the present FAST programme should not be totally wasted because of the absence of any procedure or institution for pursuing it further.

Currently there appear to be three levels at which the organisation of research is inadequate:

- i) There appears to be no adequate procedure for relating the research efforts of the member states to the research needs and efforts of other member states or of the Community;
- ii) Within the E.E.C. Commission there appears to be little relationship between the research requirements and activities of related directorates, and little co-ordinated action to set priorities and set up inter-Directorate programmes of research.
- iii) Within the Transport Directorate, there is no explicit research responsibility.

Two important research needs appear to be neglected as a consequence of these institutional deficiencies:

- a) The special mutuality of interest between member states in improving the efficiency of their national research efforts by exchange of information and co-ordination is not well provided for.
- b) The areas of research of peculiar interest at the Community level, where the work may have a higher priority than within any national programme, may find no adequate sponsorship.

In seeking proposals to overcome these deficiencies, we are aware of several practical impediments to progress. Firstly, there are areas within which free competition in research, as in production, may be not only consistent with the underlying philosophy of the E.E.C. but also the most conducive framework for research initiatives. Second, where the requirement is for co-ordination, that co-ordination may not be most effectively limited to, or organised by, E.E.C. members as such. There is no point in taking any E.E.C. action which narrows rather than broadens the existing range of co-ordination. Thirdly, it is necessary to ensure a continuing relationship between the policy interests of the Community and the organisation of research. That does not mean, however, that the research interest should be restricted to areas where current short term policy initiatives require it. Finally, we must recognise that the institutions of the E.E.C. are already complex and that the development of new institutions or relationships is bound to be a slow, cautious and incremental process. It would be inconsistent with the view that we have taken of the development of the Community and its policies to recommend a new, major, supervening research responsibility.

These considerations lead us to seek a very limited reorganisation within DG VII, which might be implemented initially without any change in relationships outside that directorate. Only on the basis of a successful and proven development of the internal research strategy would external relationships and institutions be affected.

We therefore suggest that a specific responsibility be created within DG VII for long term and strategic research and development matters. Such a responsibility for preparing the long term basis for policy and support to policy might be viewed as in some sense analagous to the Division A responsibility for the administration of policy. There would clearly have to be very close internal relationships with the other divisions on the substance of the programmes, and some joint responsibility or joint appointment arrangement might be appropriate.

We would envisage that it would be the task of this Division:

- a) To prepare and maintain long term, strategic forecasts of supply and demand for transport in E.E.C.;
- b) To co-ordinate and develop the research requirements of the other divisions for policy formulation;

c) To develop an understanding, and ultimately to make co-ordinating initiatives in the areas of research as may be identified as requiring such an effort. Direct E.E.C. involvement in such areas is possible, but may not be necessary, if adequate links exist between countries or through the other wide international organisations.

Our immediate recommendation, therefore, is that the Commission should consider the creation of a specific responsibility for strategic research and development within DG VII which would consult the member states on the kinds of issues raised in our report and would itself progress the most important areas identified. This would clearly change the scope and emphasis of the DG VII research activity, but would not involve any unnecessary separation of the strategic research and strategic policy responsibilities.

ANNEX

PURPOSE AND SCOPE OF THE RECOMMENDATIONS

- A Transport Policy
- B Energy Policy
- C Regional Policy
- D Social Policy
- E Environmental Policy
- F Methods of Transport Planning

A Recommendation to further TRANSPORT POLICY

A1 General Transport Policy

Detente with Eastern Europe - a major research study should be set up in cooperation with UN-ECE. This should identify deficiencies in the transport networks within the area of influence of the east-west border with a view to identifying projects for subsequent feasibility study; and should examine how future action should be organised.

Impedance to international transport - this should establish in cooperation with UIC the causes of impediments to international travel and trade and should include all modes. Arising from it common action affecting several modes may be required (customs and collection of statistics for example) as well as mode-specific action (international marketing in respect of railways for example).

Information systems for transport - a study should be mounted to identify the public role in establishing intermodal information systems for long distance and international passenger and freight transport. It should examine the mechanisms which may bring this about and should result in demonstration projects where appropriate.

Impact of new technology on transport demand - a programme of research should be devised to increase understanding of the possible impacts of communications technology on transport. This should focus on case studies so that behavioural hypotheses can be tested and the basis for forecasting established. The implications for the main transport modes, notably air transport, should be identified, to inform future policy making.

Motorail services - the feasibility of the widescale introduction of motorail services (where car occupants accompany their car on trains for the line-haul section of long journeys) should be established under both conventional and energy crisis scenarios. The main requirement is market assessment and financial viability as the technology exists.

Freight distribution systems - a research programme should establish how the future scenario may change existing distribution networks, and what opportunities exist for developing more efficient combined road/rail operations (this being an extension of the existing Commission initiative).

A2 Road Transport

Truck weights and dimensions - under continuing pressures to increase weights and dimensions, a programme of research is required to inform future EEC policy - necessarily closely tied to research on road maintenance described below. This should seek to identify the overall costs and benefits of change taking account of market characteristics and establish whether there are any major cost thresholds which may preclude certain types of change.

Information systems for drivers - research should continue into ways of communicating effectively with vehicle drivers en route (this is an extension of the COST 30 project).

In the event of high traffic growth without major increases in road capacity (for whatever reason), there are two strategic options - controlling demand or increasing the capacity of existing trunk roads:

Controlling congestion on trunk roads - research should assess the costs and benefits of alternative approaches to this problem (ramp metering, pricing policies, regulatory policies etc.) to inform future policy.

Automated guidance of vehicles - an up-to-date evaluation of this technology to increase capacity, reduce accidents etc. should be carried out, particularly focussing on implementation. If appropriate a demonstration project should be mounted.

Road maintenance - an extensive programme of empiric and basic research should be established to increase understanding of the mechanisms of pavement failure and effectiveness of maintenance strategies, so that (total) costs can be minimised on sane rational basis.

A3 Rail Transport

Several options of far-reaching importance exist for railways. Research should be coordinated with national programmes and the UIC.

Plan for flexibility in network capacity - the future may require rapid increases in railway capacity to accommodate unexpected demands; these would be most pressing in the event of an energy crisis. A programme of research is required

- to establish (or at least make widely known) existing levels of congestion and spare capacity. These do not appear to be known with any accuracy and are a prerequisite to forward planning
- into the determinants of network capacity
- an assessment of the options which will exist for rapidly increasing capacity
- into how the concept of 'standby capacity' can most effectively be translated into operational programmes, taking account of the financial and organisational implications.

New technology and train control - research should identify how the progressive automation of railway operations can be most cost effectively introduced. It should focus on the economics of different stages in automation (for which the technology generally exists) and on managing the transition to more controlled forms of operation, removing the impediments to its implementation. If appropriate it should result in demonstration projects.

New technology and the passenger interface - a programme of research based on the potential of new technology to improve the interface with the passenger before the journey, at the station and en route is required; again this should result in demonstration projects.

Cost effectiveness of safety standards - research should rationally examine current standards of construction, maintenance and operation in

the light of future needs, and should recommend changes to existing practices. This is very closely linked to the following issue:

Track maintenance - a programme of research should be designed to reduce maintenance costs. This requires research to better understand the mechanism of track deformation, and then to devise improved maintenance strategies.

A4 Air Transport

New technology and airports - a programme of research is required to assess the opportunities for introducing new technology into airport functions, and the implications of this for the capacity of existing airports, for airport costs, and for passenger convenience.

Deregulation - we support the on-going research by the Commission, and in the event of a ruling by the Court of Justice opening the way to further deregulation, recommend this should be extended to monitor the effects of change and inform future policy.

Policy for general aviation - the prospects for general aviation (i.e. all non scheduled aviation) should be examined against the future scenarios and the need for a Community policy established. If necessary research necessary to formulate such a policy should be undertaken taking account of the implications for airports, scheduled air operations and environmental disturbance.

Airship feasibility - a preliminary feasibility study should be undertaken of the potential of airships for medium and long distance passenger and freight transport in Europe. This should assess the technical and cost characteristics of the technology insofar as they are known, and the market potential. If a potential is considered to exist, R and D resources may be required for prototypes and experimental operations.

B Recommendations to further ENERGY POLICY

Electric vehicles - the need for a major public initiative in this field based on international collaboration is recognised in COST action 302 which should identify major R and D needs. At that stage, if not before, R and D resources will be required leading to demonstration projects.

Aircraft energy efficiency - we are aware that this is a very important issue where much is happening in both private and public sectors. It may be that further R and D resources could be made available and cost effectively committed.

Planning for an energy crisis - a major research effort should confront the possibility of an energy crisis and seek to identify the main strands of a coherent policy within the transport sector (although the logic is that this approach should be extended to other sectors).

C Recommendations to further REGIONAL POLICY

no recommendations.

D Recommendations to further SOCIAL POLICY

Drivers hours regulations - a programme of research extending over a considerable time should be instituted to identify the links between various aspects of these regulations, and driver compliance, levels of fatigue, proneness to accidents and operating costs. This should involve research in the different member States and progressively improve the basis of policy making.

Impact on employment in the transport industry of Eastern European freight operators - the need for research action should be assessed in the light of the Economic and Social Committee's 1978 report, subsequent action and an up-to-date assessment of the problem.

Long distance transport and the disadvantaged - the need for research to improve understanding of the importance of long distance travel to all non car owners, and in particular the ease with which the long distance transport modes can be used by the disabled and elderly should be assessed.

E Recommendations to further ENVIRONMENTAL POLICY

Perception of the environmental problem - there are grounds to believe that our understanding of how, and with what importance, environmental problems associated with transport are perceived is only partially understood. The implication is that current legislation may be deficient and efforts to resolve the problem misconceived. A programme of fundamental research should seek to increase understanding in this important area.

F Recommendations to improve METHODS OF TRANSPORT PLANNING

Commodity flow studies - to provide an understanding of freight demand characteristics and determinants now and in the future throughout the Community, the first requirement is a programme of studies into selected key commodities which are critical to the transport sector. We recommend these are carried out over a period of time. In parallel the Commission will continue to monitor global flow levels as part of their market observation policy.

Passenger demand studies - a programme of research should seek to build on the COST 33 exercise and increase considerably our understanding of the characteristics and determinants of long distance and international passenger demand. This should particularly focus on business travel, and should extend to many member States.

Set up panels - consideration should be given to setting up European panels (of the general public, representatives of business and the transport industry for example) who would be questioned periodically, thus giving an early indication of new influences and trends on the transport sector.

Review the need for statistics - many statistics are collected on behalf of the Commission (for example at borders and as part of their market observation policy). This both imposes costs and brings benefits. Consideration should be given as to whether the right (useful) data is collected in the right (statistical) amounts and in

the right (cost effective) way; also whether it is made available in the best way. A research study should tackle this whole complex field, and recommend improvements to current practices.

Define and monitor scenarios - the Commission should define a broad set of scenarios suitable for all strategic planning carried out under its auspices, ensuring relevance and coordination. From time to time these should be updated to ensure continuing relevance.

Accuracy requirements and characteristics (of the planning process) - a programme of research should be directed to relating the required accuracy of outputs necessary to inform decision makers to the errors in data, models and scenario variables. This would require examination of actual studies to identify objectives, constraints, and methods used.

Case studies for treatment of uncertainty - a small programme of case studies should be set up so that alternative approaches to the treatment of uncertainty can be assessed and developed. These should be actual studies for which suitable information is available.

Development of efficient strategic models - a prerequisite to adequate strategic planning is the development of models which are faster and cheaper to operate (this is closely related to the previous issue). Research is required to develop the most appropriate strategic models.

APPENDIX

FAST

FORECASTING AND ASSESSMENT
OF SCIENCE AND TECHNOLOGY

THE COUNCIL OF MINISTERS of the European Communities decided in 1978 to initiate a five-year experimental programme : Forecasting and Assessment in Science and Technology (FAST), which was implemented early in 1979. The main aim of FAST is to contribute to the definition of long-term Community research and development (R&D) objectives and priorities, and thus to the formulation of a coherent long-term science and technology policy.

To this end, the programme has to highlight prospects, problems and potential conflicts likely to affect the long-term development of the Community, with an orientation towards defining alternative courses of Community research and development action likely to help to resolve forthcoming problems and exploit opportunities. The programme has also to encourage the establishment of an ad hoc system of collaboration in the form of networks, as informal and flexible as possible, between Community centres with capability in forecasting and assessment in science and technology.

FAST is not intended to predict the future but rather to study the possible sources of alternative developments and hence to throw light on possible and desirable options for R&D policy. A central tenet of the programme is that the possible futures are not a matter of chance, but will be as our societies determine them.

Within this mandate, three sub-programmes, reflecting problem areas of three different time horizons, have been defined :

- (1) Work and Employment
- (2) Information Society
- (3) Bio-Society

Each sub-programme has included a number of research projects, conferences, workshops, network activities, etc., and there have also been additional activities not falling within one specific sub-programme. Further information about FAST activities is available from the various publications listed in the following pages.

FAST Publications

The FAST publications can be divided into four categories :

- I FAST Documents : These are reports and documents serving as points of reference for the programme. They can be obtained from the FAST team.
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3. Riccardo Petrella : "Modernisme et Experimentation Sociale". In "L'Université et la Région" publié par La Ministère de l'Education, Belgique, 20 p., 1981.
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This report summarizes the results of a research project carried out in the context of the FAST programme of the EEC. The main volume is published in the FAST Occasional Paper Series (No 25). The aim of the project was to identify the major long-term prospects, problems and risks in international transport in Europe; and on this basis to identify research and development which can extend our range of options and our capabilities for using them, and to show how European cooperation in transport research can be improved.

Two introductory chapters state the objectives of the research and describe the present role of the EC Commission in transport research. Chapter 3, on alternative futures, identifies three key issues confronting the transport sector: high energy prices, new technology, and trade with eastern Europe. Chapter 4, on opportunities and constraints, analyses the relationships between transport policy and other sectoral policies. The final chapter summarizes the main recommendations for Community R&D in transport.