1991-90

ET

05348

Faculteit der Economische Wetenschappen en Econometrie

Serie Research Memoranda

Missing Networks and European Telecom Systems

P. Nijkamp
J.M. Vleugel

Research Memorandum 1991-90
december 1991

BIBL. VRIJE UNIVERSITEIT
AMSTERDAM
ET
053-R-

1. Missing Networks

Transport and communications infrastructure has played a critical role in the history of Europe, not only many centuries ago but also in recent years. The European political and economic system has increasingly evolved from a set of relatively independent states into a collection of interacting economies connected by means of various types of network infrastructures.

Historically major transitions in the European economic system were always accompanied (or even induced) by major changes in transport and communications infrastructures. Four main transport and logistic revolutions in the history of Western Europe have been distinguished, each of them characterized by the emergence, adoption and implementation of a new type of international infrastructure. These four revolutions are:

- the Hanseatic period (from the thirteenth to the sixteenth century), in which waterways (inland and coastal transport links) emerged as a new logistic system connecting cities along rivers and coastal areas;
- the 'Golden' period (from the sixteenth century to the seventeenth century), characterized by a drastic improvement in sailing and sea transport and by the introduction of new banking systems, through which trade to the East Indies and West Indies was stimulated (with Lisbon, Antwerp and Amsterdam as major centres);
- the Industrial Revolution (from the middle of the nineteenth century), in which the invention of the steam engine generated new transport modes (sea transport, railways) which also created new market areas (e.g., North-America);
- the period from the seventies in our century, which is marked by informatization and flexibilization; in this framework JIT (just-in-time) systems and MRP (material requirements planning) are evolving as new management principles. The rapid developments in the area of new information technology have also led to the emergence of integral logistics. This may mark the beginning of a new era.

Economic development and infrastructure development go apparently hand in hand. Therefore, the European economy will remain critically dependent on well functioning networks as catalysts for future development. There is nowadays however a growing awareness that the current European infrastructure network is becoming outdated, without being replaced by modern facilities which would position the European economies at a competitive edge. There is not only a problem of missing links (i.e., segments in a network), but even a more serious problem of missing networks as a whole. **Thus the notion of missing networks refers here to the absence of strategic layers or components of Europe's transport and communications infrastructure, be it material or immaterial in nature. Thus the term 'missing networks' applies to the poor performance - in terms of convenience, speed, comfort, flexibility, reliability, costs, safety or social costs - of European infrastructure.**

Missing networks exist, because transportation systems are developed in a segmented way, each country seeking for its own solution for each transport mode without keeping an eye on the synergetic effects of a coordinated design and use of advanced infrastructures. Another reason for missing networks is the focus on hard ware and the neglect of soft ware and organizational aspects as well as financial and ecological implications. Cabotage, protection of national carriers, segmented European railway companies, and lack of multi-modal transport strategies are but a few examples of the emergence of missing networks. A European orientation of all transport modes is necessary to cope with the current problems of missing networks.

2. Europe on the Move

In talking about missing networks, we have to be aware of the fact that the European economies have never been in a static situation, but always in a state of flux. Older infrastructures are constantly being replaced by more up-to-date networks to respond to new developments in the transport and communications sector.

In recent years a series of drastic changes can be observed in Europe's transport and communications. At the same time the fear is growing that our current networks are far from satisfactory in fulfilling the needs for the European infrastructure. Such changes concern **commodity** transport, **passenger** transport and **services/information** transport.

Far reaching changes in commodity transport include:

- the trend towards high value and low weight commodities (**dematerialization**), requiring flexible and varied transport modes.
- the tendency to produce more tailor-made goods in more diverse and smaller product series (**customization**), leading to a decrease in the role of bulk transport.
- an increasingly important role of new information technology and (both internal and external) logistics management (**informatization**), which places more emphasis on the coordination of physical transport (e.g., door-to-door transport).
- a world-wide orientation of modern transport, accompanied by the emergence of transnational transport companies (**globalization**), which also generates many new international trade patterns.
- the rise of combined transport of previously competitive modes (**integration**), leading to new demands for transhipment facilities (e.g., road-rail or road-air).

In the area of passenger transport various megatrends are arising:

- a reduction in the growth of population (the '**grey revolution**'), leading to an aging society with much leisure time and hence a high geographical mobility.
- a tendency towards more, but smaller and alternative types of households (**individualization**), creating an additional demand for more mobility.
- an (expected) trend of gradually rising income levels per capita, accompanied by a higher female labour force participation and flexible working hours (the '**new economic progress**'), leading to a rise in car ownership and car use (for both business and personal purposes).
- an ongoing rise in commuting distance and in urban sprawl (**suburbanization**), implying a rapid rise in motorization of our society.

Finally important developments in the field of information/services include the following:

- a trend toward integral logistic systems (the '**fourth logistic revolution**'), leading to the need for just-in-time (JIT) concepts, an increase in delivery frequencies and an increase in road haulage (based e.g. on preprogrammed routing).
- an increasingly important role of telecommunication and information in transport (**telematics**), leading to an intensification of physical and human interactions in space (telematics may act as both a generator of and a substitute for physical transport).

The conclusion which can be drawn from the above trends is evident: transport and communications become more intensive, not only locally/regionally, but also internationally. The potential offered by modern information technology and logistic systems will lead to a re-orientation of conventional transport systems. The need for reliability, flexibility and multi-modality in modern transport systems requires also modern infrastructure networks. An absence of such networks will hamper further balanced economic progress in Europe.

3. The New European Economy

The world economy is in full dynamics, expecially in recent years. Traditional patterns of competition - within national borders - are being increasingly replaced by vigourous competition on a multi-national and even worldwide scale. "Intra-country" competition is being replaced by "inter-trade-block" competition, since traditional boundaries disappear, as is the case in Europe and will be the case in other parts of the world. Countries within such trade-blocks are then part of an economic network. To maximize the competitiveness of such a network, and thereby maximize its socio-economic potential and performance, the quality of its infrastructure is of critical importance, as transport has become an important component of modern production processes, among others because of intensified division of tasks between firms (in different countries).

Because of this globalization and other factors (including the need for higher and sustained economic growth), transportation in Europe has grown enormously, especially in recent years. As the supply of infrastructure - for various reasons - followed this trend only in part, existing infrastructure bottlenecks have been accentuated. This is a very serious problem, since economic development and infrastructural development have always been strongly interlinked, as shown by hundreds of years of European history. The full benefits of the foreseen Internal European Market will only be reaped in case of (physical and non-physical) infrastructural adjustments in Europe. What is needed then, is European - and not national - thinking and action in infrastructural policy, based on knowledge of past successes and failures in infrastructural planning and of the future needs of the economy, the people living in Europe and their (increasingly threatened) (natural) environment.

In the past, infrastructure and its bottlenecks were normally dealt with in uni-modal terms: decision making focussing on only the mode in question and with specific links in uni-modal networks. Such uni-modal solutions have considerable limitations and the upgrading of specific problematic links gains only a little time as additional demand generated by the improvements follows additional supply. Consequently decision makers have begun to think in terms of the coupling effects of networks, both spatially and intermodally; individual transport infrastructure is part of a "network" of infrastructure. Proper decision making concerning the needs for new infrastructure and developing strategic solutions is likely then to increasingly have to rely on a more comprehensive systems approach, in which the quality of a hierarchy of different levels of harmonized transportation subsystems is the backbone.

The failure to recognize that individual transport infrastructure is part of a network, casts serious doubt on the ability of Europe to renew its transport infrastructure; as a result growing congestion, increasing waiting times and booming transport costs may severely worsen Europe's competitive position severely and may even force increasingly footloose firms to move to other parts of the world.

4. Missing Economic Development

As mentioned in section 3, Europe is in motion, politically, economically and spatially. In the past decades the European 'space-economy' has featured a wide variety of socio-economic problems and bottlenecks at both the local/regional and the national/international level. The 'old world' however, has in recent years shown surprising signs of economic and political revitalization. After several decades of desperate struggling for economic and political unification among the countries of the European Community, the tide has changed. The magical year 1992 has been accepted throughout Europe as a decisive historical landmark in the evolution of Europe toward international competitiveness, economic and technological leadership at a global level, and internal cohesiveness and cooperation. It has become a widely accepted belief that a unification of the European economies is a **necessary** condition for economic survival of Europe in the medium and long term.

In the meantime, the socio-economic, socio-political and socio-political impact of 1992 is already immense, as can be seen from the current wave of international mergers and joint ventures. It has led to a complete reorientation of economic policies - both private and public - in Europe, followed by new initiatives in technology, finance, transport and science policy (e.g., ESPRIT, RACE, EUREKA, DRIVE). And it is conceivable that several non-member states (such as Austria, or Turkey) may apply for membership, whilst others (such as Switzerland, Sweden, Finland, Norway and Hungary) look for special ways of avoiding exclusion from the economic benefits of the largest trade block in the world.

In various documents of the Commission of the European Communities, especially in the so-called White Paper (1985), a strong plea has been made for the completion of the single European market of all EC member countries from the viewpoint that the gains of an open and integrated market far outweigh the costs of semi-protected national markets. The failure of the original EEC treaty to realize a really common European market meant in practice support for national protectionism, despite the abolition of customs duties. The legalized common practice of non-tariff barriers has led to high opportunity costs. It is hoped that these **'costs of non-Europe'** can be avoided by creating a free internal EC market without frontier controls for goods, services and production factors. However, it is also recognized that a really free European market will only reap the fruits of an international integration if all social, economic, technology, environment, energy, transport and regional policies are harmonized and coordinated. The removal of many unnecessary and irrational obstacles - seen from a European angle - may herald a new era for the countries and regions in Europe.

The benefits of integration are already considerable if one only looks at **static** reallocation effects caused by relative price changes, but they may be much higher in the case of **dynamic** integration effects caused by shifts in the production structure itself, e.g. as a consequence of technological progress, institutional reforms or deregulation, improved international connections, or higher regional accessibility. The assessment of the potential gains of completing the internal market -or, alternatively, the costs of non-Europe - is of course far from easy, but may amount on an annual basis to at least 150 to 250 billion ECU's, with the highest benefits achieved in the micro-electronics industry, car industry, chemical industry, mechanical engineering and food industry.

These expected integration benefits will only come into being if Europe becomes an open and flexible network in which transport and communications infrastructure provides efficient connections between all regions and states in Europe. Consequently, the opportunity costs of missing networks are extremely high. There is plenty of evidence to show that productive investments and social overhead investments (notably infrastructure investments) need each other to arrive at a balanced economic development of nations. In general, the spin-off effects of new infrastructure investments -provided they are tailor-made with respect to spatial-economic needs - are significant.

5. The Crucial Role of Modern Transport and Communications

Transport and communications provide a stimulus for economic development (exchange of commodities, division of tasks, specialization etc.). According to the Cecchini Report any additional economic growth is critically dependent on the physical exchange capacity of Europe.

Improvements in transport and communications systems are thus a critical success factor in generating highly significant dynamic integration effects. And there is an urgent need for such a strategic improvement. Even nowadays we see already that - from a geographical viewpoint - Europe is in fast motion. The action radius of commuting is structurally rising, the volume of commodities transported nationally and internationally is increasing, and airline activities for both passengers and commodities are booming. In a recent publication this mobility drift in Europe has been described as the 'Euro-mobile' phenomenon.

Transport policy favouring a free movement of persons and commodities in the EC is a sine qua non for a single market. The removal of existing barriers is of great importance for obtaining the highest dynamic integration benefits from a network economy.

In recent years transport in most European countries has exhibited clear signs of **devolution** leading to a less intensive involvement of central governments, although a European view would call for better coordination. This devolution appears to be a uniform phenomenon, although in various countries and cities it manifests itself in different forms, e.g., deregulation, decentralization and privatization.

In this context, the first and most noticeable observation is that there is a striking parallel movement of transport infrastructure policies in most European countries in the past three decades: a period of expansion in the 1960's, a period of contraction in the 1970's and an era of selective expansion in the 1980's, in which the direction of selection is strongly governed by either market forces or by decentralization principles. Countries with a more liberal policy model and/or with severe deficits of the public budget are apparently the first ones to advocate privatization - in combination with deregulation - of transport policy, not only in the airlines sector and the freight sector, but also in the public transport sector. Among all these countries significant differences still exist, as the intensity of economic stagnation and of monetarist policies may drastically vary. In some countries local autonomy rather than privatization can be observed as a political ideology. Altogether, however, the hypothesis of a financially-driven devolution ideology is reasonably valid in many European countries.

A second observation to be made here is that European transport policy should not only be focused on an improvement of the intra-EC network infrastructure, but also increasingly on **external links** of this network. An open EC has the highest benefits for both the Community itself and the world economy as a whole. Thus the improvement of cross-frontier routes is extremely important, such as the Trans-European Motorway, or the Scandinavian links. In the future major links to East-European countries have to be envisaged. There is also a strong case here for cooperation between non-member countries which provide (transit) links between EC-members, such as Switzerland, Austria and Yugoslavia. It goes without saying that a balanced transport policy is of critical relevance for regional equilibrium in the Community. The current tendency toward major fast links is not by definition beneficial to all regions. Extensive evaluation research will be necessary here to provide policy-makers with adequate guidelines.

A third major observation is that the major stimulus for new advanced infrastructure policy is given by **information technology** (information, telecommunications and micro-electronics). Physical distribution is increasingly relying on informatics-related activities. That holds true for containerization, fast trains and airlines. Accessible and internationally coordinated information systems are becoming a major vehicle for the further improvement of the transportation and logistics network in the Community. The International Transport Information System (INTIS) in the port of Rotterdam is a good example of this development. A necessary condition for the further penetration and success of such information systems is standardization, and this policy issue is one of the most crucial corner stones of the European transport policy. JIT principles and multi-modal logistic chains will never become fully operational without sufficient European standardization.

6. Shadow Sides of the European Transport Scene

The transport system is in general the circulation system underlying the European economy. Unfortunately, no coherent view on the functioning of the European transport system has developed. Instead of a systemic view, in which the transport sector would be looked at from the viewpoint of coherence and positive synergetics, policy makers and planners have tended to develop segmented solutions to emerging bottlenecks by looking for specific local or modal solutions without due regard to the interwovenness of the transport system across different regions, sectors and modes. One of the main frictions in European transport policy is the absence of a strategic view on the 'wholeness' of the European transport system at all geographic levels.

Despite the increasing trend of JIT systems and related concepts, the actual practice of both commodity and passenger transport is disappointing and often frustrating. Severe traffic congestion phenomena at the urban or metropolitan level (e.g., Athens, Rome, Paris), unacceptable delays in medium and long distance transport during peak hours, unsatisfactory service levels of European railway systems and public transport in general, unreliable airline connections due to limited airport capacity, and the slow technical and institutional renewal of air traffic control in Europe; all these phenomena illustrate the difficult lesson facing of the European transport sector. And there is no clear perspective for a drastic improvement of this situation. On the contrary, it is increasingly claimed that a free European market (beyond the year 1992) and a further deregulation of the European transport sector may lead to unacceptable accessibility conditions in major regions in Europe.

Another important factor will be environmental policy. In contrast to the deregulation trend regarding transport, environmental policy is critically dependent on regulations and interventions at both the supply and demand sides. In particular, technical restrictions are likely to be imposed, such as limited emission levels for motorcars or maybe even a selective prohibition of the use of certain transport modes. Recently, even a plea for a car-less city has been made.

Transport policy makers in most European countries find themselves in extremely complicated situations. A large number of interest groups, ranging from multi-national companies to local environmentalists are urging them to take action, often in quite different directions. On the one hand it has become obvious that the environment poses its limits on the volume, character and pace of the extension of transport infrastructure. On the other hand many business firms in Western Europe are concerned about their competitiveness in a global context due to an inadequate infrastructure.

Inadequate infrastructure effects European business life in several ways. First, the relatively slow development of sophisticated telecommunication infrastructure in Europe may curtail the possibilities to offer new services. Moreover it may limit the possibilities to speed up international trade in a reliable way. Second, the restricted capacity of inland transport networks may cause higher production costs in Europe and affect global competitiveness.

For these reasons Europe must improve its transport and communications infrastructure to increase its competitive power, while at the same time sufficient care should be given to environmental considerations. This raises an extra difficulty, as due care is usually incompatible with swift action. Short term solutions, as advocated by some business-oriented interest groups, tend to rely heavily on a further massive extension of the European motorway system. This option may make sense in Southern and Eastern Europe, but for Western Europe this option does not seem viable in the long run. Since supply tends to generate its own demand (the 'Law of Say'), network extensions beyond the level of relieving unacceptable bottlenecks will create a new era of congestion at a higher level. Furthermore, this scenario will also be detrimental to a balanced spatial development of urban areas and the environment in Western Europe.

7. A Pentagon of Concerns

Concern about transportation problems at the European level has increased in recent years. In the past such problems were normally signalled and treated at a local or national level, without due regard to the international context, to the impacts of local/national decisions on networks elsewhere.

In the Netherlands, for instance, the strong growth of the road network - especially in the 1960's - coincided with a lack of new investment in rail infrastructure. The loss of a major client (coal transport) - because of energy conversion from coal to oil and gas - forced the Dutch National Railways to rationalization. The closure of a large number of transhipment facilities worsened their competitive power. Since the National Railways were not allowed to invest adequately in new infrastructure and rolling stock, they lost their competitive power in freight transport and to a lesser extent also in passenger transport. The strong growth of road transportation however, has led to serious environmental problems. These problems are partly due to growing congestion on the road network. Past solutions featured the extension of this network. This extension itself however, attracted extra demand, so that in a number of years this extra road capacity was seriously congested. Recently policy-makers have become aware of this phenomenon; complex problems are not dealt with any more by means of simple solutions.

As no individual network is able to satisfy current and future demands, uni-modal solutions must be rejected. Multi-modal network solutions come then to the fore, with a new spatial - i.e. European - dimension. Multi-modal solutions are part of a systems approach, of which the mutual influence and cooperation within and between networks are basic features. Combining the advantages of specific networks may then lead to synergetic effects for the whole transportation system and thereby for the economy as a whole.

This observation is once more important in the context of the European restructuring leading to an integrated Euro-market of some 320 million consumers - the USA has 'only' 245 million consumers -, a truly European hemisphere with no political, economic or social borders between its member countries. Then Europe itself will be a network, but at the same time it will need an extremely well functioning transport and communications infrastructure network.

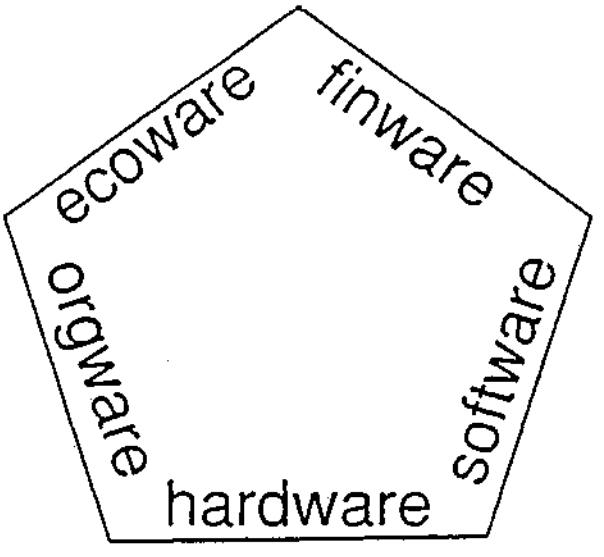
Since infrastructure networks influence both current and future economic developments, it is evident that - from a strategic viewpoint - such networks would have to be designed from a long-term European perspective. Good examples of pro-active planning in this context are the Japanese high-speed train, the Shinkansen, developed already in the 1960's in order to cope with accessibility problems in a densely populated country.

Besides the **regional attractiveness effect** of networks we should mention the **global coupling effect** of networks. This means that a qualification of networks should also take account of the fact that the quality of regional networks has both internal (intra-network) as well as external (inter-network) effects on transportation. For instance, the choice of the world's largest container shipment operator to use Rotterdam as its main port in Europe depends not only on the harbour facilities, but increasingly also on the quality of the European hinterland links from Rotterdam to West Germany -the terminal point of the major part of transhipments in Rotterdam.

In the past, solutions to infrastructure problems were seen as having only one or two dimensions, viz., the hard ware (physical infrastructure) and the fin ware (funding) dimension. A number of failures in developing infrastructure projects points to the importance of dealing with these problems in a more sophisticated and comprehensive way. Proper solutions should take account of the following dimensions:

1) hard ware:	physical infrastructure
2) soft ware:	logistics and informatics
3) org ware:	institutional and organizational setting
4) fin ware:	financial arrangements/funding
5) eco ware:	environmental and safety aspects.

These five critical success factors for appropriate network design and implementation can be represented as a **pentagon**. This pentagon-model will be used hereafter as a framework for judging European infrastructure network planning. It should be noted, that the pentagon model not only applies to links and uni-modal networks, but in particular to multi-modal network systems in which synergy is a sine qua non.



Transport and communication networks should not only be judged in view of physical infrastructure and funding problems. Instead, all of the above dimensions must be considered simultaneously.

8. An Illustration: European Telecommunications

The development and use of telecommunications infrastructure has been evaluated in the light of the EC policy elaborated in its Green Paper on Telecommunications. Following the main line of argument in this paper, we conclude that the most important cause of missing links in the field of telecommunications is the product of a chicken-egg problem, since **hard ware** and **services** are not introduced because of lack of demand, and demand is not revealed because of the lack of hard ware and services. With the execption of the French Minitel and a few pilot projects, telecom in Europe is mainly used for basic services (telephone, datalinks and telefax), and more sophisticated services have not been introduced. One factor responsible for this is the lack of common European standards of hard ware. This underlies the current EC stimulation of research and development in this field (e.g., by means of programmes like ESPRIT, RACE etc.). The 'Costs of Non-Europe' because of market fragmentation are high, both at the supply side (low economies of scale etc.), as well as on the user side (higher transaction costs because of time loss, unnecessary travelling time, productivity loss etc.).

Trends

On the **demand side** there is an ongoing and rapidly increasing upward trend in the use of telecommunication services in business for data-transmission, telex, telefax and telephone purposes. There is also a similar trend in household usage. In the transport sector, however, telecommunications are only slowly being utilized - a missing network.

Missing networks in European telecommunications

The main problems in this field are the following:

At the **hard ware** level there is an extreme kind of diversification between EC-members. This is particularly evident in the differences in developing infrastructure (ISDN) and differences in transmission capacity etc.; incompatibility and lack of interconnection.

At the **org ware** level the main problems lie in the lack of standardization between national norms and standards for equipment, approvals etc., and - most important - in the way and pace in which European standardization is eventually achieved. Given the non-existence of a common European market in telecommunications, national priorities will then determine the kind of response to market needs. Another problem lies in the asymmetric way of price setting in telecommunication, determined by national considerations. For instance, high international telecom prices are often used to subsidize national users. Consequently, prices and costs are then more or less unrelated.

At the **soft ware** level a major problem lies in the absence of demand for sophisticated services using the telecom network. As long as this situation continues, suppliers of such services will not develop new applications.

Fin ware bottlenecks are also very important, since large investments are needed to develop a basic European telecommunications network.

Because of these problems, there is a real danger of a Europe 'a deux vitesses', with a clear division between those countries and/or regions having access to recent technology and those that have not. The socio-economic impacts of such developments are considerable, since existing differences in wealth and business opportunities will be accentuated.

Suggested improvements

To improve the current situation in European telecommunications the following suggestions can be formulated:

- the introduction of a base European telecom network including standard facilities, uniform rules and tariffs, and services. Local networks should be at least hard ware compatible with this base network. Management and ownership should be take the form of a public-private partnership in which governments, operators and users participate. Developing such a network will be very expensive, but will have positive economic impacts both for the users as well as for the industry, the use of EC (development) funding is needed.
- a separation of responsibility between regulators (government; policy) and operators (implementation) (**org ware**) is needed.
- avoidable barriers to entry should be minimized (**org ware**); the existence of monopolies should be avoided.
- since delivery technologies are changing too fast, a sustainable basis for regulation is missing. Improving competition should then be the keyword (**org ware**).
- telecom prices should be cost-related (**org ware**).
- use the outcome of current ENS-applications (e.g., the European NERVOUS-system) in transportation (EDI, ATMOS, FTM, Single Document etc.), banking, environmental protection, health care, education (**org ware, hard ware, soft ware, eco ware and fin ware**) to develop European-wide applications.

  Possible solutions include:

  a) the use of new **teleports** as a operational planning tool for connecting telecommunications with physical goods transport or passenger movements (cf. the Amsterdam teleport success story)

  b) the introduction of **new networks**:

  1) substitution of postal services by more efficient and faster express mail:
  Express mail services are booming, but the lack of a true network and thereby inefficient competition leads to very high prices.

  2) the combined use of **deregulation of national PTT services** and the **introduction of new standardized telecom services**. The French Minitel might be used as a basis for such an European network (**soft ware, org ware**). Experimentation with Telecom Zones in rural areas between two or three countries (**org ware**) is also an option in line with deregulation.

  3) where substitution is impossible in goods transportation, options include the use of **orbital fleet management** in relation to **electronic customs** (replacement of physical border controls by standardized electronic vehicle identification at the big European freight terminals, ports and airports).

9. Common Problems: Standardization in European Transportation and Communications Policy

Lack of standardization is one of the main reasons for bottlenecks in transport networks. Technical standardization covers the areas of infrastructure, vehicle technology and cargo. Standardization has a number of dimensions, of which the technical one is nowadays in most cases not the most important one anymore. The org ware dimension is far more important, since standardization in European networks will only work if their design, development and management is of European nature. Joint European investments in uniform technology, components and subsystems, and experiments are the prime issue in this field.

Missing standardization in European networks

In **road transportation** the European network has a high degree of standardization. National standards for **infrastructure** are therefore no bottleneck for transportation. European standards for **international** transport exist; at this point there is no evident bottleneck. This is however not the case in the field of **domestic** transport. Harmonizing of national **standards for vehicle dimensions** is necessary because of the possibility that domestically used vehicles will also be used for international transport. The **environmental policy in the Alpine countries** may lead to standardization problems, since the favouring of combined transport forces the use of containers standardized to railway profiles. **Technical standardization of cargo** (containers, exchange bodies) is necessary, since the use of non-pallet compatible containers and exchange bodies is inefficient. This problem hinders especially the development of combined transport (road-rail).

In **inland shipping** there are only a few problems concerning standardization. There exists a European **infrastructure** network of rivers and harbours. Using a pusher tug with six carriers is only possible on the Dutch part of the Rhine under certain conditions, because of the **lack of width of parts of canals and rivers**. Efficient transport of containers (on deck) is not always possible because of **low bridges and the width of sluices**. If a wider container type becomes the standard one (the current tendency), the efficient use of decks would no longer be possible.

Rail transportation demonstrates a serious lack of standardization. Major problems exist in:
- differences in gauges (normal gauge, small gauge and wide gauge; see also section 8)
- differences in voltages, frequencies and supply type (overhead line, third rail)
- differences in signalling systems (hard ware and org ware), including norms for the use of foreign traction on domestic rails and on board (receiving) equipment, including lack of coordination
- differences in free profiles (prohibiting especially the development of international combined transportation
- differences in the carrying capacity of the infrastructure

A change of the current dimensions of containers might be fatal for the railways, since transportation efficiency would decline, while also severe org ware problems would arise. Interestingly enough, the railways themselves do apparently see standardization as of little importance, since a number of solutions is found to overcome these bottlenecks. The delay stemming from technical controls and customs when crossing borders is regarded as leading to a far greater loss of time. Full standardization of voltages, signalling and safety systems is very expensive and not part of the discussion as far as railway companies are concerned. The growing use of three-phase current motors in locomotives however, will make multi-voltage locomotion very easy, so the lack of standardization of voltages may be solved in due time.

In **air transportation** no bottlenecks exist in the field of standardization of **infrastructure and cargo**. The use of special air containers etc. is no hindrance in combined road-air transportation, whereas the opposite is through for (the very low developed) rail-air transport.

In **sea transport** standard containers are used. Changing these standards would however lead to great problems.

Combined transportation is faced with a great number of problems. Research into the necessity and problems of introducing new standard containers shows that this will hit sectors with long-term investment needs most severely (the shipping and rail sectors), both in terms of (lost) investments and less efficient transport.

Suggested improvements

The most important solution lies on the **org ware** level; the need for **a European vision on standardization**. This includes a strong need for public and private investments in standardization. The successful case of EUROFIMA in **financing** rolling stock all over Europe shows that financing and standardization may be achieved jointly and efficiently. The use of pilot projects should stimulate European standardization.

Technical standardization of **hard ware** and **soft ware** is needed in most sectors, given the need to achieve long term transport policy -increasing transport capacity, speed, reliability and safety, and reducing transport costs - and **environmental** policy aims -less accidents, more efficient transport etc. The use of three-phase current locomotives easily permits running on multi-current tracks.

The debate concerning changing cargo and vehicle standards should incorporate the efficiency and costs of transport, the costs of new investments and sunk costs, and the potentials for combined transportation. This means that that **standard dimensions for cargo should serve the transportation needs of all modes**. The Eureka-context might be considered as a useful scheme to implement the above mentioned projects.

10. Plans for Action

Europe is in 'fast-motion'. Missing networks act as stumbling blocks for a rapid pace. The way in which Europe will actually move is uncertain, as strong forces of interest groups and bureaucracy are likely to act nationally, regionally and sectorally, since disappearing frontiers in the new emerging Europe will threaten their positions. This leads us to the heart of the problems, since a major part of current transportation problems is due to short-sighted self-interest of national politicians.

From the foregoing exposition it has become clear, that the transport system performs the same kind of function to the European economy as the blood circulation performs in the human body. There are however, also big differences between them, since the human body has a number of sophisticated control systems trained to cooperate with each other and is therefore able to achieve a high-level performance, whereas the 'European network body' lacks coherent materialization and coordination, since sometimes even basic transport functions do not exist (or perform very poorly), whilst major parts of this body compete with each other rather than complement each other.

It should be emphasized - particularly when considering policy choices - that transportation is a derived demand. Transportation is not an aim in itself, it serves 'higher' economic goals related to the requirements of a network economy. Access to economic activities and social facilities is the major service provided by infrastructure networks and - irrespective of the type of mode - this is the main goal of a European-oriented transport policy. This holds true for the two-tier system of a European-based transport system, viz. the local-regional network in metropolitan nodes and the long-distance network between major centres in Europe. Recent initiatives regarding Trans-European Networks are worth mentioning here, as they also take for granted a systems view on European infrastructure.

An important caveat for transportation planning is the fact that the most favoured solution to transportation problems (in the past) - viz. physical extension of networks (i.e., investments in hard ware) - has proven to be valid only for very short periods of time, since capacity extension will very soon show the same kind of congestion as other parts of the network. Three options seem to be useful to cope with this dilemma:

(1) Investments in **advanced modes of transport**, e.g., transportation based on telematics infrastructure, open new opportunities to expand interactions without major extensions of other networks, but it remains to be seen for how long, given the predicted massive growth of transportation in the years to come. Large and focused investments in telematics and new information technology infrastructure is certainly necessary in order to reduce the problems of missing networks.
(2) It is increasingly necessary to **tackle the causes** of the growing demand for transportation facilities - e.g., physical planning of residential areas, locational behaviour of firms and user charges -, in stead of just extending networks at increasingly growing social (i.e. external) costs.
(3) **Improvement and/or establishment of multi-modal networks** is another meaningful option. This indicates both the need to think and act from a European perspective, when dealing with transportation problems and the need to give serious thought to all five dimensions of networks, i.e., hard ware, soft ware, org ware, fin ware and eco ware. **Network quality** is the corner stone of this approach and must therefore be set high on the political agenda.

From the large number of **solutions** to the above mentioned frictions caused by missing networks the following directions are promising and viable for various transport modes.

To create a genuine European **railway** network for international connections requires stronger cooperation between the European railway companies (e.g., by means of mergers), international technical standardization, upgrading of cross-border lines and large investments in multi-modal transhipment. To tackle the connection problems in public transport, the establishment of a coherent international public transport agency with a broad competence should be favoured.

To improve the quality of the European **road network** upgrading of existing or building of new cross-border motorways should be given high priority. Both the road safety and road capacity as well as environmental impacts may be improved by means of traffic guidance systems.

Investment in inland **waterways** (including sluices) and coastal transport systems is necessary to establish a European waterway network for mass transportation as well as for the growing container transport. The proposed and more or less environmentally-induced shift from road to rail transportation is likely to highlight strong capacity constraints in the railway network. Although water transportation

has a lower environmental impact than road transportation, building new waterways however, has also a strong negative impact on the environment. An extension of the waterways network and a restructuring of existing facilities should however be considered as a useful option.

The major bottleneck in **air transportation** is definitely the lack of an integrated European air control system. Such a system may give capacity improvements of some 30 percent, thereby largely eliminating current - and extremely costly - air congestion.

In addition, **multi-modal** network solutions have to be favoured. Examples of multi-modal networks which could be established in Europe include the following:

(1) high speed trains as feeder lines between or for airports have a great potential;
(2) combined terminals for transhipment between vessels, trucks, trains and airplanes are necessary for commodity transport;
(3) transhipment of commodity transport between road and rail should be favoured.

In terms of **policy initiatives**, the following strategy for the various planning levels (regional, national and European) regarding all transport and communication modes is needed:

- a declaration of infrastructure development as a basic economic interest for Europe; such a status should, for instance, include access to the various fiscal and financial instruments of the EC for R&D and pilot projects in this field;
- the definition of a priority plan of base European networks (road, rail, air, waterways and telecom) in terms of network quality and performance (e.g., maximum travel time, reliability of transportation etc.). Such a network would need sound links with lower level national and regional networks;
- a strategic policy analysis of how to implement such a network; for instance, coupling existing national networks is only a first step in this process, since nationalistic planning failures and thinking have strongly prevented a European network vision from emerging;
- the creation of efficient decision making procedures for European infrastructure (e.g., coordination via a European Institute for Standardization. Growing constraints on infrastructure (e.g., financial, environmental, technical, etc.) have helped to create a climate in Europe which seriously affects its competitive position;
- a clear strategy on priorization of European infrastructure projects, including a sound transnational financing (e.g., on the basis of a European Infrastructure Bank associated with a coordinating body for European transport policy).

These initiatives are not adressed to the planning of infrastructure in the short term, but are focused on medium and long term projects, and contrast with the well-known short term demand-oriented planning failures of the past.

Based on the foregoing considerations and recommendations, the following **plans for action** to remove missing networks in Europe have to be implemented:

(1) **To pursue a combined transport strategy for rail and road with several layers of networks, including a system of big European freight terminals linked by block trains on a higher level, and soft technology piggyback transport facilities on a lower level. This would ask for organizational and logistic innovations on a European level.**

(2) **To create an integrated European air traffic control system. In order to improve the capacity on the European sky traffic, corridors would have to be enlarged, air traffic control systems would have to be coordinated, and ground control technology will need improvement. In addition a coordination between the regional air traffic system and the rapid train network is needed.**

(3) **To create a genuine European railway network. The concept of common carriage has to be realized with a European public transport agency which owns the infrastructure and coordinates the activities. Investments are necessary in terminal capacity, transhipment facilities and logistic solutions.**

(4) **To improve the quality and use of the European road network. Road capacity can be significantly revised by implementing logistic systems.**

(5) **To invest in inland waterways and coastal transport systems. A European waterway network for mass transportation and containerized transport has to foresee multimodal solutions including rail and road transport.**

(6) **To ensure a stronger market orientation in transport in Europe where infrastructure users have to pay the full social marginal cost and at the same time foresee a flexible regulation in order to guarantee coordinated European solutions. Institutions like a European Institute for Standardization in intra- and intermodal transport technology, a European Infrastructure Bank and a coordinating body for European transport policy would help to realize the indicated solutions.**

(7) **In order to ensure a consistent and strategic European-oriented analysis and planning of infrastructure networks, intellectual talents in the area of transportation science would have to be brought together. This could be realized, for instance, in the form of a European Infrastructure Institute.**

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