THE CHALLENGE OF MOBILITY IN EUROPE

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Executive summary

This paper briefly reviews the transport networks and socio-economic indicators affecting the development of transport and shows the share of different modes of transport in passenger transport volume in Europe.

Based on statistics and studies of mobility, carried out earlier in the framework of European programs, an assessment of accessibility and performance of main transport systems was made. Pointed out the need to fill the existing gap transport occurring in the range of 300 km to about 1200 km.

1. INTRODUCTION

Man's natural need to reduce inconveniences effects in action that generates numerous movements. The ever changing, relatively temporal location of agents has been a part of human history and will, most likely, remain until the end of, what we call, the civilization. There are, however, various dimensions, various vehicles and subjects of movement, which we discover, facing the dawn of global information society. Expecting inevitable changes in human nature caused by the emergence of virtual worlds, we spend our lives in millions of traffic jammed cars.

Car luxury or engine power does not please as it did yesterday. Despite the efforts of manufacturers' marketing departments, the prestige attached to road vehicle possession diminishes when a multitude of competing owners struggle for scarce parking places.

The real powers of a mankind for the sake of its survival and prosperity, which are in possession of everyone – creative minds – are in a continuous trial-and-error processes searching for optimal solutions of the day. Imagine a businessman on his five-hundred-kilometer-car-journey for a meeting, controlling time nervously and realizing "if only I had wings…", "why do none of the airlines offer service from my region?", "aren't we here rich enough to be connected to high-speed train network?". The ideas simply spark around…

And – here we are – the **European Personal Air Transportation System** is one of the proposals for the European society to fill the transportation gap that exists on interregional national and European destinations with underdeveloped transport network, where implementation of others modes of fast transport is irrational due to too low flow of passengers. A system that could improve air taxi business services to be more cost-efficient and transform its status to regular product thanks to the economy of scale and net-centric management.

This paper shows the current trends of European mobility focusing on areas where the aforementioned transportation gap occurs.

2. EUROPEAN GLOBALIZED ECONOMY

The European Union economy holds up relatively well due to sound fundamentals.[1]

Table 1. Economic growth and consumer price inflation in EU

economic growth (GDP)				consumer price inflation		
2007	2008	2009		2007	2008	2009
2,8%	2,0%	1,8%		2,4%	3,6%	2,4%
labor market (jobs created)				public deficit level		
2006/7	2008/9			2008		2009
7,5M	3M			1,2%		1,2%

European Commission forecasts of the EU economy (EU economy: 2007 review – Moving Europe's productivity frontier, EC Directorate-General for Economic and Financial Affairs, COM(2007) 721 final, Brussels, 21 November 2007.)

In the long term, however, its one of the top positions in global rankings measured by GDP level[2], has experienced a more than a half-age decline, balanced only by means of a reliance on the political dynamic of enlargement.[3] The productivity growth is constrained by restrictions concerning labour and product markets, lack of openness to foreign direct investments and barriers to access or the creation of new technologies and their diffusion, and especially for the near future, the turmoil in the financial markets and oil prices.

European welfare states stemming from ageing populations need to implement polices, defined by the revised Lisbon Growth and Jobs Strategy, which favors competition-friendly product market regulations, R&D activity and the quality of human capital. Globalization and Information and Communication Technology (ICT) revolution proved that small countries or small start-up companies can be technology leaders in specialized fields and international mobility of researchers and financial capital are main vehicles of diffusion.

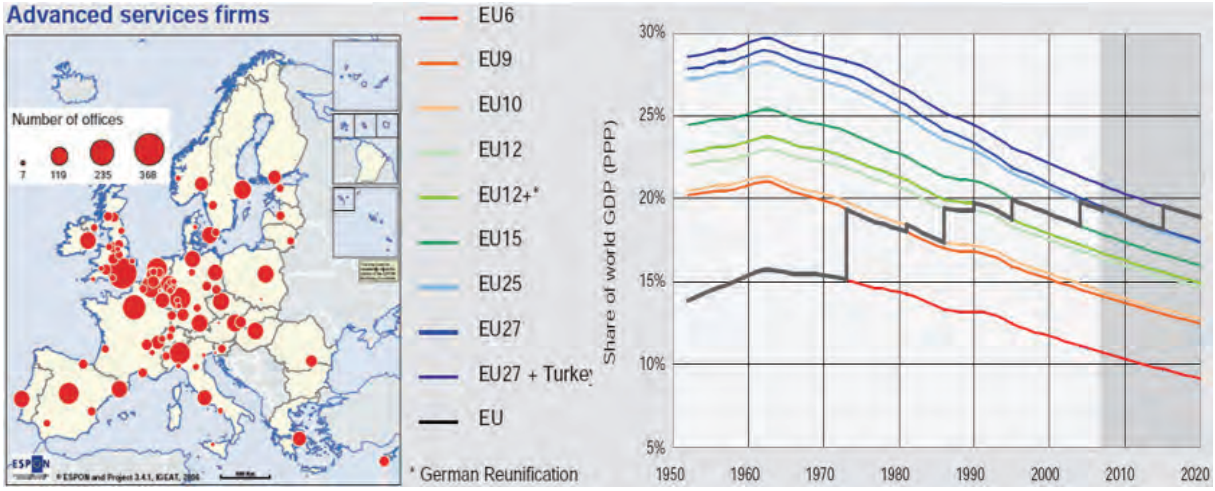

Fig. 1 Advanced services firms offices spatial distribution and GDP (PPP) level in European Union and its predecessors as a share of world GDP [ESPON Project 3.4.1, Europe in the World: Territorial evidence and visions, results by autumn 2007, pp. 17, 29]

"Globalisation tends to increase the economic inequalities between European regions. The metropolitan regions of the Pentagon where the major gateway cities are localised are actually the most likely to benefit from the opening up of EU27 + 2 territory to internationalisation.

[1] *Economic Forecast*, EC: Directorate-General for Economic and Financial Affairs, Spring 2008, pp. 1, 5, 31, 49.
[2] IMF (2007): EU27 - $14,7 trillion ; USA - $13,8 trillion ; China - $6,99 trillion ; Japan - $4,2 trillion
[3] UMS RIATE/ESPON 3.4.1, 2006 , Vol. 1, p. 205.

But globalisation does not necessarily have negative effects on all peripheral regions. Depending on their economic specialisation some peripheral regions can benefit from the development of tourist flows or from the relocation of traditional industrial activities for which they display comparative advantages".[4] Nevertheless, to exploit benefits of comparative advantages of remote regions an effective transportation system is required also there.

3. TRANSPORT NETWORKS

The trans-European transport network (TEN-T) is one of the important pillars that secures the free movement of passengers and goods in the European Union. The revised Lisbon strategy intends to unblock major transport routes and ensure sustainable transport.[5]

This policy direction pointed at the beginning of EUROSTAT's 2007 *Panorama of Transport* immediately gives a quick image of situation - the European mobility channels are blocked or tend to be blocked, despite one of highest density in the world. Ground transportation takes c.a. 2% of the EU area and the tendency is to take more, while the existing routes and parking places are becoming congested. There are serious bottlenecks in the air, especially in ECAC core areas caused by the situation where 85% of air activity is generated by 43 main airports. High-speed rail seems to be an excellent solution to intensive passengers flow routes, however its infrastructure construction is very expensive.[6] There are no serious offers for out-of-core long distance travelers, who are therefore forced to use cars and contribute to congestion in sensitive locations. If we are to be conscious of the scale and shape of the problems we need to focus on respective, main modes of transport separately.

3.1. Road transport

There are more than 4,8 million kilometers of roads and 60 000 km of motorways in the EU.[7] According to European Spatial Planning and Observatory Network, million kilometers of roads have been built during the period of 1990-2003. The ever growing number of cars reaches 220 million and 5 million more vehicles are registered every year. The road transport consumes 83% of total energy used in transport industry.

The ESPON Project 2.1.1 evaluated road infrastructure in Europe as well developed, however distinguished some main bottlenecks. Any increase in terrestrial traffic on connections: Paris – Bilbao, Marseille –Paris, Marseille –Ruhr, London – Manchester – Liverpool – Glasgow and Dublin, Lisbon – Madrid will effect in significant increases in the travel times. There are also recognized two critical passages: Trans-Pyrenees and Trans-Alpine. Greece and Cyprus have worse road density with respect to the EU27+2 average in the Mediterranean area and the infrastructure of Baltic states was recognized to have poor links to the rest of Member States. The Central Area has extremely good road infrastructure, however noise, emissions of pollutants or land fragmentation become serious drawbacks. It is on the extreme to the Eastern Area where the density of motorways and expressways by population is comparatively very low with the European average. There exists not a real motorway network, and its construction costs vary from 5 million Euro per km (to e.g. 20 as in case of Poland in Silesia region).[8]

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[4] ESPON 3.4.1, *Europe in the world*, 2006, Vol. 1, p. 242

[5] *Panorama of Transport*, EUROSTAT, 2007, p.2.

[6] **€10 - 30 million** per construction of 1km of high speed rail, International Union of Railways, UIC (Nov 2005), High Speed Rail's leading asset for customers and society, http://www.uic.asso.fr/download.php/gv/HighSpeed.pdf, p. 30; + **€70 thousand** of upkeep costs per 1km annually, UIC Project - Lasting Infrastructure Cost Benchmarking (LICB) - LICB Summary Report UIC C 2006/12/15, p. 7.

[7] Eurostat for 2003

[8] Signaled as the most expensive in Europe. Kraków regional bureau for roads budget, Generalna Dyrekcja Dróg Krajowych i Autostrad (GDDKiA) oddział w Krakowie, http://www.krakow.gddkia.gov.pl/budzet/budzet.htm, 9.05.2008.

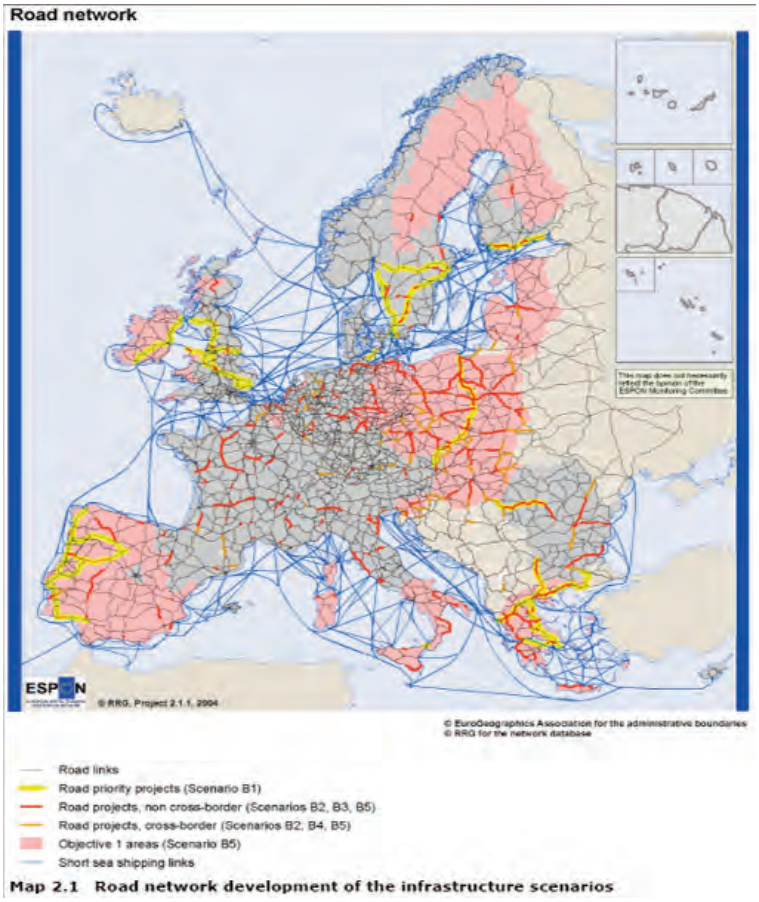

Fig. 2. Road network in the EU27+2 prepared by EPSON Project 2.1.1.

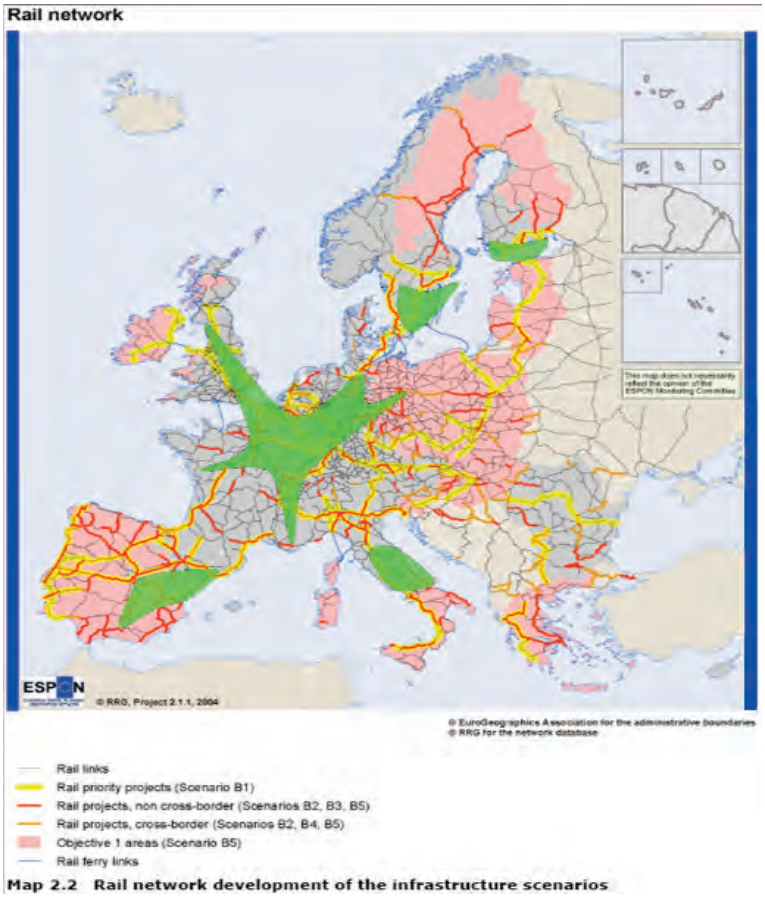

Fig. 3. Rail road network in the EU27+2 [ESPON Project 2.1.1] extended by the up-to-date information on High speed train (HST) [UIC, 02.2008]

3.2. Rail network

The Eurostat's Panorama of Transport says about 199 000 km (2003) of rail tracks with high population density lowland countries like Germany, France and Poland situated at the top of track length list and a country of numerous islands and mountainous regions - Greece - at bottom. The overall dynamics indicates 8% decrease in network length.

Sacrificing huge amounts of capital (hundreds of billions of Euro)[9] Europe builds its high speed rail network. The situation of certain cities located on high-speed railway lines is a factor favorable. It is clear that the system of relations between Paris, Lyon, Avignon and Marseilles was modified by the high-speed train, including a strong modal shift in favour of rail. This characteristic is going to spread partially with the development of high-speed railway lines in other macro regions. There are regions, where the high speed network is not likely to reach even in many years horizon. E.g. Baltic states experience the same poor situation in rail linkage as in the road infrastructure.

For 50 000 rail cars, crossing a frontier still remains somewhat exceptional, and only a few locomotives are equipped with the multiple systems required to easily cross national borders (e.g. Thalys connecting Paris-Brussels-Amsterdam).

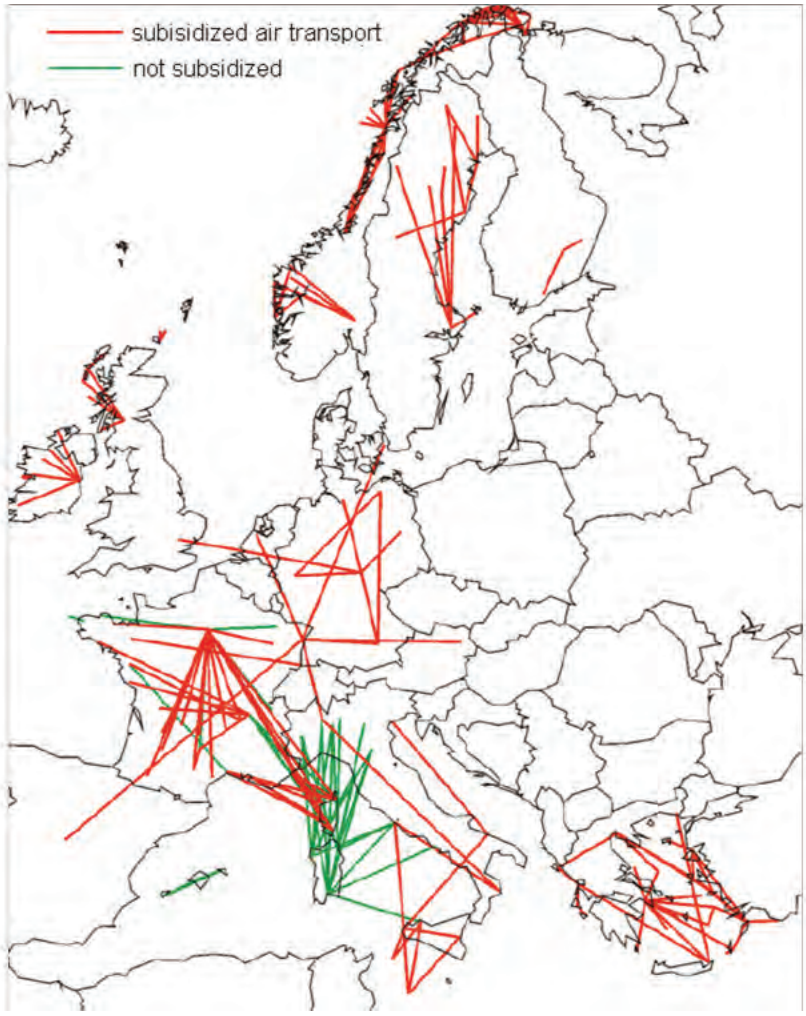

Fig. 4. Air transport provided under Public Service Obligation rules, [Les obligations de services publics aériens en Europe, ou l'intervention résiduelle des États face au libre marché, Frédéric Dobruszkes, 2005.]

[9] Lines in operation 170 billion Euros (for 8 570 km); Lines under construction 109 billion Euros (for 6 240 km); Planned lines 84 billion Euros (for 3 040 km)

3.3. Airspace network

The air network dominates for professional mobility of more than 500km in the absence of high speed trains.[10] Regions, as for example, Mediterranean islands depend on air transport links operated under Public Service Obligations (PSO) rules.[11] These profile of service exists, however, in whole Europe. Many low-cost carriers (also in the Eastern macro region) use this possibility at the invitation of local authorities, which aid their businesses. The PSO form of activity is very carefully examined and controlled by the European Commission as it breaches the market competition paradigm.

One cannot easily talk about 'network length' in aviation. The virtual nature of 'air corridors' makes it harder to grasp the image than it is with any other mode. The network is changeable and morphing, according to traffic volume. A classification of airports on the basis of their technical or infrastructural features is not useful for statistical purposes, because airports are by their nature intermodal nodes. Anyway, that most of the traffic is generated at 112 "main" airports[12] with a passenger volume of over 1 500 000 passengers annually and the rest of European airports and landing fields are generally unused (2570 according to EPATS[13]). The airspace has its capacity as well. For an Air Traffic Management System it is defined as "the volume of traffic that could be accommodated with 1 minute per flight average delay".[14] The total gate-to-gate costs of Air Navigation Service provided by EUROCONTROL in 2005 reached €7,1 billion (about 0,8 €/km).[15]

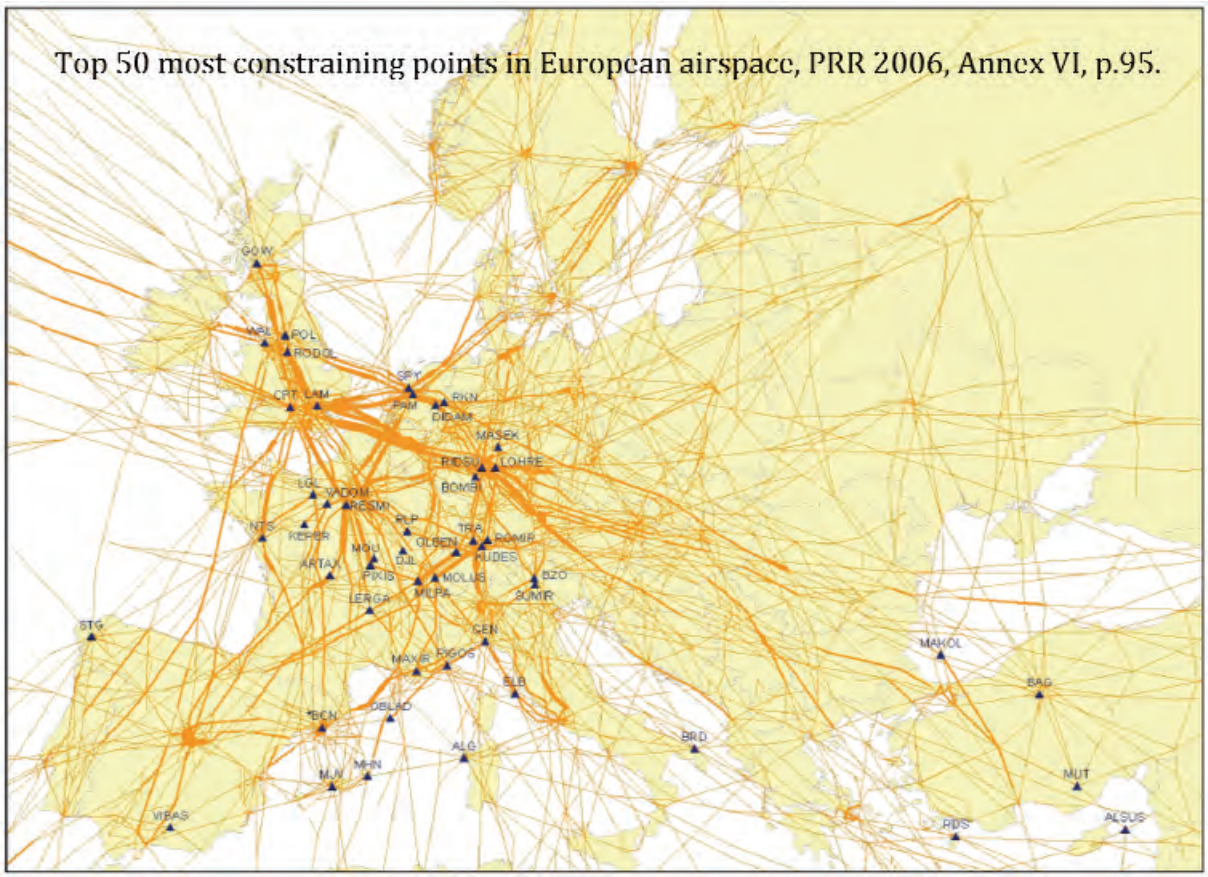

Fig. 5. Current capacity of airspace is very much constrained by fragmented approach to ATM – a heritage of national borders. Europe is on its way to reform this architecture within the SESAR Project.[16]

[10] ESPON Project 1.2.1, *Transport services and networks: territorial trends and basic supply of infrastructure for territorial cohesion*, 2004, p. 23.

[11] According to the EC 2408/92, which, as a result of local authorities initiative and willingness to pay, exempts certain services due to of **socially desirable advantage** from the EC Treaty general rule (Art. 87): "[...] any aid granted by a Member State or through State resources in any form whatsoever which distorts or threatens to distort

4. VOLUME OF TRANSPORT IN EUROPE

The total volume of passenger-kilometers generated by three main modes of transport reached the level of 5 trillion.
Enormous road traffic has increased its volume by nearly 18% during 1995-2004 period. Air transport has been very dynamic growing by 49%.

Table 2. Passenger transport performance, by main transport mode EU-25, 1995-2004 (in billion passenger-kilometers) [Panorama of Transport, EUROSTAT, 2007, p.102]

	Road	Rail	Air	Total
2004	4458	352	482	5292
2003	4399	347	454	5200
2002	4370	351	435	5156
2001	4277	355	441	5073
2000	4196	353	440	4989
1995	3787	324	324	4435

Fig. 6. Transport mode share in 2004

The EU-25 1 078 000 transport enterprises reached a turnover of €1024,3 billion[1], out of which 640 rail companies sold services worth €61 billion (6%) and 3200 air carriers sold services worth €100 billion (9,8%). Almost half of transport industry turnover is not generated by physical transport service selling companies, but by the auxiliary surrounding.

- One employee[1] generated for its rail transport company added value of €37 962 on average.
- One employee[1] generated for its air transport company added value of €74 943 on average.

competition by favoring certain undertakings or the production of certain goods shall, in so far as it affects trade between Member States, be incompatible with the common market." Jacques Barrot, Commission Vice-President responsible for transport, explained "[…]those obligations must not improperly close off a viable market from competition[…]", http://europa.eu/rapid EC press release, Reference: IP/07/539 Date: 23/04/2007.

[12] Eurostat for 2004, EU-25

[13] EPATS D1.1 T1.2 EPATS Airports and facilities database

[14] PRR 5, Annex 6, EUROCONTROL, pp. A9-A13

[15] PRR 2006, EUROCONTROL, p. 72.

[16] Single European Sky ATM Research, http://www.eurocontrol.int/sesar/public/subsite_homepage/

5. ACCESSIBILITY

A "total track length" unfortunately does not answer the question of transport infrastructure. A major problem with this measure is that it disregards the infrastructure network quality. To overcome these problems, one might weigh infrastructure with certain characteristics in a potential function.

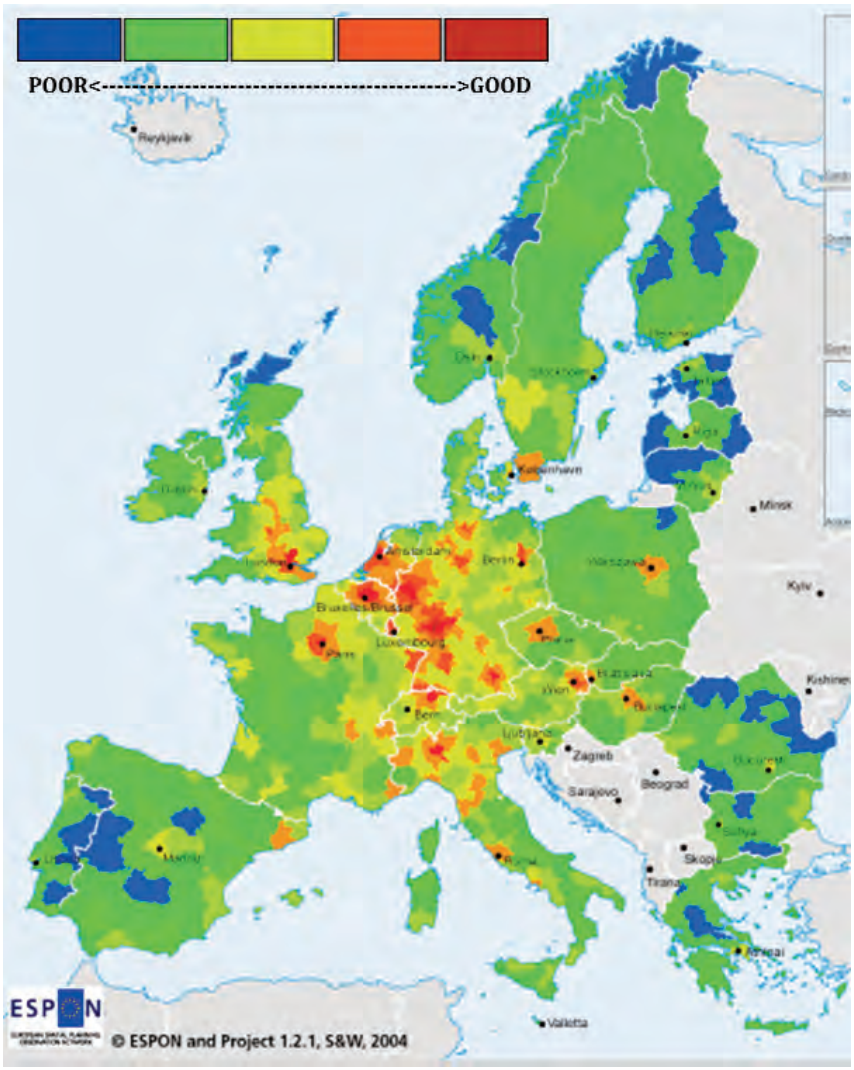

Fig. 7. Transport infrastructure quality expressed as summed potential accessibility of road, rail and air transport in the EU27+2, ESPON Project 1.2.1 by S&W, 2004

The **regional accessibility** defined[17] by ESPON Project 2.1.1 for the purpose of the SASI model, takes the following form:

$$A_i = \sum_j \left(W_j\right)^{\alpha} e^{-\beta c_{ij}}$$

where W_j denotes the potential of region j, and c_{ij} is a measure of 'cost' of travelling between the regions i and j.

The potentials of the various regions are chosen equal to their populations, which corresponds with the idea that the accessibility to highly populated regions is more relevant than the accessibility to sparsely populated regions. The cost measure can e.g. be based on travel time and political and cultural barriers. The summation is over all possible regions, including the 'own region' i.

[17] The SASI model was build to explain locational structures and locational change in Europe in time-series/cross-section regressions, with accessibility indicators being a subset of a range of explanatory variables. See more: ESPON Project 2.1.1, *Territorial Impact of EU: Transport and TEN Policies*, 2005, p. 73-89

The travel costs between two regions are composed of four parts:

- the travel times between the regions
- the difference in the level of integration within Europe
- language differences
- cultural differences

The travel times between regions are computed using timetable travel times (rail and air transport) and road-type specific travel speeds (road). Aggregation over different modes (road, rail, air) takes places through the logsum impedance:

$$c_{ij} = -\frac{1}{\lambda}\ln\left[\sum_{m}\exp\left(-\lambda c_{ijm}\right)\right]$$

where c_{ijm} equals the travel costs between the regions *i* and *j* given that mode *m* is used. Note that these travel costs consist precisely of the above mentioned components.

The potentials Wj are chosen equal to the population size of the various regions.

Transport infrastructure quality of the EU27+2, expressed as a regional accessibility indicator matrix focusing on lower values of this measure, was taken under consideration in EPATS analysis to find the most possible spatial distribution of potential **transportation gap**.

6. MODAL CHOICE

The travelling public has available a wide choice of modes of transport including car, bus, train, ship and aircraft. By far the most significant advantage of air travel is the time saved by the fast cruising speed. Professor Bouladon of the Geneva Institute aptly described this in his analysis of transport gaps in 1967. [11]

The total trip time shown in Fig. 8 is a combination of delay caused by the infrequency of the service, the speed of travel and the wasted time due to the inter connection of services. Of the three 'gaps' identified, the short- and long-haul ones are directly targeted by the air transport industry. Reducing each of the component times contributing to the overall trip time presents opportunities for both operational and technical improvements in new air transport and continues to challenge aircraft designers, airline managers and airport operators. For short stages it is no longer acceptable to have long reporting times prior to boarding.

As we all know, for shorter journeys and where a suitable public transport system is not available the private car is the natural choice of travel. For journeys less than 300 km the car is the dominant mode of transport. In this market the train and bus are seen to be disadvantaged by the infrequency of service, by the out-of-pocket cost and the slow journey times (especially for distances greater than 250 km). As public transport services are developed into a frequent, fast and comfortable option (e.g. by the introduction of high speed trains), the competition to air becomes stronger in the mid-range, (250-900 km). Over about 900 km the time saving of air travel becomes attractive and air dominates the market. The total journey time is affected by schedule, delays and transfers between modes. The links to the airport (road, rail and public services), the appropriate time of departure and arrival have a major impact on the success of the transport service. For leisure travel the choice of mode is strongly influenced by ticket price and airport convenience, for business the value of time is the most important factor . This has led to the idea to develop an Intelligent Small Aircraft Transportation System. The concept is to use modern small planes and dense network of local airports, new information technology and navigation systems, and the Internet network to associate individual travel itineraries and time, and adapt to them, the type and size of aircraft and flight plans, and therefore reduce the wasted time caused by airport time access, boarding, schedule and infrequency of the service, interconnection and route. As personal disposable income increases this sector will become increasingly significant.

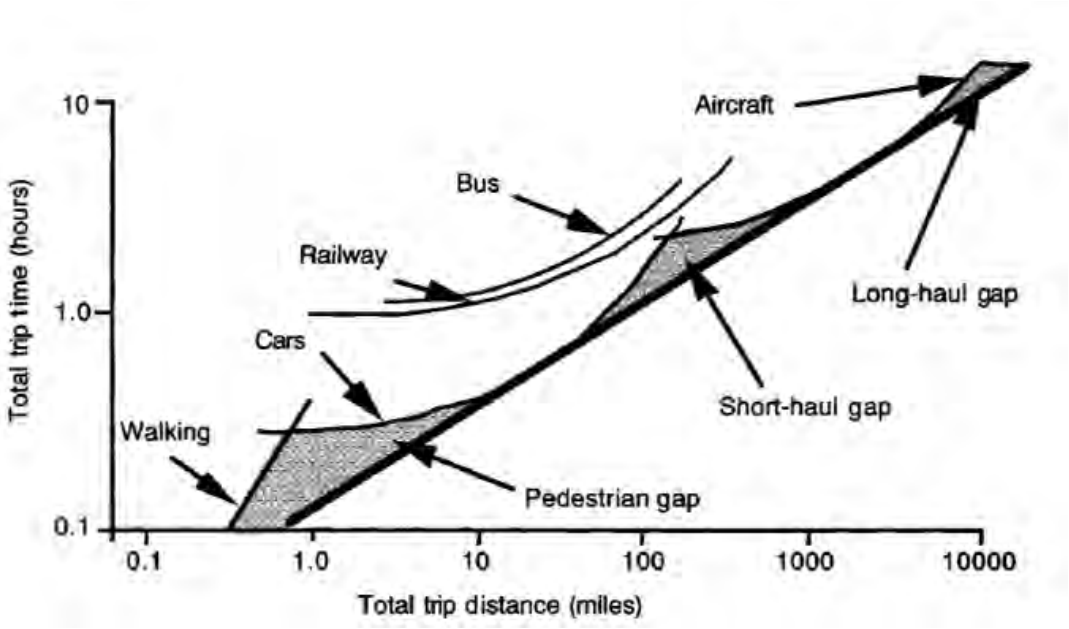

Fig. 8. Transport gaps (source Bouladon)

The influence of time saving is shown by the modal split (for business travel) between the three major transport forms of travel (Fig. 9). Above 250 km, implementation of EPATS will reslult in a futher shift of car trip to aircraft.

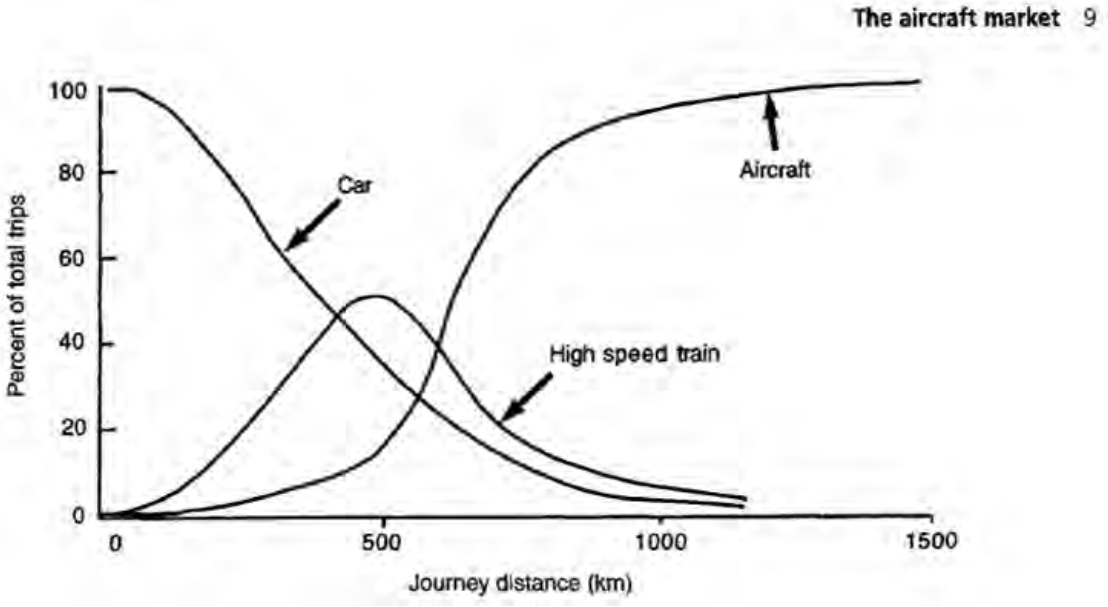

Fig. 9. Modal traffic split (source Airbus)

7. CONCLUSIONS

Mobility is essential for Europe. Still 86% of all traffic in Europe is by road. Every year the number of cars in Europe increases with 5million (or 2.5%) whilst on average 100.000 KM are added to the European road system of 4.8 million KM. This causes increasing traffic jams all over Europe.

The widespread accessibility of high speed mode of transport is a prerequisite for the sustainable development of European Regions.

Europe needs a new, supplementary mode of transport. A mode that is harmonized with general trends (door-to-door, multimodality, energy efficiency). A mode that will give us a new tool to manage the challenge of mobility.

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[9] http://www.gddkia.gov.pl/

[10] Dobruszkes, F., *Les obligations de services publics aériens en Europe, ou l'intervention résiduelle des États face au libre marché*, in: "Les politiques publiques à l'épreuve de l'action territoriale", IEP Grenoble, 15-16 juin 2006.

[11] Civil Jet Aircraft Design, Lloyd R. Jenkinson, Paul Simpkin, Darren Rhodes