The Challenge of Mobility in Europe
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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


<table>
<thead>
<tr>
<th>economic growth (GDP)</th>
<th>consumer price inflation</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>2008</td>
</tr>
<tr>
<td>2,8%</td>
<td>2,0%</td>
</tr>
<tr>
<td>labor market (jobs created)</td>
<td>public deficit level</td>
</tr>
<tr>
<td>2006/7</td>
<td>2008/9</td>
</tr>
<tr>
<td>7,5M</td>
<td>3M</td>
</tr>
</tbody>
</table>

In the long term, however, its one of the top positions in global rankings measured by GDP level², 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 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.

“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. But globalisation does not necessarily have negative effects on all peripheral regions. Depending on their economic specialisation some peripheral

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2 IMF (2007): EU27 - $14,7 trillion ; USA - $13,8 trillion ; China - $6,99 trillion ; Japan - $4,2 trillion
4 defined by the metropolises of London, Paris, Milan, Munich and Hamburg, EPSON Project 2.1.1, p. 211.
regions can benefit from the development of tourist flows or from the relocation of traditional industrial activities for which they display comparative advantages. Nevertheless, to exploit benefits of comparative advantages of remote regions an effective transportation system is required also there.

3. Transport networks

In 1996, the European Union agreed on 14 priority trans-European networks in the transport sector (TEN-Ts), which are very important pillars securing the free movement of passengers and goods in cross-border links. The main challenges were defined in the so called ‘priority axes’. The revised Lisbon strategy intends to unblock major transport routes and ensure sustainable transport.

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 network 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 and dynamic growth. High-speed

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5 ESPON 3.4.1, Europe in the world, 2006, Vol. 1, p. 242
6 Most of these ‘axes’ are at risk of falling behind schedule hampered by procedural, technical problems, and especially the difficulty of raising finance. Completing 30 priority axes will total an estimated €250 billion by 2020 – or €600 billion if non-priority projects are added. The EU’s budget for TEN-Ts projects for the period from 2007 to 2013 amounts to €8 billion. The EU is only allowed to fund 10 to 30 per cent of the costs of construction, that is why funding TEN-Ts still rests with the member-states. The EU and EIB’s ‘loan guarantee instrument for TEN-Ts projects’ (LGTT) is to increase private-sector participation by covering commercial risk during a project’s initial phase of operation, when an operator might have difficulties paying back loans on time because of lower than expected revenues. [Barysch K., Tilford S., Whyte P., THE LISBON SCORECARD VIII - Is Europe ready for an economic storm?, Centre for European Reform, February 2008, p. 47.]
8 “prices falling dramatically and the number of routes being offered rising sharply” - LISBON SCORECARD VIII
rail seems to be an excellent solution to intensive passengers flow routes, however its infrastructure construction is very expensive\(^9\). 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.\(^{10}\) According to Eurostat data a 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\(^{11}\) Project 1.2.1 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

\(\text{railroad network in the EU27+2 [ESPON Project 2.1.1] extended by the up-to-date information on High speed train (HST) [UIC, 02.2008]}\)


\(+\) €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.

\(^{10}\) (for 2003), *Panorama of Transoport*, Eurostat 2007.

\(^{11}\) European Spatial Planning and Observatory Network, for more information on ESPON, see: 4.2. ESPON KTEN model outcome O-D flows, p.10 - or - [http://www.espon.eu](http://www.espon.eu)
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 million as in the case of Poland in Silesia region).  

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 the bottom. The overall dynamics indicates 8% decrease in network length.

Sacrificing huge amounts of capital (hundreds of billions of Euro) 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).

3.3. Airspace network

The air network dominates for professional mobility of more than 500km in...
the absence of high speed trains. The total gate-to-gate costs of Air Navigation Service provided by EUROCONTROL in 2005 reached €7.1 billion (about 0.8 €/km).

Regions, as for example, Mediterranean islands depend on air transport links operated under Public Service Obligations (PSO) rules. This 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. It could be assumed that a working “infrastructure” is given continent-wide (air, airports, air traffic control, aircraft leasing, and financial support). This 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, the most of the traffic is generated at 112 “main” airports with a passenger volume of over 1 500 000 passengers annually and the rest of European airports and landing fields are generally unused (of 2570, according to EPATS). 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”.

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16 PRR 2006, EUROCONTROL, p. 72.
17 According to the EC 2408/92, which, as a result of local authorities initiative and willingness to pay, exempts certain services, due to *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 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](http://europa.eu/rapid).
18 Eurostat for 2004, EU-25
19 EPATS D1.1 T1.2 EPATS Airports and facilities database
20 PRR 5, Annex 6, EUROCONTROL, pp. A9-A13
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.  

3.4. 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 volume has been the most dynamically growing (by 49%) in the same period, however its share maintains the level only (6-8%). The rail generated passenger-kilometers are in slight decline of share.

<table>
<thead>
<tr>
<th>Year</th>
<th>Car</th>
<th>Rail</th>
<th>Air</th>
<th>Other</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>4458</td>
<td>352</td>
<td>482</td>
<td>738</td>
<td>6061</td>
</tr>
<tr>
<td>2003</td>
<td>4399</td>
<td>347</td>
<td>454</td>
<td>755</td>
<td>5955</td>
</tr>
<tr>
<td>2002</td>
<td>4370</td>
<td>351</td>
<td>435</td>
<td>747</td>
<td>5903</td>
</tr>
<tr>
<td>2001</td>
<td>4277</td>
<td>355</td>
<td>441</td>
<td>749</td>
<td>5822</td>
</tr>
<tr>
<td>2000</td>
<td>4196</td>
<td>353</td>
<td>440</td>
<td>744</td>
<td>5733</td>
</tr>
<tr>
<td>1995</td>
<td>3787</td>
<td>324</td>
<td>324</td>
<td>714</td>
<td>5149</td>
</tr>
</tbody>
</table>


### Economy of transport services

The EU-25 1 078 000 transport enterprises reached an annual turnover of €1024,3 billion, 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 generated for its rail transport company added value of €37 962 on average, annually.
- One employee generated for its air transport company added value of €74 943 on average, annually.

3.5. 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.

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\(^{22}\) by ESPON Project 2.1.1 for the purpose of the SASI model, takes the following form:

\[ A_j = \sum_j (W_j)^\alpha e^{-\beta c_{ij}} \]

where W\(_j\) denotes the potential of region \(j\), and \(c_{ij}\) is a measure of ‘cost’ of travelling between the regions \(i\) and \(j\).

\(^{22}\) 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 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.

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 place through the logsum impedance:

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

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 \( W_j \) 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.

3.6. A transportation gap

There exists a transportation gap, i.e. a recognized demand, that is not addressed by the transport services supply. The multimodal potential accessibility map helps to identify the spatial distribution of the transportation gap. A sudden decrease in transport infrastructure quality occurs in the Atlantic Arc and Eastern macro region. Most of the Mediterranean and Nordic regions are also unnecessarily contributing to car traffic congestion in long distance journeys.\(^{23}\)

4. How wide is the transportation gap?

4.1. How to measure the gap?

Knowing Origin-Destination passenger flows enables calculations, that could provide a potential estimates of demand for long distance, interregional, pan European, car traffic.

However, it is very difficult or even hardly achievable to gather such complete empirical data. Therefore, a model should be built. Or in case of limited time and resources - an existing model outcomes could be adopted.

\(^{23}\) See maps. This demand is partially satisfied by the subsidized air transport that already exists there at local airports. A group of air companies (usually local) periodically take part in the run for state benefits, however the service profile seldom allows for transnational door-to-door travels (like in Greece, Sweden or Norway), offers services to one of the hubs only (like in France or Ireland) or could be optimized by certain improvements.
4.2. ESPON KTEN model outcome O-D flows

European Spatial Planning and Observatory Network (ESPON), a multimillion Euro initiative part-financed by the EU within the Interreg III ESPON 2006 Programme, has built, as a part of a large scale macroeconomic benchmarking activity, a passenger and freight traffic forecast meta model called KTEN (“Know trans-European Networks”)\(^\text{24}\). KTEN model have been used by ESPON to precise qualitative scenarios into quantitative ones.

![Modal split for interregional trips. Source: ESPON Project 1.2.1, Mcrit](image)

Among several other outputs, KTEN provides a multimodal passenger trips forecast between NUTS2, which can be used to build passenger flows matrices, and, consequently to identify the scale of interesting transportation gap.

5. What fits the transportation gap?

5.1. European Personal Air Transportation System (EPATS)

The concept of EPATS is mainly based on\(^\text{25}\):

- Using the already existing local and regional airports network (more than 2000), especially located on the periphery of European main transportation infrastructure in the areas with low level of accessibility indicator;

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\(^{24}\) *Elements of support for the scenario building process*, in: “ESPON Project 3.2 Scenarios, Spatial Scenarios and Orientations in relation to the ESDP and Cohesion Policy”, Final Report, Vol. 4, Oct 2006. KTEN is a sequential Four-steps model, with combined modal split and assignment on multimodal networks; assignment of interurban trips and freight between NUTS3 is made without congestion constraints (1 complete run of KTEN takes about 4 days; KTEN is 4GB large in total); KTEN bases on STREAMS project results, WTO data and EUROSTAT Air Traffic OD databases as well as ETIS-BASE freight matrices plus infrastructure regional endowment as output for MASST (another ESPON model), GDP and population predictions from MASST as inputs.

Using a potential enabled by the opening of Single European Sky and conducted research in the area of management and air traffic control by e.g. SESAR;

Using new technologies concerning aerodynamics, materials, propulsion, communication, navigation and control based on satellite systems;

Adjusting aircraft fleet and operational structures to interregional passengers flow, local demand and society needs;

Increasing economic efficiency of interregional air transport by creating small carriers and private aircraft owners friendly legal and economic conditions, promoting unification, standardization and integration of maintenance networks; and

Including remote interregional communication networks areas (with low accessibility) into public transport financing.

EPATS is a complex collection of systems, procedures, facilities, aircraft and people. They work together as one system to ensure safe and efficient operation. The system includes:

- Network of all existing and future airports and airfields in Europe satisfying the EPATS requirements, i.e. an EPATS-compliant airport meets a set of desired characteristics appropriate for the community’s transportation demand and requirements;
- Pistons, turboprop and jet aircraft, having a capacity from 4 to 19-seats, fulfilling the requirements of FAR-23 or CS-23 and FAR 135 operating regulations;
- Air traffic management and control systems adapted to intensified air traffic generated by the EPATS. They include: radio, TMU and TFM, weather, radar, navigation and en route sites;
- Flight Service Station;
- Internet-based passenger travel booking and demand optimisation, offering transport capacity adjusted to the demand at the lowest price/performance ratio;
- Aircraft maintenance and management companies; and
- Aircraft owners and users associations.
- Aviation authorities;
- Air Navigation Service Providers;
- Flight training schools; and
- Research centres.

Moreover, the system surroundings include public transport powers (adequate local government units), aviation authorities, air traffic managers, aviation schools, aviation industry with its research and development centres. The system aims to operate in the public transport infrastructure framework.

5.2. EPATS volume estimations

The most probable volume of EPATS could reach about 150 billion passenger-kilometers. The EPATS IFR flights are found to grow from less than 1 million (as in 2007) to 3.5 or 3.7 million. The EPATS VFR segment is expected to grow from about 15 million flights a year (as in 2007) to c.a 40 million.

The method and outcomes concerning volume of passenger-kilometers transfer and the respective number of operations may be found in detailed EPATS D2.1 EPATS Potential transfer of passenger demand to Personal Aviation. Other information such as the ATM or environmental impact could be found in EPATS D3.2 Analysis of the Impact of EPATS on ATM Parameters: ATM impact assessment and D3.2 EPATS Airports General Requirements including Safety and Environmental Issues.

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26 EPATS D2.1 EPATS Potential transfer of passenger demand to Personal Aviation, M3Systems, Feb 2008.
6. Conclusions

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

The EPATS, most likely, will not change our transportation habits, however it could open another dimension for traveling, revitalize the General Aviation industry and give a strong boost in research and development activity searching for our future personal means of travel.

Bibliography: