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10 Connectivity and Congestion on European Road Corridors

A. Reggiani, P. Nijkamp and G. Pepping

10.1 Introduction

Europe is increasingly moving towards a network economy, in which physical flows of people and goods form the connecting elements. This means that European corridors - especially those between major metropolitan areas or centres of economic activity in Europe - are playing a critical role in the new, evolving map of Europe. At the same time it has to be recognized that traffic congestion on many European transport corridors is dramatically increasing, while also the environmental implications and the poor safety conditions cause unacceptable social costs. Conventional transport policy is apparently unable to keep up with Europe's growing demand for mobility. New transport technologies are hence increasingly regarded as necessary instruments for ensuring sustainable mobility.

Advanced Transport Telematics (ATT) is nowadays generally regarded as a potentially powerful tool for coping with future transport problems on European corridors.

It is clear, however, that not all European corridors present the same characteristics. Therefore, it is necessary to develop an appropriate typology of European corridors on the basis of the indigenous relevant features of these corridors and also of the potential of relevant ATT applications. The rationale behind the identification of European corridor typologies is the idea that European policy resolutions (like ATT introduction) may generate different behavioural responses for each type of corridor and ATT technology.

In the context of the present paper, particular attention will be given to the role of peripheral corridors (such as the 'Mediterranean' corridors connecting Greece).

10.2 Description of the Corridors Investigated

The identification of relevant types of road corridors is not an easy task. The first step of the present study is the selection of relevant inter-urban corridors,

i.e. the identification of those inter-urban corridors whose characteristics may be considered relevant for studying the various potential impacts of ATT. In particular, this can be undertaken by investigating two aspects of the problem, viz. the expected ATT impacts (on system's efficiency, on network reliability, on environmental quality, etc.), and the different actors interacting within a comprehensive transport system (i.e., users, operators, public decision-makers and decision-makers in governments and the political system as well as in the economic and social system).

These interacting factors lead to the following two categories of criteria that are useful for the selection of the corridors:

- the *spatial location* of the corridor, which refers both to its geographical coverage (for instance, the corridors considered should contain not only central, but also central-peripheral and peripheral patterns of interaction) and the strategic relevance of the corridor (in particular, the strategic importance of the corridor in the European communication network and also in the increasing process of regional integration);
- the *different mobility patterns* within the regions crossed by the corridors (especially various aspects of traffic flows, such as degrees of congestion, pollution, network reliability, safety, etc.) in combination with different socio-economic situations (in terms of wealth, productive specialization, etc.).

It also has to be added that quite some field work on various corridors has already been undertaken, so that it makes sense to focus in particular on DRIVE 2 projects undertaken by the EC. Therefore, in addition to four pilot projects in DRIVE (PLEIADES, META-FORA, MELYSSA, ADS), three other DRIVE 2 projects will be considered (INVAID, COMBICOM, FRAME) which all together cover Centre-East and Centre-West directions. However, in order to deal with a more balanced set of European mobility patterns, an additional five corridors are taken into account reflecting East-West directions (such as the Trieste-Lisbon and Vienna-Nantes corridors) as well as inner links in the core of Europe (such as London-Berlin, Amsterdam-Milan and Amsterdam-Utrecht) (see Figure 10.1).

Consequently, on the basis of the above criteria the following list of corridors has been identified:

1. Glasgow-London-Paris-Marseille (PLEIADES-DRIVE)
2. London-Athens (META-FORA-DRIVE)
3. Stuttgart-Lyon-Barcelona (MELYSSA-DRIVE)
4. Aosta-Athens (ADS-DRIVE)
5. Amsterdam-Madrid (INVAID 2-DRIVE)
6. Rotterdam-Munich-Verona (COMBICOM-DRIVE)
7. Amsterdam-Athens (FRAME-DRIVE)
8. Trieste-Lisbon
9. Wien-Nantes
10. London-Berlin
11. Amsterdam-Milan
12. Amsterdam-Utrecht

Fig. 10.1. Relevant European inter-urban corridors

Each corridor route is identified on the basis of the main road infrastructure (first motorway, otherwise highway; see Figure 10.1). Figure 10.1 also shows that corridors can be subdivided into shorter segments connecting two relevant nodes along the route.

Based on the analysis of the corridor segments and the related nodes within corridors, it is also possible to make some observations on regional interactions and relevant nodes on the network (see Table 10.2). Firstly, three important 'hubs' in the regional interactions emerge: the Baden-Wurtemberg region (around Stuttgart) expanding towards the North (Nordrhein-Westphalia and West-Netherlands) and the South (Bavaria and North Italy), the Nord-Pas-de-Calais region linking England to the European continent, and the French Centre-East region interacting with the Paris region, Spain and the North of Italy.

As regards the nodes (36) identified on the network, Stuttgart and Frankfurt are those with the greatest number of inter-urban links (they are crossed by 6 and 5 corridors respectively), confirming the hypothesis that the German axis is one of most strategic axes in the European mobility system, both in the centre/centre-periphery interaction and in a North-South/East-West direction.

These two nodes are followed by a series of nodes which are crossed by four corridors. They are: Amsterdam (which mainly emerges as a terminal point of three important inter-urban corridors, viz. Amsterdam-Madrid in North/South-West direction, Amsterdam-Milan in North/South direction and

Amsterdam-Athens in North/South-East direction), Cologne and Munich (which form the strongest axis in Germany) and Verona and Lyon, (whose main characteristic is to act as an important crossroad for North/South and East/West movements).

By considering the nodes which are crossed by up to three corridors, it is possible to gain strategic insights into the relevant axes in Europe. In fact, three other main inter-urban links emerge, notably the triangle London-Brussels-Paris, the Spanish axis between Barcelona and Madrid, and the Italian Adriatic axis to Greece (in particular, the corridor 'Aosta-Athens'; see Figure 10.2). Finally, the nodes of Rotterdam, Strasbourg, Milan and Torino serve a number of corridors at a minor level, despite their seemingly central position. It is interesting to note that the above classification of nodes also reflects the so-called European pentagon model conceived by Nakicenovic (1992), which regards as the core of Europe the socio-economic and traffic network among the five centres of Amsterdam, London, Paris, Milan and Berlin.

This qualitative analysis of corridors will be the basis for a more detailed investigation of the main differences and similarities of the corridors in order to construct a European typology in light of potential ATT applications (see Sections 10.4 and 10.5). A further examination and interpretation of the related data will be the subject of the next section.

Fig. 10.2. The corridor Aosta-Athens

Table 10.1. Corridor basic attributes

Corridors	Length	Relevant Nodes	Crossed Regions(*)
Amsterdam-Utrecht	40	Amsterdam, Utrecht	NL3
Amsterdam-Milan	1200	Amsterdam, Koln, Frankfurt, Stuttgart, Strasbourg, Basel, Milan	NL3,NL4,GE5,GE6 GE8,SW1,IT2
London-Berlin	1300	London, Calais Brussels, Frankfurt,	UK5,FR3,BE1,BE2 BE3,GE5,GE6
Rotterdam-Verona	1200	Rotterdam, Koln, Frankfurt, Stuttgart, Munich, Verona	NL3,NL2,GE5,GE6 GE8,GE9,AUS,IT3
London-Athens	2350	London, Calais, Brussels, Koln, Frankfurt, Stuttgart Munich, Verona, Bologna, Brindisi, Patra Athens	UK5,FR3,BE1,BE2 GE5,GE6,GE8,GE9 AUS,SWi,IT3,IT4 IT5,IT8,IT9 GR2
Amsterdam-Athens	2300	Amsterdam, Koln, Frankfurt, Stuttgart, Munich, Verona, Bologna, Brindisi, Patra, Athens	NL2,NL3,GE5,GE6 GE8,GE9,AUS,SWI IT3,IT4,IT5,IT8 IT9,GR2
Glasgow-Marseille	1700	Glasgow, Manchester London, Calais, Paris Lyon, Marseille	UK10,UK1,UK8,UK7 UK5,FR3,FR1,FR2 FR7,FR8
Amsterdam-Madrid	2250	Amsterdam, Rotterdam Brussels, Paris, Lyon Barcelona, Madrid	NL3,NL2,BE1,BE3 FR7,FR8,SP5,SP2 SP4,SP3
Aosta-Athens	1350	Aosta, Torino, Bologna, Brindisi, Patra, Athens	IT2,IT4,IT5,IT8 IT9,GR2
Vienna-Nantes	1600	Vienna, Munich, Stuttgart, Strasbourg, Paris, Nantes	FR5,FR2,FR1,FR4 GE8,GE9
Trieste-Lisbon	2800	Trieste, Venice, Verona Milan, Torino, Lyon, Barcelon, Madrid, Lisbon	PO2,SP3,SP4,SP2 SP5,FR8,FR7,IT1 IT2,IT3
Stuttgart-Madrid	1900	Stuttgart, Zurich, Geneva, Lyon Barcelona, Madrid	GE8,AUS,FR7 FR8,SP5,SP2,SP4 SP3

Legend:

AUS Austria	GE5 Nordrhein-Westfale	IT7 Campania	SP5 Este
BE1 Vlaams Gewest	GE6 Hessen	IT8 Abruzzi-Molise	SP6 Sur
BE2 Region Wallonne	GE7 Rheinland-Pfalz	IT9 Sud	SP7 Canarias
BE3 Bruxelles	GE8 Baden-Wurtemberg	IT10 Sicilia	SWI Switzerland
DK Danimarca	GE9 Bayern	IT11 Sardegna	UK1 North
FR1 Ile-de-France	GE10 Saarland	L Lussemburgo (GD)	UK2 Yorkshire-Humbers
FR2 Bassin Parisien	GE11 Berlin West	NL1 Noord Nederland	UK3 East Midlands
FR3 Nord-Pas-de-Calais	GR1 Voreia	NL2 Oost Nederland	UK4 East Anglia
FR4 Est	GR2 Kentrike	NL3 West Nederland	UK5 South-East
FR5 Ouest	GR3 Anatolia E Nord	NL4 Zuid Nederland	UK6 South-West
FR6 Sud-Ouest	IR Irlanda	P01 Nord	UK7 West Midlands
FR7 Centre-Est	IT1 Nord-Ovest	PO2 Sud	UK8 North-West
FR8 Mediterranee	IT2 Lombardia	P03 Isole	UK9 Wales
GE1 Schleswig-Holstein	IT3 Nord-Est	SP1 Noroeste	UK10 Scotland
GE2 Hambourg	IT4 Emilia-Romagna	SP2 Noreste	UK11 Northern Ireland
GE3 Niedersachsen	IT5 Centro	SP3 Madrid	
GE4 Bremen	IT6 Lazio	SP4 Centro	

* The regional disaggregations is based on the nomenclature of territorial units for statics (NUTS I level according to the Eurostat regional statistics)

Table 10.2. Frequency analysis for the nodes

Nodes	Number of Corridors	Corridors Identified (*)
Stuttgart	6	AMS-MIL; ROT-VER, LON-ATH- AMS-ATH, VIE-NAN- STU-MAD
Frankfurt	5	AMS-MIL; LON-BER; ROT-VER, LON-ATH, AMS-ATH
Amsterdam	4	AMS-UTR, AMS-MIL, AMS-ATH; AMS-MAD
Koln	4	AMS-MIL- ROT-VER- LON-ATH- AMS-ATH
Lyon	4	GLA-MAR- AMS-MAD- TRI-LIS, STU-MAD
Munich	4	ROT-VER, LON-ATH; AMS-ATH; VIE-NAN
Verona	4	ROT-VER, LON-ATH; AMS-ATH; TRI-LIS
Brussels	3	LON-ATH; LON-BER; AMS-MAD
Calais	3	LON-BER- LON-ATH- GLA-MAR
London	3	LON-BER, LON-ATH, GLA-MAR
Paris	3	GLA-MAR; VIE-NAN- AMS-MAD
Barcelona	3	AMS-MAD, TRI-LIS, STU-MAD
Madrid	3	AMS-MAD- TRI-LIS- STU-MAD
Bologna	3	LON-ATH; AMS-ATH; AOS-ATH
Brindisi	3	LON-ATH; AMS-ATH; AOS-ATH
Patra	3	LON-ATH; AMS-ATH; AOS-ATH
Athens	3	LON-ATH; AMS-ATH; AOS-ATH
Rotterdam	2	ROT-VER- AMS-MAD
Strasbourg	2	AMS-MIL; VIE-NAN
Milan	2	AMS-MIL- AOS-ATH
Torino	2	AOS-ATH, TRI-LIS
Aosta	I	AOS-ATH
Basel	I	AMS-MIL
Berlin	I	LON-BER
Dresden	I	LON-BER
Geneve	I	STU-MAD
Glasgow	I	GLA-MAR
Lisbon	I	TRI-LIS
Manchester	I	GLA-MAR
Marseille	I	GLA-MAR
Nantes	I	VIE-NAN
Trieste	I	TRI-LIS
Utrecht	I	AMS-UTR
Venice	I	TRI-LIS
Vienna	I	VIE-NAN
Zurich	I	STU-MAD

(*)In the sequel, the first three letters of the names of the terminal nodes are used as a code for each corridor

10.3 Selection of Corridor Attributes: Data Base and Interpretation

10.3.1 The Selection of Attributes

In order to study the differences in the potential ATT impact as a result of different corridor contexts (defined by a given corridor typology), a first step is the construction of the 'states' of the corridors, i.e. the main categories of criteria necessary for identifying the characteristics of an inter-urban corridor consistent with the objective of assessing the ATT potential. Thus, these 'states' of the corridors are characterized by relevant variables (or corridor features) in light of a possible ATT introduction. In particular, we have taken into account the threefold ATT potential effect on:

- the mobility system's efficiency, particularly with regard to lower management costs and use by operators, and to new network services and capacities, etc.;
- network reliability, with regard to better safety and information and service levels for users;
- environmental quality, particularly with regard to pollution reduction.

From these features, a (preliminary) list of interesting 'states' of the corridors can be derived. These can be expressed in a qualitative sense as follows:

- *socio-economic conditions* (within the regions crossed) which refer to different mobility patterns and, as a consequence, to different needs in terms of ATT functions as well as to different behavioural responses;
- *geographical position* (in other words, the comparative locational advantage or the strategic network position of the corridor) which is useful to capture its strategic importance¹ and its effective function;
- *corridor management*, which deals with the organizational/managerial perspective of the network corridor at hand. It tries to mirror the level of the infrastructure supply as well as the degree of complexity of such management. This concept indicates that the different degrees of interrelation/cooperation among transport operators along the corridors, the different complexities of infrastructural management, the different numbers of managers in infrastructural administration, the different operative strategies adopted and, finally, the different levels of technological innovation already achieved, do influence the ATT impact on that particular corridor;
- *traffic conditions*, with particular reference to (i) the degree of congestion (i.e., the identification of bottlenecks along the corridors generated by an insufficient supply of infrastructure or by an excess of demand) including its impact on corridor management efficiency and on user costs; (ii) safety (reliability or accident rates on the corridor), which will impact on the social (direct or indirect) benefits linked to the introduction of ATT;

¹The strategic network position may be described in relation to the various functions offered by the corridor, like internal integration, interregional exchange or regional crossing (transit).

- *environmental quality* (acoustic or air pollution), which appears to be one of the principal incentives for implementing ATT.

Tentative assessments of the association between 'states' of the corridors and the potential impacts of ATT are given in Table 10.3 (for details on the various kinds of potential impacts of ATT see Nijkamp et al, 1993).

On the basis of the above considerations, appropriate data will be selected on specific indicators to be outlined in the next subsection.

Table 10.3. Exploratory relationships between the state of the corridors and the potential impacts of ATT.

socio-econ. conditions			geographical conditions			corridor manageme- ment			traffic conditions: congestion			traffic condition: safety			environm. quality		
LO	ME	HI	C	SP	P	LO	ME	HI	LO	ME	HI	LO	ME	HI	LO	ME	I
+++	++	+	+	++	+++	0	+++	+	0	+++	+	+++	++	+	+++	++	+

Legend:

LO, ME, HI = low, medium/high and very high performance levels of corridors, respectively
C, SP, P = central, semi-peripheral and peripheral locational conditions, respectively
0 = negligible impact
+ ++ +++ = increasing impact levels (in terms of positive performance)

10.3.2 The Data Matrix

In this subsection, the corridor characteristics needed for the construction of an inter-urban corridor typology will be presented. In total, 19 different features are considered. As mentioned before, they may be regarded as factors influencing potential impacts of ATT in terms of user benefits, efficiency, safety and environmental quality. The classification of these features is based on the five categories discussed in Subsection 10.3.1.

This leads to a series of variables whose characteristics (source, year and unit of measurement) are contained in Table 10.4.

Most of the indicators used concern measurable variables. Many of them are taken from Eurostat Regional Statistics, in which extended definitions can be found. Details on the specific data can be found in Nijkamp et al, (1993) and Reggiani et al (1994).

10.4 Comparison of Corridors: Common Elements and Differences Relative to Potential ATT Applications

As indicated in the previous sections, the selected attributes of corridors contain relevant information on the potential impact of ATT applications. In this section the main differences/similarities will be examined in order to show the main characteristics of the selected inter-urban corridors and to identify preliminary categories and classifications of such corridors.

Table 10.4. List of features for the corridor typology with source, year and unit of measurement

Variable	Source	Year	Unit of Measurement
<i>Socio-economic</i>			
1 population density	Eurostat	1985	habitants per km ²
2 (Total) GVAMP (*)	Eurostat	1984	ECU per habitant
3 GVAMP of industrial sectors	Eurostat	1984	ECU per habitant
4 GVAMP of market services	Eurostat	1984	ECU per habitant
5 employment	Eurostat	1984	employment places per km ²
6 employment in industrial branches	Eurostat	1984	employment places per km ²
7 employment in market service branches	Eurostat	1984	employment places per km ²
8 stock of dwellings	Eurostat	1985	dwellings per km ²
<i>Locational</i>			
9 large agglomerations on corridor	-	1992	number of large agglomerations on corridor
10 crossed EC member states	-	1992	number of national borders crossed by corridor
<i>Infrastructural</i>			
11 motorway density	Eurostat	1985	length of motorway(km)per km ²
12 accessibility of crossed	Keeble	1982	accessibility index, see explanation zones
<i>Traffic demand</i>			
13 private car ownership	Eurostat	1985	private owned cars per km ²
14 road traffic accidents	Eurostat	1985	motor vehicle traffic accidents per km ²
15 vehicle flows	NEA	1985	passing vehicles in yearly daily averages
16 growth of vehicle flows	NEA	1985	relative growth of vehicle flows between 1980 and 1985
17 heavy vehicle flows	NEA	1985	share of heavy vehicles
18 traffic flow smoothness	NEA	1985	level of service, see explanation
<i>Environmental</i>			
19 NOx pollutions	Europe 2000 (CEC)	1985 per year	NOx pollution in tons per km ²

(*) GVAMP: gross value added at market prices.

From the point of view of 'socio-economic' attributes (see Figures 10.3 and 10.4), a subdivision between central (C) and peripheral (P) European regions immediately emerges. In particular, it can be noted that by shifting from the European peripheral regions towards the central ones (in other words, moving from the corridors connecting the centre-periphery towards the corridors joining central nodes in Europe), the residential density increases as well as the service share in total employment.

Fig. 10.3. Residential density (1987) (Habitants per km2)

Fig. 10.4. Industrial products versus market service employment density (1987)

In addition, by considering only the centre-periphery corridors, differences in the residential density appear, since those in the North-South direction have an intermediate level of residential density with respect to those in the East-West direction (which show a low value).

Fig. 10.5. Motorway density versus accessibility index

As a consequence, from these different combinations of socio-economic attributes *different needs*, both in terms of mobility and of specific ATT implementations, as well as *different reactions* of potential users are likely to emerge. The differences in mobility (in terms of both the functioning of the system and the user needs) are confirmed by considering the *infrastructure supply side* (see Figure 10.5). In particular, Figure 10.5 shows, on the basis of the motorway density, the emergence of a two-fold classification, viz. central corridors and peripheral corridors, while on the basis of an indicator of accessibility (which reflects the different effects of dominance and dependence among the regions) a further subdivision between quasi-peripheral and peripheral corridors appears. This is mirrored by a high, medium and low supply of infrastructure.

By combining *transport supply and socio-economic attributes*, a classification emerges based mainly on the *geographical position* of the corridors with respect to the 'core' of Europe.

With reference to the *transport demand attributes*, it is possible to identify the same type of classification which mainly reflects the different congestion situations. In particular, by investigating Figures 10.6 and 10.7 we can see that the peripheral corridors are characterized by a low accessibility index as well as a low value of traffic flows. Next, by considering the level of services related to traffic flows and the share of freight transport on total flows (see Figures 10.8 and 10.9, respectively) again the peripheral corridors appear to be clustered and clearly separated from the other central corridors.

Fig. 10.6. Accessibility index (1988) versus total emission of NOx (1985)

Fig. 10.7. Traffic flows (1985) versus traffic growth rate (1980-1985)

Fig. 10.8. Level of service (1985) versus traffic flows (1985) (in 1000 veh./day) on corridors

Fig. 10.9. Share of freight transport on total flows (1985)

All this information can be visualized in comprehensive diagrams (see Figures 10.10, 10.11, 10.12 and 10.13), where the role of the Aosta-Athens axis can be clearly identified in comparison with the other corridors.

Fig. 10.10. Total traffic flows

Fig. 10.11. Level of service along the segments

Fig. 10.12. Share of freight transport on total flows

Fig. 10.13. Traffic growth rate (1980-1985)

In conclusion, on the basis of the above diagrams reflecting strategic information on socio-economic, transport supply and transport demand attributes, two main categories of European corridors emerge:

a) Central corridors:

- Amsterdam-Utrecht
- Amsterdam-Milan
- Rotterdam-Verona
- London-Berlin
- London-Athens
- Amsterdam-Athens

They are characterized by a high infrastructural density and accessibility degree, but are clearly insufficient in satisfying the total traffic flows (as witnessed by the high congestion level and pollution emission);

b) (Quasi)/Peripheral corridors:

- Aosta-Athens
- Glasgow-Marseille
- Amsterdam-Madrid
- Stuttgart-Madrid
- Trieste-Lisbon
- Vienna-Nantes

The axes are characterized by a medium congestion level and a low accessibility, and hence show the necessity of more infrastructural investment in order to avoid a rapid increase of congestion.

It should be noted that the above two-fold classification can be verified by means of a further analysis on interdependencies among the attributes, based on a Multi-criteria approach. This analysis will be presented in the next section. However, from our first examination it seems plausible that for each of the two groups of corridors, significant differences in both the potential of ATT introduction (as well as of other European resolutions) and the related behavioural responses are likely to emerge.

10.5 A Two-Fold Classification of Inter-Urban Corridors by Means of Multicriteria Analysis

10.5.1 The Methodology Adopted

In the previous section we have shown how the investigation of the corridors on the basis of the data collected has led to a preliminary typology, clustering the corridors into two main 'structural' groups (central and peripheral corridors). The above typology derives from the analysis of two-dimensional diagrams connecting the following types of variables for the corridors:

- a) Socio-economic attributes
- b) Transport supply attributes
- c) Transport demand attributes

However, it should be noted that all these indicators constitute a *multi-dimensional profile* of the corridors which provides different aspects of the role of the corridors in relation to the potential introduction of ATT. This implies that the corridors can also be valued by a multi-attribute utility approach, by considering the previous attributes a), b), c) as a basis for a comprehensive evaluation of the corridors.

In this context, a multidimensional approach such as Multicriteria Analysis (MCA) is suitable for designing a ranking scheme of corridors in relation to their 'compound value', determined by the interdependencies of the various attributes.

Table 10.5. Criteria used in the multicriteria analysis

a. Socio-economic profile	c. Transport-demand profile
a1 Population density	c1 Private car ownership
a2 (Total)GVAMP (*)	c2 Road traffic accidents
a3 GVAMP of industrial sectors	c3 NOx pollutions
a4 GVAMP of market services	c4 Vehicles flows
a5 Employment	c5 Growth of vehicle flows
a6 Industrial branches employment	c6 Heavy vehicle flows
a7 Market services br. employment	c7 Traffic flows smoothness
a8 Stock of dwellings	
b. Transport-supply profile	
b1 Motorway density	
b2 Accessibility of cities	
b3 Large agglomeration on corridor	
b4 Crossed EC member states	

(*) GVAMP = Gross value added at market prices

MCA has become a popular tool in policy evaluation studies in many countries (see, e.g., Nijkamp, 1979 and Nijkamp et al, 1990), not only in the case of 'hard' (quantitative) information but also in the case of 'soft' (qualitative) information. In this framework, a suitable multiple criteria method, viz. the 'Regime Method' meeting methodological soundness, mathematical and statistical accessibility and easy computer use (Hinloopen et al, 1983; Hinloopen and Nijkamp, 1990) has been used in the present study. In our investigation, we assume *three main evaluation criteria*, viz. the Socio-Economic Profile, the Transport Supply Profile and the Transport Demand Profile. Each of these main judgment profiles is composed of observable criteria or attributes, based on the data collected, as shown in Table 10.5. Nineteen indicators, grouped in the three main criteria categories, are used here. The resulting impact matrix is shown in Table 10.6.

The application of the Regime Method is based here on five different scenarios, A, B, C, D and E, approximated by five different weight sets. Table 10.7 shows for each of these five scenarios an ordinal ranking of attributes according to their expected relevance, utilized in the MCA.

Table 10.6. The impact matrix

	Socio-Economic Profile								Transport Supply Profile			
	a1	a2	a3	a4	a5	a6	a7	a8	b1	b2	b3	b4
Amsterdam-Utrecht	12	8	6	11	12	10	12	12	12	10	1	1
Amsterdam-Milan	11	12	11	12	10	11	10	11	11	12	6	10
London-Berlin	10	9	8	8	11	12	11	10	10	11	2	9
Rotterdam-Verona	9	10	12	9	9	9	9	9	9	9	5	6
Amsterdam-Athens	7	6	9	5	7	7	6	7	7	4	11	11
London-Athens	8	5	7	6	8	8	8	8	8	7	12	12
Glasgow-Marseilles	6	7	5	7	6	5	7	6	4	6	8	2
Amsterdam-Madrid	3	4	3	4	3	4	4	3	3	5	9	5
Aosta-Athens	5	1	1	1	4	3	3	4	5	3	3	3
Trieste-Lisbon	2	2	2	3	2	2	2	2	2	2	10	7
Stuttgart-Madrid	1	3	4	2	1	1	1	1	1	1	4	8
Vienna-Nantes	4	11	10	10	5	6	5	5	6	8	7	4

	Transport Demand Profile						
	c1	c2	c3	c4	c5	c6	c7
Amsterdam-Utrecht	12	12	12	12	1	2	12
Amsterdam-Milan	11	10	10	11	3	1	10
London-Berlin	10	11	11	8	4	5	4
Rotterdam-Verona	9	4	9	10	2	4	11
Amsterdam-Athens	7	6	7	6	11	8	9
London-Athens	8	9	8	5	10	7	8
Glasgow-Marseille	6	7	6	9	9	11	6
Amsterdam-Madrid	3	5	4	7	7	10	5
Aosta-Athens	4	8	3	3	12	12	7
Trieste-Lisbon	2	3	2	2	5	9	2
Stuttgart-Madrid	1	1	1	4	8	6	3
Vienna-Nantes	5	2	5	1	6	3	1

Table 10.7. Ordinal ranking of the attributes for five scenario sets A, B, C, D and E

Scenario A	c7 c4 c5 c6 b3 b4 c3 b1 c2 b2 c1 a1 a8 a2 a5 a3 a4 a6 a7
Scenario B	a7 a6 a4 a3 a5 a2 a8 a1 c1 b2 c2 b1 c3 b4 b3 c6 c5 c4 c7
Scenario C	c4 c3 c7 c5 c6 c2 c1 b2 b4 b3 b1
Scenario D	b1 b3 b4 b2 c1 c2 c6 c5 c7 c3 c4
Scenario E	a1 a8 a2 a5 a3 a4 a6 a7

In the scenarios A and B, priority is given to attributes related to the 'traffic' criteria (both supply and demand) and to 'socio-economic' criteria, respectively. In the scenarios C and D the 'socio-economic' criteria are not taken into account, so that the corridors can be classified only in the context of transport characteristics. In scenario C more weight is given to the 'demand-side' attributes, in scenario D to 'supply-side' attributes. Finally, in scenario E priority is only given to socio-economic data, in order to evaluate the relationship between 'transport data' and 'socio-economic' characteristics. For each scenario a Regime analysis is carried out. The results are discussed in the next subsection.

10.5.2 Results and Conclusions

The results of the MCA (by applying a Regime Method) within the framework of the 'complex' evaluation of twelve European inter-urban corridors for the ATT introduction are presented in Table 10.8.

Table 10.8. The results of multicriteria analysis

A	B	C	D	E
Amsterdam-Utrecht Amsterdam-Milan London-Berlin Rotterdam-Verona London-Athens Amsterdam-Athens	Amsterdam-Utrecht Amsterdam-Milan London-Berlin Rotterdam-Verona London-Athens Amsterdam-Athens	Amsterdam-Utrecht Amsterdam-Milan London-Berlin Rotterdam-Verona London-Athens Amsterdam-Athens	Amsterdam-Milan London-Berlin Amsterdam-Utrecht London-Athens Amsterdam-Athens Rotterdam-Verona	Amsterdam-Utrecht Amsterdam-Milan London-Berlin Rotterdam-Verona London-Athens Amsterdam-Athens
Glasgow-Marseille Aosta-Athens Amsterdam-Madrid Vienna-Nantes Trieste-Lisbon Stuttgart-Madrid	Glasgow-Marseille Vienna-Nantes Amsterdam-Madrid Aosta-Athens Trieste-Lisbon Stuttgart-Madrid	Glasgow-Marseille Aosta-Athens Amsterdam-Madrid Trieste-Lisbon Stuttgart-Madrid Vienna-Nantes	Glasgow-Marseille Aosta-Athens Amsterdam-Madrid Vienna-Nantes Trieste-Lisbon Stuttgart-Madrid	Glasgow-Marseille Vienna-Nantes Aosta-Athens Amsterdam-Madrid Trieste-Lisbon Stuttgart-Madrid

From these results we can draw the conclusion that the *two-fold classification constructed in Section 10.4 seems fairly robust when confronted with changes in the scenarios: this is also the case for the MCA results*. In other words, our Multicriteria analysis displays the highest scores for the central group of corridors in light of relevant 'socio-economic and traffic' aspects. Thus, again a clear subdivision between central and (quasi-)peripheral corridors appears to emerge. It should be emphasized here that the rationale behind the definition of such a classification is the hypothesis that *differences in the impact of the corridors with ATT introduction are dependent upon hierarchical levels based on 'socio-economic and traffic' characteristics*.

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