Feasibility of a high-speed railway network on the main corridors of the countries recently incorporated into the European Union

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Synopsis

Over the last two decades railways have made important efforts among the EU-15 countries to improve the quality of daytime inter-city train services. In particular, this effort has been devoted to the construction of new infrastructure suitable for high speed traffic.

The incorporation of new countries into the European Union to constitute the EU-25 allows us to consider the convenience of approaching the railway policy in the CEEC (Central and Eastern European Countries) space in a similar way to the policies carried out in the EU-15.

The paper analyses the experience available, synthesizes the guidelines used in the EU-15 countries and applies them to the countries that have recently joined the European Union to form the EU-25.

The conclusion of the research, carried out by the authors at the Center for Innovation in Transport (CENIT) during the year 2004, warns of the risks of a direct extrapolation of the EU-15 countries' experience to the Central and Eastern European Countries.

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Transport needs have constantly increased since the last century. High-speed railways in the western countries of the European Union have demonstrated their capacity to respond to these needs from an efficient and sustainable perspective. The incorporation of 10 central and eastern European countries to form the EU-25 in 2004 has called into question the convenience of the development of high-speed rail networks.

OBJECTIVES AND SCOPE

This paper is based on a study carried out for the International Union of Railways (UIC), whose title, "L'opportunité pour la grand vitesse dans l'espace PECO", sums up the crossroads at which the railway currently stands in the countries of Central and Eastern Europe, due to the deterioration of the railway infrastructure, the gradual loss of market share, and the opportunity which their incorporation into the European Union presents.

In fact, the railway in the CEEC countries has an incredible potential thanks to the magnitude of the existing network, as well as the relative lack of adequate road infrastructures. However, in most of the countries included in this study, the railway is immersed in a process of evident decline. Figure 1 shows the overall reduction in the number of passengers-km transported in the period 1997-2001 in most of these countries. The total reduction in traffic in the area comprising Bulgaria, the Czech Republic, Hungary, Poland, Slovenia, Slovakia and Rumania is 14%, which is equivalent to an average annual reduction of 3,3%. However, it is worth mentioning the particular case of Hungary, where passenger traffic has increased considerably.

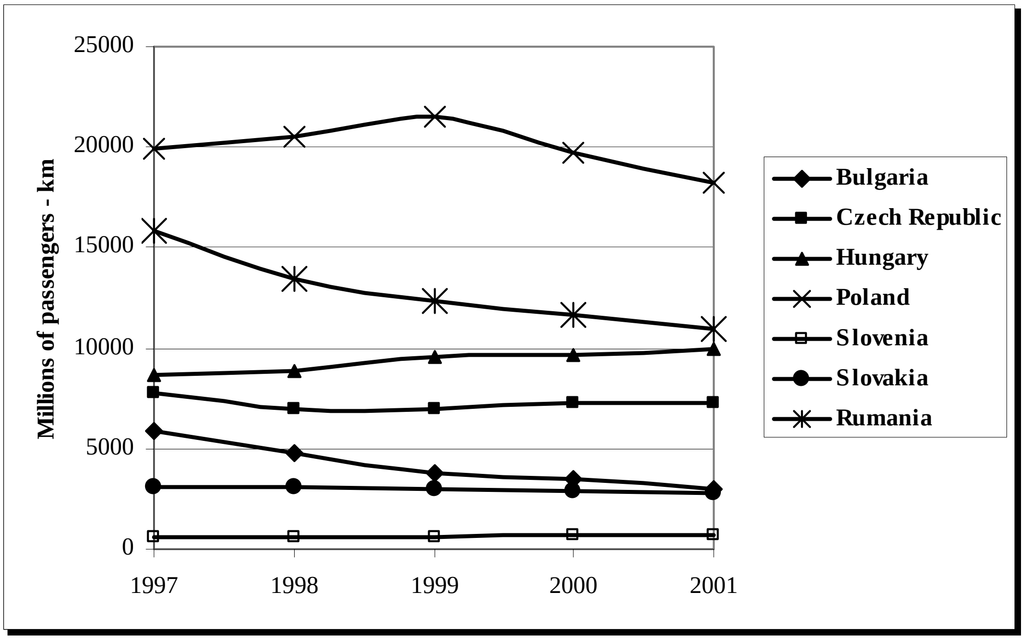

Figure 1: Evolution of passenger traffic in the period 1997-2001. Source: Independently produced with Eurostat data, 2003.

In short, the general railway panorama in the CEEC countries shows us a dense railway network in poor condition, with low running speeds and a clearly deteriorated rolling stock. In general, the railway is undergoing a steady decline (similar to that which occurred in Western Europe, from the middle of the 20th century until the appearance of the high-speed railway) which has manifested itself in a reduction in the length of the rail network (table 1) and the loss of market share, mainly in comparison with road transport.

Table 1: Development of length of infrastructure in the 1990s (km)

Country	Railway			Motorway		
	1990	1999	Change 1999 to 1990 (%)	1990	1999	Change 1999 to 1990 (%)
Bulgaria	4299	4290	-0,2	273	324	18,7
Czech Republic	9451	9444	-0,1	357	499	39,8
Hungary	7772	7642	-1,7	267	448	67,8
Poland	26228	22891	-12,7	257	268	4,3
Romania	11348	10981	-3,2	113	113	0,0
Slovakia	3660	3665	0,1	192	295	53,6
Slovenia	1196	1201	0,4	228	399	75,0

Source: CE, IWW, ME&P, TRT, TNO INRO and NOBE (2004).

As was also the case in Western Europe, the construction of high-speed railway lines seems to be the only possible solution to prevent the further decline of the railway in Central and Eastern Europe. However, planning a high-speed rail network requires carrying out costly traffic studies, the accurate evaluation of investments and, in general, the evaluation of the socio-economic and financial profitability of the investments based on the usual indicators.

In this context, the aim of the work carried out did not lie in carrying out a socio-economic and financial analysis of the profitability of constructing and commissioning a high-speed rail service, but in the development of a simplified methodology (based on the experience acquired over the last 25 years in the high-speed rail network in Western Europe) which could contribute to the strategic planning of a high-speed network in the countries of Central and Eastern Europe.

Once the methodology has been established, its application makes it possible to determine which corridors have a reasonable potential for railway high-speed and, therefore, to determine which corridors require the most costly and detailed studies, with the aim of specifying the actions that need to be taken and their profitability.

EXPERIENCE IN RELATION TO THE HIGH-SPEED LINES OF WESTERN EUROPE

The existing experience in Western Europe in relation to planning, developing and operating a high-speed rail network has highlighted the fact that there are basically four strategic aspects which determine the convenience of constructing a high-speed line:

- Total demand on the corridor
- Investment
- Increase in railway traffic
- Reduction of journey time.

By analysing these aspects, we can define a methodology based on the most significant indicators that can be deduced.

Total demand on the corridor

Analysis of the introduction of high-speed services on a specific corridor in a Western European country has highlighted the following aspects, among others:

1. Due to the large investment required for constructing a new high-speed railway infrastructure, it is only possible to obtain positive results in terms of social and economic profitability in corridors with a heavy demand for traffic.
2. The biggest market share for high-speed trains corresponds to corridors where the railway journey time is between 2 hours and 2 hours 30 minutes.
3. The profitability of a corridor can be improved by operating high-speed regional services if the existence of attractive intermediate routes makes it viable to do so.
4. The existence of an “induced demand” due to a network effect.

In order to make an initial selection of the corridors which could be of interest from a high-speed point of view, a specific methodology has been devised. This methodology is based on the gravitational model, according to which the traffic between two geographical areas can be expressed by the following formula:

$$T_{ij} = \frac{k \cdot P_i \cdot P_j \cdot W_i \cdot W_j}{Cg_{ij}^{r}} \quad (1)$$

Where

Pi and Pj: respective populations of the two geographical areas
Wi and Wj: indices of wealth according to purchasing power parity (they indicate the population's tendency to consume and, consequently, to travel).
Cgij: generalized cost of the considered mode of transport between areas i and j.
r: elasticity of traffic at the generalized cost.
k: adjustment parameter. (asT_{ij} is calculated as an index to compare relations, it is taken that k=1)

In this formula, the numerator includes the factors of attraction and the denominator those of repulsion or resistance.

A detailed study of the traffic forecast for each mode of transport requires a precise specification of both its generalized cost and the elasticity of the traffic at this generalized cost. The preceding analysis, in particular the formula (1), allows us to deduce that priority should be given to the following aspects (in the absence of line capacity problems) when selecting corridors:

1. The populations affected by the new line.
2. The wealth index.
3. The journey time.

In fact, the first two aspects allow us to establish the potential of the corridor in terms of mobility in general. However, the journey time (as well as its frequency and cost in a more detailed analysis) is the main indicator of the convenience of the high-speed railway for passenger transport.

The application of this methodology to the existing high-speed lines in Western Europe reveals that for corridors whose journey time is less than 1 hour and 15 minutes, the Traffic Index varies between 700 and 1400, and for corridors with a journey time of over 1 hour and 15 minutes, the Traffic Index varies between 40 and 500. This distinction is important, given that the indicator depends on the square of the journey time. Consequently, the high-speed railway corridors with journey times of around 1 hour have a very high traffic potential, especially in comparison with air transport.

Investment

The necessary investments for the construction and commissioning of a high-speed line can be divided into two main items: on the one hand, the construction of the line and, on the other, the purchase of the rolling stock for its operation.

The construction and remodelling of railway stations must also be included, as must the construction of maintenance centres and the purchase of the necessary maintenance materials (for maintaining both the lines and the trains).

Despite that fact that all these costs carry a considerable specific weight within the total investment, we will assume that the cost of constructing the high-speed line is the most important item of the investment.

In relation to this particular cost, experience shows that it varies considerably according to various factors, especially:

- Topography
- Geometric characteristics of the line (gradients, radii of the curves)
- Tunnels and bridges/viaducts
- Environmental protection actions

It should be emphasised that once the geometric characteristics of the line have been established, the most important aspect is the topography (given that it determines the number of tunnels and bridges/viaducts that will need to be built).

In fact, the proportion of tunnels and bridges/viaducts in relation to the total km of line is the key determining factor in the cost of the line. However, all the factors are interrelated. For example, constructing a high-speed line in densely populated areas necessarily involves building a very long tunnel, which obviously gives rise to extra costs that cannot be attributed to a complicated orography.

Likewise, construction costs are clearly influenced by labour costs, which are far from equal in the different countries. In fact, the differences in table 2 cannot be explained solely by the different proportion of tunnels and bridges/viaducts of the different lines. For example, the Mediterranean LGV line (Valencia – Marseilles) is much more expensive than the Madrid – Lleida line despite the number of tunnel and viaduct km being approximately only 1% higher. However, besides the labour cost differences between France and Spain, it should be pointed out that the French line includes the construction of three new stations, as well as the renovation of an existing station.

Table 2: Influence of the different aspects of the line on the cost of the infrastructure

LINE	% tunnel	% bridges and viaducts	% total	% environment	Minimum radius (m)	Max. gradient (mm/m)	Cost per km (106)
Madrid – Lleida	5,4	5,8	11,2	-	7.000	25	10
Lleida – Barcelone	-	-	-	-	7.000	25	10,5
Aéroport de Saint Exupéry – Sillon Alpin	21,25	6,25	27,5	-	-	-	24,2
Valence – Marseille	5,1	6,8	11,9	22% 3,9 M€/km	7.000	35	17,7
Tunnel de Guadarrama	100	0	100	-	-	-	20,7

Source: CENIT (2004).

Furthermore, environmental protection actions are increasingly important. This is why costs relating to the reduction of environmental impact have risen from 6% in the case of the Paris-Lyon high-speed line (1981/83) to 22% on the Mediterranean high-speed line (2001).

In short, there are many different aspects, such as topography, the geometric characteristics of the lines, the proportion of tunnels and bridges/viaducts, urbanization and the level of environmental sensitivity, which directly influence the cost of constructing a high-speed line.

It is very difficult to determine the importance of each one of these aspects, given that they are interrelated. However, for any given set of characteristics, the most important aspect will be the topography.

The construction costs of the first high-speed lines varied quite considerably, as can be seen in table 3. In France and Spain these costs were clearly limited, amounting to less than 6 M€/km. In Germany, however, the costs were more than three times as high. It is difficult to explain the reasons for such extraordinary differences, bearing in mind that all these lines consist of ballasted track. However, various possibilities can be suggested: very high levels of urbanization, considerable environmental sensitivity, gradients limited to 12.5 mm/m, minimum radii of around 7,000 m and higher labour costs, among others.

Table 3: Orders of magnitude of the construction costs of the first high-speed lines.

Country	Line	Minimum radius	Max. gradient	Cost per km (106 €)
Germany	Hanover - Würzburg	7.000 m	12,5 mm/m	19,7
	Mannheim - Stuttgart	7.000 m	12,5 mm/m	21
Spain	Madrid – Sevilla	4.000 m	12,5 mm/m	5,7
France	Paris – Lyon	4.000 m	35 mm/m	3,5
	TGV Atlantique	4.000 m	25 mm/m	5,7

Source: A. López Pita (2000).

In the particular case of the Madrid-Seville, Paris-Lyon and LGV Atlantique high-speed lines (table 4), the construction costs clearly correspond to the proportion of necessary tunnels and bridges/viaducts, so that in the case of similar values (Atlantique and Madrid-Seville), the resultant costs were also similar.

Table 4: Characteristics of the first high-speed lines

Line	Total length	Tunnels length (Km)	Bridges and viaducts (Km)	Tunnels (%)	Bridges and viaducts (%)	Total (%)
Madrid - Sevilla	471	15,819	9,845	3,36	2,09	5,45
Paris - Lyon	410	3,157	2,969	0,77	0,72	1,49
LGV Atlantique	280	13,043	3,068	4,66	1,10	5,75

Source:CENIT (2004).

Analysis of the construction costs of the most recently opened high-speed lines (table 5) reveals that these costs are gradually becoming more similar (in Spain, France and Germany), although considerable differences still exist. For example, the Cologne – Frankfurt line is 50% more expensive than the Valencia – Marseilles line (as opposed to the 350% difference between the construction costs of the first high-speed lines), although it should be borne in mind that the German line consists of slab track, which clearly involves a more laborious construction process.

Table 5: Orders of magnitude of the construction costs of the most recently constructed high-speed lines, updated to 2004

Country	Line	Minimum radius (m)	Max. gradient (mm/m)	Cost per km (106 €)
Germany	Köln – Frankfurt (slab track)	4.000	40	26
Spain	Madrid – Lleida	7.000	25	10
France	Valence – Marseille	7.000	35	17,7*
Belgium	Bruxelles – Frontera francesa	6.000	10	15,7
United Kingdom	Londres – Folkestone (1er tronçon)	-	-	37

Source: CENIT (2004).
* Includes the cost of renovating one station and constructing three new ones.

Owing to the idiosyncrasy of the lines and their more recent construction, the costs of the Madrid – Lleida, Valencia – Marseilles and Brussels – French border lines will be taken into account as reference values.

Table 6: : Orders of magnitude of the construction costs of the high-speed lines currently under construction or being designed, updated to 2004

Country	Line	Cost per km (10^6 €)
Germany	Nuremberg – Ingolstadt (slab track)	40,4
Spain	Lleida - Barcelone	10,5
France	Tours – Bordeaux (LGV Sud – Europe Atlantique)	11,20
	Aéroport de Saint Exupéry – Sillon Alpin (LGV Lyon – Turin Alpin)	24,2
	Variante de Nîmes et Montpellier	12
	Genlis – Lutterbach (Eastern branch of the LGV Rhine Rhône line)	10,8
	Vaires-sur-Marne – Baudrecourt (LGV Est Européen 1st phase)	11,5*
	Baudrecourt – Strasbourg (LGV Est Européen 2nd phase)	13

Source: CENIT (2004).
* Includes the cost of three new stations.

Table 7: Deviation between the initial budget and the actual budget for the construction of high-speed lines.

Project	Initial budget	Actual budget	Deviation (%)
Eurotunnel	16,8 Md€	25 Md€	48,8%
PKBA Pays-Bas	1,3 Md€	7 Md€	438,5%
West Coast Main Line	3,2 Md€	15 Md€	368,8%
Rome – Naples	2,8 Md€	4 Md€	42,8%

Source : Bernard Joly (2003).

The initial construction budgets for the lines which are currently under construction or being designed are the same as or smaller than those described above (table 6). It has been proved, however, that the envisaged costs differ considerably from the actual costs, as table 7 clearly shows. Therefore, the values corresponding to the costs of the lines which are currently under construction or being designed will be used for reference purposes, bearing in mind that they are very conservative estimates.

The synthesis of the experience available (table 8) allows us to establish a range of costs according to the topography in which the high-speed lines will be constructed. The limit values in this range are low, because the labour costs in the CEEC space are generally lower than in the countries of Western Europe.

Table 8: Order of magnitude of the construction costs of the high-speed lines in Western Europe

Topography	Range of tunnels and viaducts	Range of costs per km (10^6 €)
Flat - Slightly Uneven	Between 0 and 12%	10 to 15
Uneven	Between 12 and 25%	15 to 20
Very Uneven - Rugged	> 25%	20 to 25

Source: CENIT (2004).

On the basis of the range of costs established according to the topography, it is possible to establish the order of magnitude of the construction costs of the high-speed lines in the CEEC space.

Increase in railway traffic

The introduction of high-speed railway services on the lines in Western Europe has led to significant increases in railway traffic. The estimated increase, in relation to the hypothesis of not constructing the line, can exceed 10 million passengers per year, as in the case of the Atlantique high-speed line (table 9).

Table 9: Railway traffic on the Atlantique high-speed line

	Actual traffic in 1980	Reference traffic 2000 if TGV did not run on the line	Traffic recorded in the year 2000 (with TGV)
Atlantique high-speed lines	16.4 million passengers	15.1 million passengers	26.2 million passengers

Source: Guyard, M. (2004)

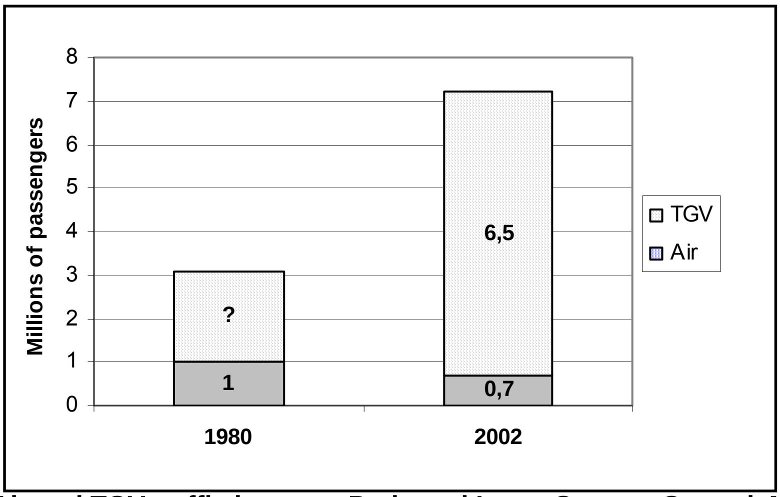

Figure 2: Air and TGV traffic between Paris and Lyon. Source: Guyard, M. (2004).

It is worth emphasising that a significant proportion of the traffic is captured from aviation (figure 2), a situation which is clearly reflected in the case of the Paris-Lyon corridor. Air traffic between Paris and Lyon stood at 1 million passengers in 1980 (the railway traffic figure is not known). Assuming the absence of the high-speed train, it can be estimated that this number of passengers would have risen to 2.2 million by the year 2002. However, the reality is that in 2002 air traffic accounted for 700,000 passengers, whereas the railway transported 6.5 million passengers (giving it, as a result, a 90% market share in relation to its competitor). It should also be mentioned that the total annual traffic on the TGV Sud-Est line is roughly 22 million passengers.

In short, experience has shown that the usual railway traffic increases resulting from the introduction of high-speed railway services vary between 1 and 10 million passengers per year. A significant proportion of these increases is due to the capture of passengers from other modes of transport, particularly the aviation, although the induced traffic is also very significant (figure 3).

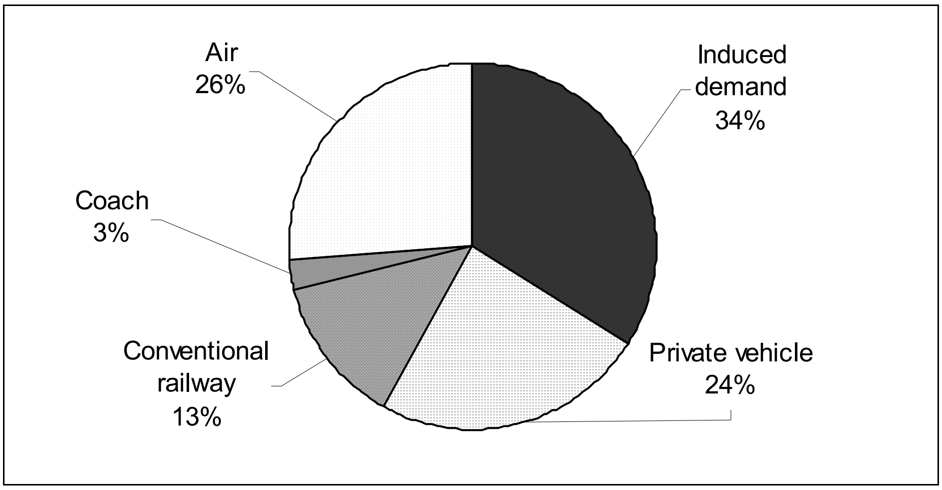

Figure 3: Origin of the demand for the Madrid-Seville AVE line. Source: RENFE.

Reduction of the journey time

With regard to the reduction of the journey time brought about by the construction of a high-speed line, it is worth pointing out that the best possible journey time between origin and destination prior to the construction of the line is usually reduced by between 40 and 60% (table 10).

Table 10: Reduction of the journey time due to the introduction of high-speed railway services

Line	Relation	Travel time without High speed line	Travel time witH High speed line	Travel time reduction (%)
TGV Sud-Est	Paris – Lyon	3h 45’	2h	46%
TGV Atlantique	Paris – Tours	1h 46’	1h 1’	42%
AVE Madrid – Sevilla	Madrid – Sevilla	6h 30’	2h 30’	61,5%
TGV Est Europénne	Paris – Strasbourg	4h	2h 20’	42%

Source: Independently produced on the basis of various sources (2005).

Besides the most significant reductions between the origin and destination of the new line, numerous routes are usually affected by the improved journey time, routes which extend to the conventional network. For example, thanks to the construction and commissioning of the TGV Est high-speed line, the journey time between Paris and Frankfurt will fall from 6h 15’ to 3h 45’.

METHODOLOGY

The proposed methodology is divided into two phases:

1. The first phase consists in determining the corridors whose potential traffic is comparable to that of the existing corridors in Western Europe, based on the Traffic Indicator described earlier (1). Comparison with the existing experience in Western Europe allows us to define which corridors offer the most potential for the construction of high-speed railway lines.

2. The second phase involves determining, for a hypothetical consolidated traffic situation, the main investment indicators. Specifically:

    - The ratio between investment and total traffic (in terms of passengers and passengers-km)
    - The ratio between investment and journey time reduction

As in the first phase, comparing the proposed indicators with the reference values in Western Europe will assist the decision-making process involved in planning a high-speed rail network in the CEEC space.

APPLICATION OF THE METHODOLOGY TO ANALYSE THE FEASIBILITY OF HIGH-SPEED RAILWAY LINES IN THE CEEC SPACE

Application of the methodology described above to the countries of Central and Eastern Europe.

Phase 1: Determining the potential of the corridors by means of the Traffic Index

The factors which must be evaluated to determine the Traffic Index are:

- Wealth index of each country (of the city of origin/destination)
- Population of the city of origin/destination
- Estimated journey time

The wealth index has been defined as the ratio of each country's GDP per capita, in terms of purchasing power parity, in relation to Portugal's (in such a way that the wealth index corresponding to Portugal is 100), data corresponding to the year 2003 has been used.

As for the evaluation of the journey time on the potential corridors in the countries and Central and Eastern Europe, it has been assumed that the high-speed lines would be designed for a maximum speed of 250 km/h. Bearing in mind that the commercial speed is approximately 80% of the maximum speed (equation 2), the commercial speed would be about 200 km/h.

$$\text{commercial speed} \approx 0{,}80\ \text{maximum speed} = 0{,}80 \cdot 250\ {}^{km}\!/_{h} = 200\ {}^{km}\!/_{h} \qquad (2)$$

The maximum speed which has been taken into consideration is clearly lower than the design speed of the new high-speed lines currently under construction in Western Europe (between 300 and 350 km/h). However, given that the distances between cities "as the crow flies" will be used, this speed should be conservative so as not to overestimate the potential of the different corridors for high-speed rail.

The evaluation of the Traffic Index for certain corridors in Central and Eastern Europe, as well as others between Western and Eastern Europe, have produced the results shown in table 11.

Table 11: Traffic Index of various national and international corridors in the CEEC space.

Relaciones nacionales	Índice de Tráfico
Warsaw – Lodz	190
Prague – Brno	53
Warsaw – Poznan	28
Warsaw – Wroclaw	23
Bucharest – Craiova	29
Bucharest – Constanza	30

Relaciones internacionales	Índice de Tráfico
Vienna – Bratislava	678
Prague – Vienna	104
Berlin – Warsaw	71
Bratislava – Budapest	57
Budapest – Belgrade	30
Budapest – Bucharest	15

Source: Independently produced (2004).

As we have already mentioned, the reference values (corresponding to the existing lines in Western Europe) are between 40 and 500 for corridors with journey times of over 1h 15' and between 700 and 1400 for corridors with journey times of less than 1h 15'.

Given that the CEEC countries have a significantly lower GDP per capita than the countries of Western Europe, albeit accompanied by higher growth rates, corridors whose minimum Traffic Index is approximately 25% of the reference index will be considered to have potential for high-speed railways:

- 10 for the corridors whose distance between origin and destination "as the crow flies" is greater than 200 km.
- 175 for the corridors whose distance between origin and destination "as the crow flies" is less than 200 km.

According to the preceding results, and bearing in mind the geographic location of the different cities, it is worth analysing the feasibility of constructing the following national corridors:

- Warsaw – Lodz – Poznan and Wroclaw
- Craiova – Bucharest – Constanza and Braila-Galati

And the following international corridors:

- Berlin – Warsaw
- Prague – Brno – Vienna – Bratislava – Budapest
- Budapest – Bucharest
- Budapest – Belgrade

Phase 2: Evaluating the main investment indicators

The evaluation of the investment indicators requires estimating the journey time reductions, the number of passengers transported annually in a consolidated traffic situation, the distance they travel and the infrastructure construction costs.

The construction costs have been calculated according to the illustrative results proposed in table 8 and by using the distances "as the crow flies".

With regard to traffic in the reference situation, the lack of up-to-date figures has forced us to use the forecasts for the year 2010, made by Setec, DE-Consult and Sistra in 1999 at the request of the UIC (International Union of Railways). The annual traffic forecast, assuming the existence of a consolidated high-speed line, has been obtained by making comparisons with the existing lines in Western Europe.

The results obtained for each one of the corridors are summarised in table 12.

Table 12: Main indicators for the construction of high-speed railway lines on various national and international corridors in the CEEC space

Líneas seleccionadas	$\frac{\text{Investment cost}}{\text{Total trafic (passenger} \cdot \text{km)}}$	$\frac{\text{Investment Cost}}{\text{Total trafic (passengers)}}$	$\frac{\text{Investment Cost}}{\Delta\text{time}}$
Varsovie – Lodz – Poznan et Wroclaw	0,99 €/pas·km	344 €/pas	$28 \cdot 10^{6}$ €/min
Craiova – Bucarest – Constanta et Braila-Galati	1,9 €/Pas·km	421 €/pas	$21 \cdot 10^{6}$ €/min
Berlin – Varsovie	3,45 €/pas·km	1.123 €/pas	$37 \cdot 10^{6}$ €/min
Prague-Brno-Vienne-Bratislava-Budapest	6,36 €/pas·km	1.453 €/pas	$30 \cdot 10^{6}$ €/min
Budapest – Bucarest	2,14 €/pas·km	451 €/pas	$16{,}5 \cdot 10^{6}$ €/min
Budapest – Belgrade	2,09 €/pas·km	203 €/pas	$13 \cdot 10^{6}$ €/min

Fuente: CENIT (2004).

The reference values in Western Europe for ballasted track show that the cost of constructing the line in relation to the total traffic varies between 180 and 900 € per passenger transported, and that the construction cost in relation to the journey time reduction varies between 15 and 30 million euros per minute. Table 13 highlights the maximum reference values in Western Europe for the investment cost in relation to the total traffic (passengers-km), which in a consolidated traffic situation would stand at 2 or 3.

Table 13: Reference values of the Madrid-Seville line

Year	Passengers (millions)	Passengers-km (millions)	$\frac{\textbf{Investment cost}}{\textbf{Total traffic (passengers-km)}}$
1995	3,8	1.294	2,8
1999	5,2	1.787	2
2003	6	2.027	1,8

Source: RENFE.

Comparison of the results obtained and the experience available allow us to conclude that the proposed corridors have high-speed rail potential. However, the national corridors offer more positive indicators. It seems reasonable to assume that these are the corridors, together with those that connect Western and Eastern Europe, which will begin to give shape to the high-speed network in the CEEC space.

CONCLUSIONS

The analysis of the existing experience in Western Europe in relation to the construction and operation of high-speed lines has made it possible to develop a simplified methodology for making an initial evaluation of the potential of the main corridors in the countries of Central and Eastern Europe for the construction of high-speed lines.

This methodology is only one of the tools that can be used to assist the initial decision-making process. However, the definitive planning of the high-speed network would also require more detailed studies which evaluate the financial and socio-economic profitability of the projects.

Direct extrapolation of the results obtained is not feasible due to the significant economic, geographic and demographic differences that exist between the two areas. However, the indicators obtained that relate to lines which are currently in operation in Europe should be taken into account for reference purposes.

The results corresponding to the lines that have been analysed allow us to conclude that, a priori, the construction of high-speed lines is an option that should be studied during the next stage.

The railway in the CEEC space is going through a difficult period. High speed has proved to be a catalyst which has transformed the railway into an efficient, competitive and more sustainable means of transport than the aviation and the road. If we want to avoid the problems of congestion and saturation that already affect roads and airspace in Western Europe, now is the time to consider the possibility of constructing an interoperable high-speed rail network in the countries of Central and Eastern Europe.

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