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Achievement of Efficient Railway Network in South East Europe: Technical Approach for supporting Comprehensive Decision Making

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The Need

- The low quality of provided services in the railways and the less competitive travel times had as a result the decline of the modal share of the railways and a stabilisation of the modal share of passenger transport although an overall increase of 300% took place.
- Specifically in the South East Europe the current railway network suffers from a low commercial speed (60 km/h), insufficient capacity on core routes between key urban centres, excessive delays at border crossings and poor service quality.
- Due to the wars in the area, various parts of the infrastructure (not only the one of the railways) have been damaged resulting to disruption on the main corridors and diversion of traffic towards other, less adapted routes.
- The achievement of interoperability due to all the above reasons has been made impossible
- The budget constraints do not permit ambitious plans for infrastructure.



The SEECP Agreement

- Mindful of the above, the Ministers of Transport of eleven countries signed in 2006 the SEECP (South East Europe Cooperation Process) Agreement.
- The eleven countries were: Albania, Bulgaria, Bosnia, Herzegovina, Greece, Croatia, FYROM, Romania, Serbia, Montenegro, Turkey and Moldavia as an observer.
- The **priority objective** of the Agreement is the development of a high standard railway network in the area of SE Europe that will provide high level service railway transports, with reduced travel times between the main urban and commercial centres of the geographical area in reference.
- The target speeds of the Agreement were:
 - ✓ At least **130 km/h for passenger trains** with a minimum design speed of 160 km/h (rising to 220 km/h on certain sections where possible)
 - ✓ The **commercial speed for freight trains shall be adjusted accordingly**, with regard to the speed of passenger trains.

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The SEECP Network (1/2)

- The SEECP High Performance Network includes the 16 railway axes:

Axis No	Description
1	Athens – Thessaloniki – Skopje – Nis – Belgrade – Zagreb – (Ljubljana – Salzburg)
2	(Budapest –) Subotica – Belgrade – Dimitrovgrad – Sofia – Plovdiv – Istanbul – Ankara – Adana/Sivas
3	Constanta – Bucharest – Brasov – Arad (– Wien)
4	Durres – Tirana – Oafë Thanë – Kicevo – Skopje – Kriva Palanka – Gueshevo – Sofia – Plovdiv – Stara Zagora – Varna/Burgas
5	Strymonas – Kulata – Sofia – Gorna Oryahovica – Varna
6	Veles – Bitola – Florina – Amyntaio/Kalambaka – Ioannina – Igoumenitsa/Thessaloniki
7	Thessaloniki – Pehlivanov – Istanbul – Eskisehir – Izmir
8	Floce – Sarajevo – Vrnolje – Osijek (– Budapest)
9	Bar – Podgorica – Belgrade
10	Podgorica – Tirana – Durres
11	Bucharest – Craiova – Timisoara/Arad – Belgrade
12	Craiova – Calafat – Vidin – Sofia
13	(Kuchurgan –) Chisinau – Ungheni – Iasi – Pascani – Bucharest – Giurgiu – Russe – Gorna Oryahovica – Stara Zagora – Pythion
14	(Budapest –) Zagreb – Rijeka
15	Zagreb – (Maribor – Graz)
16	(Zagreb) – Dobrljin – Banjaluka – Doboj – Tuzla – (Belgrade)

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The SEECP Network (2/2)

SEECP NETWORK - TECHNICAL SECRETARIAT



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The Role of CERTH/HIT

- The Hellenic Railways (OSE) were assigned to chair the Steering Committee (SC) and the Technical Secretariat (TS) of the SEECP for the first 2 years.
- CERTH was assigned to consult the Hellenic Railways to all of the tasks, including the coordination of the SC and the TS.
- However, the basic goal of CERTH/HIT was to conduct the necessary research on behalf of OSE.



The 4 – STEPS Methodology

- The methodology proposed and followed by CERTH/HIT for the first 2 years included 4 steps:
 - ✓ Current Situation Analysis
 - ✓ Definition of Operational Standards for each connection
 - ✓ Calculation of target values
 - ✓ Prioritisation of Goals

STEP 1: The Analysis of Current Situation (1/6)

In order to make the analysis of the current situation more efficient, the network was divided in several major connections in each axis. The criteria for selecting these connections were:

- Connections between capital cities
- Connections between major urban centres
- Connections between major commercial centres



39 Connections were finally identified

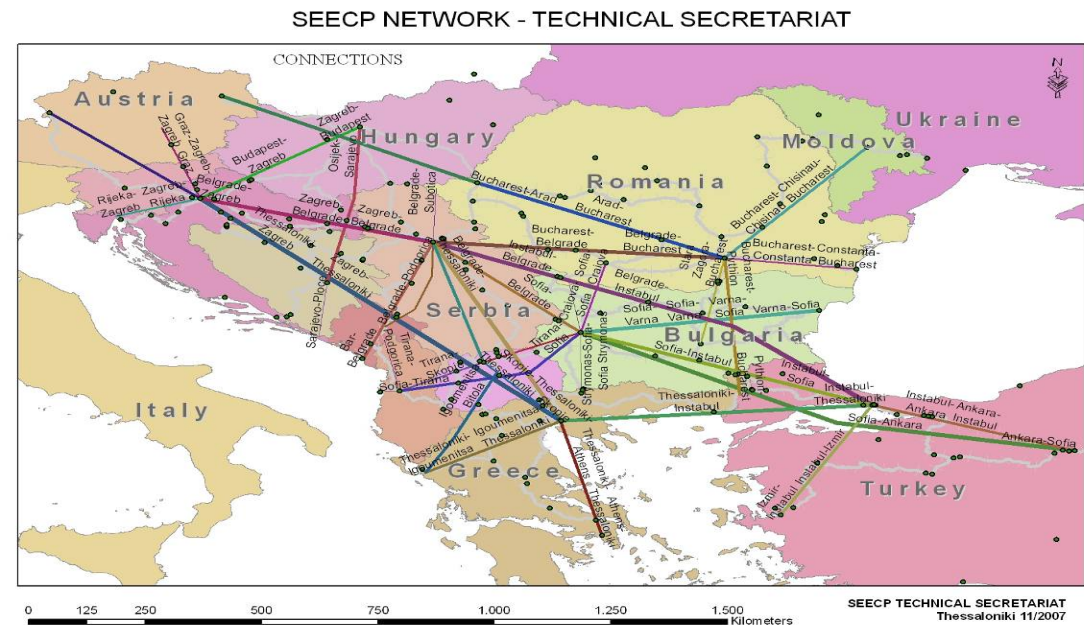
- These connections were further divided in smaller sections
- The connections often run through two or more countries, while the sections are smaller parts of the network running inside one country.



138 Sections were finally identified

STEP 1: The Analysis of Current Situation (2/6)

Axis	Connections
1	1. Athens - Thessaloniki 2. Thessaloniki - Skopje 3. Thessaloniki - Belgrade 4. Thessaloniki - Zagreb 5. Belgrade - Zagreb 6. Skopje - Belgrade
2	7. Subotica - Belgrade 8. Belgrade - Sofia 9. Sofia - Istanbul 10. Belgrade - Istanbul 11. Sofia - Ankara 12. Istanbul - Ankara
3	13. Constanta - Bucharest 14. Bucharest - Arad
4	15. Dures - Tirana 16. Tirana - Skopje 17. Skopje - Sofia 18. Tirana - Sofia 19. Sofia - Varna
5	20. Strymonas - Sofia
6	21. Igoumenitsa - Thessaloniki 22. Bitola - Thessaloniki 23. Bitola - Igoumenitsa
7	24. Thessaloniki - Istanbul 25. Istanbul - Izmir
8	26. Ploce - Sarajevo 27. Sarajevo - Osijek
9	28. Bar - Belgrade 29. Podgorica - Belgrade
10	30. Podgorica - Tirana
11	31. Bucharest - Belgrade
12	32. Craiova - Sofia 33. Vidin - Sofia
13	34. Chisinau - Bucharest 35. Bucharest - Pythion 36. Bucharest - Štara Zagora
14	37. Budapest - Zagreb 38. Zagreb - Rijeka
15	39. Zagreb - Graz
16	Belgrade - Zagreb (already studied for axis 1)



The 39 Connections of the SEECP Agreement

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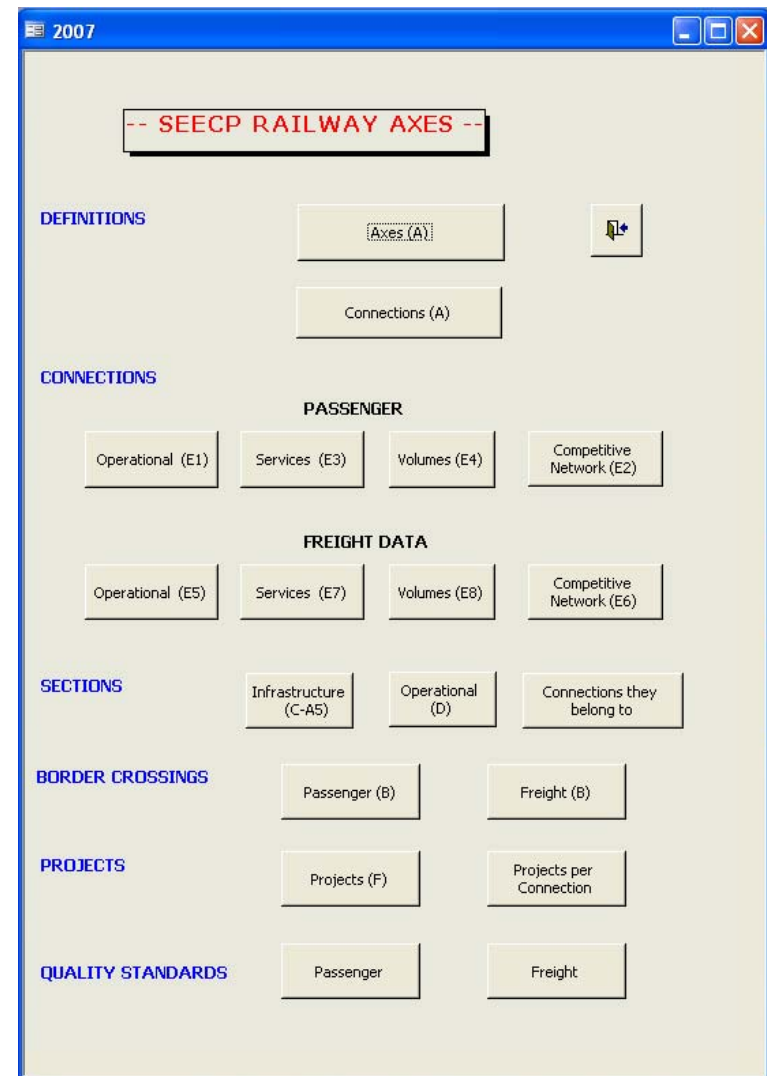


STEP 1: The Analysis of Current Situation (3/6)

- The actual analysis of the current situation was initiated with a data collection process.
- The data collection was conducted through a questionnaire that was distributed to and filled in by the representatives of the participating countries (railway agencies, relevant ministries, etc)
- 6 areas of information were covered by the questionnaire:
 - The specific Corridor (Pan-European Corridors, HLG Priority Axes, etc.) to which each connection belongs and its impact on its construction and operation
 - Main physical and operational characteristics
 - Rolling stock information
 - Existing competitive corridors
 - Analysis of procedures and information on delays at border crossings
 - Exploitation of the corridor and technology and IT systems use

STEP 1: The Analysis of Current Situation (4/6)

- In order to store and further analyze the collected information, a GIS technology based tool was developed.
- The main components of the Analysis tool are:
 - ✓ Database for hosting the questionnaire and other sources of information
 - ✓ Spatial representation of the network of the SEECP (geoDatabase) connected to the database
 - ✓ Functionality layer for thematic maps creation
 - ✓ Functionality layer for analysis tools (queries for standards definition, comparison current situation 0-future horizon, logical checks etc).



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STEP 1: The Analysis of Current Situation (5/6)

- After the finalization of the Data collection, an Action Plan was formulated.
- The Action Plan included a summary of the current operational level of each connection.
- Data was collected for the previously mentioned quality parameters.
- Due to the extent of the whole procedure, only the parameter “Travel Time” has been dealt in this paper.



STEP 1: The Analysis of Current Situation (6/6)

The initial conclusions that were drawn based on the data collection and regarding travel time aspects were:

- Many connections with $V_{aver} \leq 130\text{km/h}$
- Few connections with $V_{aver} \geq 130\text{km/h}$
- Many connections which suffer from very long delays at borders . Such an example is the case of Thessaloniki – Zagreb where the delay is almost the 10% of the travel time.
- In many connections, the unacceptably high travel times can be attributed to the high number of intermediate stations.
- Several connections cannot be actually studied because there are missing links.
- There is one connection that cannot be studied either because no data could be found.

STEP 2: Definition of Operational Standards for Each Connection (1/3)

- Several other standards were set, besides the need for average design speed of 130km/h or more.
- The standards determination was based on specific criteria:
 - ✓ The existing situation;
 - ✓ The future situation based on the projects already planned (with secured funding);
 - ✓ The competitiveness towards other transport means and the possibility to create a qualitative railway product at “integrated network” level;
 - ✓ The homogeneity of the characteristics along the segments and the possibility for formulating high quality “operational corridors”; and
 - ✓ The necessary interventions cost



STEP 2: Definition of Operational Standards for Each Connection (2/3)

Quality Standards for passenger transport service

- Competitive travel times
- Delays at borders
- Itinerary reliability / regularity
- Itinerary frequency
- Passenger comfort during trip
- Transport safety
- Competitive fares
- Special services (accompanied cars, night cars, etc.)

TRAIN TRAVEL TIME – PASSENGER TRAINS		
Quality Standard parameters	Criteria to be decided	Target values
(Train travel time (T_{tp}))	$T_{tp} \leq$ travel time of private cars $T_{tp} \leq 0,8 * \text{travel time of buses}$ $T_{tp} \leq 2 * \text{travel time of plane}$	Train travel time
Delays at borders (T_{bp})	$T_{bp} \leq 30$ min (in total for the two border points)	Minimum delay at borders
Number of intermediate stations (N_{sp})	$2/500 \text{ km} \leq N_{sp} \leq 5/500\text{km}$	Minimum number of stations
Design speed per track section (V_{dsp})	$V_{dsp} \geq 130\text{km/h}$ $V_{dsp} \geq \text{existing speed}$	Minimum design speed per track section
Average permitted speed per track section (V_{psp})	$V_{psp} \geq 0,8V_{dsp}$	Minimum average permitted speed per track section
Rooting of tilting trains	Not obligatory	

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STEP 2: Definition of Operational Standards for Each Connection (3/3)

Quality Standards for freight transport service

- Competitive fares
- Competitive travel times
- Cargo safety (thefts, damages)
- Delays at borders
- Itinerary reliability / regularity
- Freight monitoring during transportation
- Dangerous goods special handling
- Applied technologies

TRAIN TRAVEL TIME - FREIGHT TRAINS		
Quality Standard parameters	Criteria to be decided	Target values
(Train travel time (T_{tf}))	$T_{tf} \leq$ road travel time $T_{tf} \leq 0,8 * \text{maritime travel time}$	Train travel time
Delays at borders (T_{bf})	$T_{bf} \leq 60$ min (in total for the two border points)	Minimum delay at borders
Stop time at intermediate stations and marshalling yards (N_{sf})	$N_{sf} \leq 12$ hours	Minimum delay at stations
Design speed per track section (V_{dsf})	If only freight trains $V_{dsf} \geq 100\text{km/h}$, $V_{dsf} \geq$ existing speed If mixed circulation $V_{dsf} \geq 130\text{km/h}$, $V_{dsf} \geq$ existing speed	Minimum design speed per track section
Average permitted speed per track section (V_{psf})	$V_{psf} \geq 0.8V_{dsf}$ if only freight trains $V_{psf} \geq 0.6V_{dsf}$ if mixed circulation	Minimum average permitted speed per track section

STEP 3 : Calculation of Target Values (1/3)

- For the identification of the exact modifications that should take place in the network in order to achieve the standards that have been set, a calculator of values was created.
- The 1st version of the calculator is embedded and fed from the data base.
- The 2nd version of the calculator can operate independently and serves for scenarios testing.
- In the case of travel time, the user can estimate the target design speed in order to achieve travel time for the railway that is less than the one of the competition (bus, airplane, etc).



STEP 3 : Calculation of Target Values (2/3)

- The user inserts the existing values and after hitting the “Calculate” button the target values are presented.
- If the existing situation is not adequate, then the message “Take measures” appears and all the target values are calculated.
- In case the current situation is sufficient, the message “No measures are necessary” appears.

The screenshot shows a software window titled "Travel Time - Passenger Trains". It is divided into two main sections: "INPUT" and "RESULT".

INPUT section:

- train travel time: 500
- travel time for competition: 400
- number of border crossings: 0
- total delay at borders: 0
- no of intermediate stations: 5
- length of connection: 500

RESULT section:

- report: Take measures (dropdown menu)
- Travel time calculated by sections for design speed: 333
- Length calculated by sections: 500
- target total delay at borders: 0
- target total train travel time: 400
- target train running travel time (excluding stops): 375
- Target running speed: 80
- Target design speed: 100
- Average weighted design speed (calculated from sections): 90

Summary:

- target design speed: 130

Buttons:

- Clear ALL values
- Clear Connection values
- Calculate
- Open Section Form
- Help icon

STEP 3 : Calculation of Target Values (3/3)

- With the use of the calculator, several projects were proposed that must be realized in order to achieve the standards that were set.
- Each connection was examined separately and the proposed projects were based on its special characteristics.
- The categories of proposed projects were:
 - Construction of new single line
 - Construction of new double line
 - Construction of bridges
 - Construction of missing links
 - Electrification of line
 - Upgrading of existing line
 - Rehabilitation of line
 - ERTMS installation
 - Installation of electric side signalling
 - Improvement of maintenance
 - Elimination of track defects
 - Alignment amelioration

STEP 4 : Prioritisation of goals (1/3)

- Several reasons, mostly related to budget restrictions do not permit the implementation of all the proposed solutions simultaneously.
- For this reason a prioritisation of goals took place.
- In order to select the final connections to be promoted a multi-criteria methodology was followed. The criteria were:
 - 1. Participation in priority networks:** Percentage of the length of the connection that participates in these networks. This criterion represents the regional importance of each connection, its contribution to the economic, social and territorial cohesion and its alignment with the wider framework for regional development and transport in the region of Southeast Europe.
 - 2. Intervention required according to the Action Plan:** This criterion examines the readiness of each connection to accept low cost investments, in order to upgrade the railway services along the connection, which is in function with the projects identified in the SEECP Action Plan.



STEP 4 : Prioritisation of goals (2/3)

- **3. Trans-national cooperation:** This criterion accounts the promotion of international cooperation, which is achieved through trans-national projects that of course depend on the number of the countries involved in a connection.
- **4. Competitiveness with other modes:** This criterion evaluates the potential and readiness of each connection to compete directly with road and air transport. Therefore, fee and travel times are compared for all the modes of transport.
- **5. Homogenization of the target for 2020:** This criterion examines every connection regarding the achievement of a homogenous result having as a time horizon the year 2020.

STEP 4 : Prioritisation of goals (3/3)

- The connections that were finally selected after the implementation of the multi-criteria methodology are:

A. International connections

1. Thessaloniki – Zagreb
2. Sarajevo – Osijek
3. Ploce – Sarajevo
4. Belgrade – Istanbul
5. Thessaloniki – Sofia – Craiova

B. Domestic connections

1. (Budapest –) Hungarian border – Zagreb
2. Zagreb – Rijeka
3. Subotica – Belgrade
4. Constanta – Bucharest
5. Bucharest – Arad

Conclusions (1/2)

- **An efficient transport system is essential to the economic and social vitality of any country and region.**
- **A serious shift of cargo from road to the railway is essential.**
- **The railway is by far the most environmental friendly mode of transport, therefore this shift will assist also in the decrease of emissions and general decrease of the road pollutants.**
- **The railway must be able to carry these additional transports and to carry them on a sufficient level of quality. This will be feasible only through a general revitalization of the railway network and more importantly through the achievement of interoperability.**
- **Although various initiatives had been implemented in the past, at regional and EC level, in order to revitalize the railways in South East Europe, the quality of the services provided is still not sufficient.**

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Conclusions (2/2)

- It is necessary to finalize as soon as possible the projects that have already commenced so as to make the initiation of the proposed projects possible.
- A serious problem towards this direction is the lack of budget.
- In order to solve this problem, the first step should be to ratify the above mentioned Agreement, so as to add to its trustworthiness.
- The Agreement and the work that has been done up till now must be promoted to various bodies and organizations (World Bank, EC, etc) that are in the position to provide the necessary funding.
- The promotion could take place either through bilateral meetings between each country and the above mentioned bodies or through promotion events organized by the SEECF Steering Committee. The prioritization of goals is a very serious step towards this direction.



Next Steps

- The most important next steps and actions that should take place on behalf of the participating countries can be summarized as follows:
 1. Ratification of the Agreement by all participating countries
 2. Political re-engagement of the participating countries
 3. Operation of the SEECP Steering Committee as a decision making support and project promoting body for fulfilling the provisions of the Agreement.
 4. Updating of the SEECP database
 5. Monitoring of ongoing projects
 6. Initiation of proposed projects
 7. Bilateral meetings and events aiming to the promotion of the initiative
 8. Substantiate the actual goals of the SEECP initiative
 9. Position the SEECP initiative between other similar initiatives

