# Study on Orient / East-Med TEN-T Core Network Corridor

***2nd Phase***

*Final Report*

*December 2017*

Transport

## Table of content

## Figures

## Tables

## Abstract

The Study on the Orient/East-Med TEN-T Core Network Corridor (OEM) contributes to the Corridor Work Plan according to TEN-T Regulation No. 1315/2013 and the CEF Regulation No. 1316/2013 for one of the 9 TEN-T Core Network Corridors (CNC). It was elaborated between 2015 and 2017 by a Consultant team on behalf of the European Commission DG MOVE, comprising of iC consulenten (Austria), ITC (Bulgaria), Panteia (Netherlands), PwC Advisory (Italy), Railistics (Germany) and SYSTEMA (Greece).

The hereunder presented results formed the major input to the Second and Third Work Plan of the European Coordinator and were presented and discussed with the OEM Corridor Forum.

In this 2nd phase of the comprehensive CNC study, the analyses focused on the identification of existing and expected future gaps in the Corridor's multimodal transport infrastructure against the Regulations' stipulations, based on a status quo inventory of the Corridor's infrastructure and a record of all on-going and planned infrastructure projects.

For the first time, the study examines the potentials of transport innovation, emission reduction and decarbonization, as well as climate-change related impacts. Methods to estimate socio-economic impacts of Corridor investments and also to cluster mature projects and projects suitable for sustainable financing sources were presented.

## Declaration by the Consultant

The content presented herein constitutes the updated and final results of the 2nd Phase of the OEM Corridor Study. The present Final Report **supersedes** all **previous Deliverables** of the Study. In the case of contradicting information between the Final Report and earlier Deliverables, the latest valid information is the one presented in the Final Report.

## Disclaimer

## Information on current version

- This document constitutes the deliverable D8 "Draft Final Report", containing all the elements of study task 4 items set forth in the tender specifications, summarising the conclusions and key aspects from tasks 2 and 3, and providing the technical input to the Work Plan Update of the Coordinator.

- The conclusions and key aspects in assessing the Corridor development are based on:
  - the **Final project list** that has been submitted to the Commission on 28 March 2017,
  - the **Final report on the Project List**, submitted on 8 June 2017,
  - the **Final report on the elements of the Work Plan**, submitted on 8 June 2017,
  - the **Final report on wider elements of the Work Plan**, submitted on 4 September 2017.
  - The **Second Progress Report**, submitted on 13 June 2017

- The version of this deliverable is submitted to the European Commission by 15th December 2017.

| | | |
|---|---|---|
| V1.0 | 15 November 2017 | Formal submission to DG MOVE as Draft Final Report |
| **V2.0** | **15 December 2017** | Formal submission to DG MOVE as Final Report<br>Amended of Fig.5 and 7, Amendment of Tab. 12 after intervention of BG ministries<br>Section 10 – Appendix; Inclusion of 3.5.5.2, Minor edits |

## Abbreviations

| | |
|---|---|
| BCP | Border crossing point |
| bln | Billion |
| CBA | Cost Benefit Analysis |
| CEF | Connecting Europe Facility |
| CEMT class | Classification of European Inland Waterways according to European Transport Minister's Conference |
| CNC | Core Network Corridor |
| $CO_2$ | Carbon dioxide |
| DG MOVE | European Commission – Directorate General for Mobility and Transport |
| EC | European Commission |
| EIA | Environmental Impact Assessment |
| EIB | European Investment Bank |
| ERTMS | European Rail Traffic Management System |
| ETCS | European Train Control System |
| EU | European Union |
| EV | Electric Vehicle |
| GDP | Gross Domestic Product |
| GSM-R | Global Standard of Mobile Telecommunication - Rail |
| ICT | Information and Communication Technologies |
| IWT | Inland water transport |
| IWW | Inland waterway |
| km | kilometre |
| KPI | Key Performance Indicator |
| m | metre |
| mln | Million |
| MoS | Motorway(s) of the Sea |
| MS | Member States of the European Union |
| MTMS | Multimodal Transport Market Study |
| n.a. | Not applicable / not available |
| OEM | Orient / East-Med (Corridor) |
| PAX | amount of passengers |
| Pkm | passenger kilometre |
| RIS | River Information Services |
| RFC | Rail Freight Corridor |
| RRT | Rail-Road Terminal |
| SKA | Acharnes Rail Terminal (Athina area) |
| TEN-T | Trans-European Transport Network |
| tkm | tonne-kilometre |
| TMS | Traffic Management System |
| VTMIS | Vessel Traffic Management and Information system |

Country Codes after NUTS 2013:

| | |
|---|---|
| AT | Austria |
| BG | Bulgaria |
| CY | Cyprus |
| CZ | Czech Republic |
| DE | Germany |
| EL | Greece |
| HU | Hungary |
| RO | Romania |
| SK | Slovakia |

# 1 Information on the Study

## 1.1 Background and objective

Adopted by the EU in 2013, the new TEN-T Regulation No.1315/2013[1] forms the current legal basis for the development of the Trans-European Networks (TEN-T). In order to organize efficiently the future development of the Core Network towards its 2030 key completion milestone, nine (multimodal) Core Network Corridors (CNCs) were defined, each led by a European Coordinator. An integral task specified by the Regulation for each Coordinator is the development of a Work Plan for the implementation of the Core Network based on a detailed analysis of each Corridor. To support each Coordinator in the preparation of the Corridor Work Plan, the European Commission launched nine Corridor studies.

The second part of the implementation of the Regulation No.1315/2013 and the CEF Regulation No.1316/2013[2] for the TEN-T Core Network Corridor "Orient/East-Med" (OEM) was awarded to the consortium led by iC consulenten by the Directorate-General Mobility and Transport of the European Commission in August 2015, and was elaborated between September 2015 and November 2017.

The main outcomes of the 2014 Study entailed the identification and description of the Corridor's characteristics, i.e., the multimodal transport infrastructure and the market-related transport flows, as well as their compliance with the Regulations' stipulations. This led to an identification of critical issues, which hinder an efficient and seamless operation of the Corridor, and the definition of Corridor development objectives. Finally, the study included a record of all on-going and planned infrastructure projects making up a Corridor Implementation Plan.

The results of the study established the basis for the European Coordinator for the OEM Corridor, Mathieu GROSCH, to draw up the 1st Corridor's Work Plan by the 22nd of December 2014 and to issue its finalised version in May 2015. The Work Plan pays particular attention to the priorities of the guidelines: cross border bottlenecks, interoperability and multimodality. It also focused on the characteristics of the Corridor, the results of the multimodal Transport Market Study, the critical issues and objectives, concluding in a general outlook, as well as a number of key recommendations.

Given its one calendar year duration, several aspects of the Corridor were not entirely developed in that first stage of analysis. To this end, DG MOVE of the European Commission published an invitation to tender on the 17th of April 2015 entitled "Studies on the TEN-T core network corridors and support of the European Coordinators", MOVE/B1/2014-710, for the follow up of the original work. The continuation of the Study (2nd Phase) was awarded to the consortium presented in Section 1.1 and was elaborated between 2015 and 2017.

Subsequently, the work on the updating and refinement of the First Work Plan started in September 2015 with the support of the same external Consultant for the second phase of the Corridor study aiming to achieve its further development. Five Corridor Fora were held between September 2015 and December 2016 presenting and discussing the next steps in the updating of the study and the Work Plan. The Second update of the Work Plan was discussed with the Member States and issued in December 2016.

[1] REGULATION (EU) No 1315/2013 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 11 December 2013 on Union guidelines for the development of the trans-European transport network…

[2] REGULATION (EU) No 1316/2013 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 11 December 2013 establishing the Connecting Europe Facility…

In parallel, interested parties and Forum members were invited to Working Group meetings, held in March 2016, April and October 2017 discussing the potential to reduce administrative and operational barriers for freight trains at the border crossing points. In this regard, the Coordinator, in cooperation with the RFC 7 bodies, initiated a Joint Ministerial Declaration, signed in Rotterdam in June 2016, setting out the Two-Hour Goal to be achieved until mid-2018. The second seaport-related meeting was held in December 2016. During 2017, two meetings of the Corridor Forum took place, dedicated to present and discuss the study's findings materialized in the Third update of the Work Plan.

This study has the objective of supporting the European Coordinator and the European Commission in achieving the requirements of Regulation No.1315/2013:

- A core and a comprehensive network based on a single European methodology;
- Standards on the core network to be achieved by 2030;
- Coordinators and Core Network Corridors as implementation tools;
- Work Plans as "road maps" for developing the corridors.

The specific objectives of the study are:

- Further development of the Corridor study of 2014;
- Gaining technical support necessary for the refinement of Work Plans
- Quantification of potential benefits lost if projects are not implemented;
- Support for the European Coordinator and the European Commission in the Corridor Forum and related Working Groups.

The following sections include the main final findings of the activities performed for the elaboration of the Third update of the Orient/East-Med Corridor Work Plan in late 2017.

## 1.2 Consortium information

The 2nd phase of the study on the Orient / East-Med Core Network Corridor was elaborated for and in close cooperation with

- Mr. Mathieu GROSCH, the European Coordinator for the Orient/East Med Corridor,
- Mr. Patrick VANKERCKHOVEN, Advisor of the Coordinator, on behalf of the European Commission, DG MOVE, Unit B.1, Brussels, Belgium,
- the members/participants of the Corridor Forum,
- the other stakeholders, e.g. Railway undertakings
- the other CNC study consortia.

It was conducted by a group of international consultants, led by iC consulenten.

The Experts involved are listed below:

- iC consulenten Ziviltechniker GesmbH (Austria): A. MALCHEREK, S. STEINBRECHER
- Panteia B.V. (The Netherlands): A. BURGESS, H. DOYTCHINOVA, A. TIMAR (for Hungary)
- Railistics GmbH (Germany): R. ATANASSOV (for Romania), M. KAMMEL, W.D. GEITZ
- ITC Institute of Transport and Communication OOD (Bulgaria): K. CHAKAROVA

- SYSTEMA Transport Planning & Engineering Consultants Ltd. (Greece): P. MORAITI, Y. PAPAPANAGIOTOU
- PwC Advisory SpA (Italy): D. ARTUSO, F. PERCIACCANTE, K.TSOLOV (for Czechia and Slovakia)

## 1.3 Outline

The present report constitutes the Draft **Final Report** of the 2nd Phase of the OEM Study, and in accordance with the tender specifications, describes the outcomes of the Contractor's work in the period October 2015 - November 2017.

The elements included in this report are:

**Summaries and conclusions:**

- An executive summary of the analysis conducted under the 2nd Phase of the study;
- Conclusions and analysis drawn from all previous tasks;
- Conclusions providing for the further development of the Corridor, including the update of the Coordinator's third Work Plan.

**Mode specific analysis:**

- Analysis of potential market uptake for modes with highest unused capacity, inland waterway transport, in particular;
- Identification of measures to fulfil this potential;
- Analysis of further development of the co-operation with the Rail Freight Corridor.

**Modal shift and environmental impact:**

- Mitigation of environmental impact.

**Clustering and mapping of projects:**

- Objective criteria to prioritise investments on the Corridor, based on the characteristics of the Corridor, taking into consideration the outcomes of Task 3 (wider elements);
- Proposals for a mapping of projects or their groups/categories.

**Corridor projects accomplishments:**

- Summary of actions accomplished between 2014 and 2016.

**Impact of Corridor development:**

- Impact on jobs and growth;
- Infrastructure funding and financial sustainability of projects.

**Cooperation with the Rail Freight Corridor:**

- Working Group meetings;
- Survey among Railway undertakings;
- The 2-hour goal for freight trains at border crossings (pilot initiative).

# 2 Summary of the Study

## 2.1 Characteristics of the Corridor

The Orient/East-Med Corridor, as depicted in Figure 1, is running from the German ports of Wilhelmshaven, Bremerhaven, Bremen, Hamburg and Rostock via the Czech Republic and Slovakia, with a branch through Austria, further via Hungary and Romania to the Bulgarian port of Burgas, with a link to Turkey, to the Greek ports of Thessaloniki and Piraeus and a "Motorway of the Sea" link to Cyprus.

According to Regulation No. 1316/2013 and clarifications agreed with Member States, the Orient/ East-Med Corridor, as depicted below, consists of the following multi-modal parts:

**Figure 1: OEM Corridor Alignment**


- Rostock – Berlin
- Brunsbüttel – Hamburg – Berlin – Dresden
- Bremerhaven / Wilhelmshaven – Magdeburg – Leipzig/Falkenberg – Dresden
- Dresden – Ústí nad Labem – Mělník/Praha – Kolín
- Kolín – Pardubice – Brno/Přerov – Wien/Bratislava – Győr – Budapest – Arad – Timişoara – Craiova – Calafat – Vidin – Sofia
- Sofia – Plovdiv – Burgas
- Plovdiv – Svilengrad – Bulgarian/Turkish border
- Sofia – Thessaloniki – Athina – Pireas
- Athina – Patra / Igoumenitsa
- Thessaloniki / Palaiofarsalos – Igoumenitsa
- Pireas / Heraklion – Lemesos – Lefkosia – Larnaka

The **length of the Corridor** infrastructure sums up to approximately 5.800 km of rail, 5.400 km of road and 1.700 km of IWW. It is expected that the Corridor length will further adapt, e.g. with the construction of new by-pass roads, for instance, the length will increase.

The OEM Corridor is tangent to 15 urban nodes and 15 core airports of the core network, from which 6 are main airports to be connected with high-ranking rail and road links until 2050. Furthermore, 10 Inland ports and 12 Maritime ports are assigned to the Corridor, as well as 25 Road-Rail terminals (RRTs).

In Cyprus, no rail infrastructure is deployed. Maritime infrastructure exists in 4 countries, namely Bulgaria, Cyprus, Germany and Greece. The Danube IWW and its ports were not analysed in this study.

## 2.2 Traffic demand and forecast

The MTMS, performed in 2014, described the transport market characteristics of the OEM Corridor in its present condition and in the future. Its main objective was to analyse the OEM Corridor-related transport system and assess the capacity and traffic flows on the respective parts of the infrastructure, covering the time period from 2010 to 2030. The time horizon of 2030 was selected as it represents a major milestone for European policy and at the same time, provides a reliable basis for future results.

During the update of the Work Plan in 2016, it was examined whether the same premises still hold compared to the figures of the MTMS of 2014. Therefore, latest transport figures and the trend from 2010 are included. The MTMS provides information on the macroeconomic framework, as well as the Corridor-related demand flows creating the basis for the MTMS. The outcomes of the above activities led to the following results.

There are mixed results for **population** forecasts, since a decline is expected for 4 Member States (Bulgaria, Germany, Hungary and Romania). The development of **GDP** in the period 2010 – 2030 shows that for all countries in the OEM Corridor a positive growth is expected. **National forecasts** and **national transport figures** are available through the project sources; however, not for all countries on a regional level, while the timing of the scenarios may differ. This means that on the basis of this information, the OEM Corridor cannot be isolated from other Corridors and any further analysis cannot be made at this stage. Regarding **freight** and **passenger transport**, especially road transport has a more moderate growth. This is resulting in lower volumes, but also in a more favourable modal split compared to previous forecasts. On the longer distance, there is more competition between road versus rail and inland waterways.

The **first level** of Corridor traffic, that is, **transport within the Corridor catchment area**, has been described for the base year 2010. For freight transport, the domestic transport has been included. Notably, for road transport, domestic transport is carried out on short distances. This is one of the reasons why the volumes for road are relatively high. The short distance transport by road is attributed to a high share of building materials, foodstuffs, agricultural products and final products. On the longer distance, there is more competition between road versus rail and inland waterways. The **second level** (origin and destination in the Corridor) and **the third level** (transit) of Corridor traffic have been considered for rail and road transport. For rail, the first level traffic is subdivided in domestic and international traffic, and the second level in imports and exports. For road, the first level domestic traffic has been further split into domestic short distance and domestic long distance.

For **inland waterways**, in total, a growth of 25% is expected in the period 2010-2030 for land-land flows, while a 14% for maritime transport. The results for the forecasts are summarized in Table 1.

The trend analysis of the annual transport volumes since 2010 shows a stable development for **freight transport** in the OEM countries for road, rail and inland waterway. Investment in rail and inland waterway infrastructure is needed in order to attain a shift from road transport towards more environmentally friendly transport modes.

**The passenger demand** for the period of 2010 to 2030 remains almost stable with a growth rate of 0.05% per year. The analysis of the trend of 2010-2013 confirms the stable development of passenger transport, where there is a slight increase in car mobility, expected with increasing welfare levels.

**Table 1: Freight transport volume between the OEM regions for 2010, 2030 reference scenario; in 1,000 tonnes**

| Mode | 2010 | 2030 reference scenario |
|---|---|---|
| **Road** | 415,483 | 746,158 |
| **Rail** | 189,711 | 379,966 |
| **Inland waterway** | 18,694 | 23,361 |
| **Maritime** | 74,995 | 85,578 |
| **TOTAL** | **698,884** | **1,235,063** |
| ***Rail share*** | *27.1%* | *30.8%* |
| ***IWW share*** | *2.7%* | *1.9%* |

*Source: OEM CNC study, 2017*

## 2.3 Compliance with the technical infrastructure requirements

Regulation No.1315/2013 sets out the transport infrastructure requirements for each of the transport modes and the connected infrastructure components. The comprehensive set of core parameters analysed during the first Corridor study was reduced to a limited set of Key Performance Indicators (KPI), which aim at measuring the progress of all nine Core Network Corridors in a comparable way. Corridor specific characteristics have been added in order to present a more complete picture of the Corridors' development.

The evolution of the OEM Corridor and the potential effects of individual projects or groups of projects upon infrastructure interoperability and performance are assessed annually via the above mentioned Key Performance Indicators (KPIs) that have been jointly defined for all 9 Core network corridor studies. The KPIs are provided in two main categories: supply side KPIs and demand side KPIs. Furthermore, socio-economic parameters and network-related background information is given.

The KPIs present the years 2013-2016 and 2030. They allow for the second time within the present study the evaluation of the recent compliance levels against the infrastructure quality targets set out in Regulation No.1315/2013, thus highlighting the progress made so far.

Supply related Corridor indicators for rail increased between 1 and 5 %-points between 2013 and 2016, the largest increase being for the electrification (now 89%) and axle load (80%) ones. Between the years 2013 and 2016, there has been a 7% increase in the KPI for express road/ motorway and one extra airport has achieved rail connectivity. For the remaining KPIs (related to inland waterways, sea ports, inland ports and Rail-Road Terminals), there have been no changes during this period.

By 2030, there would be improvements in all modes across the EU, with the most notable ones being for rail: the *electrification* and *axle load* KPIs will almost reach 100%, whereas large absolute increases are expected in the *ERTMS implementation*, from 13% to 71% in 2030, and *train length of 740m*, from 50% to 74%. Furthermore, the Hamburg, Bremen/Bremerhaven, Rostock and Lemesos seaports will have facilities making available alternative fuels, which would bring the current KPI from 0% to 33%, while one extra seaport (Patra) will be connected to the hinterland's rail network.

**Table 2: Notable Supply related KPIs for OEM Corridor (2013 - 2016 & Forecast 2030)**

| Mode | KPI | Definition | 2013 | 2014 | 2015 | 2016 | 2030 |
|---|---|---|---|---|---|---|---|
| Rail network | Electrification | Electrified rail network km as a proportion (%) of relevant CNC rail network km. | 83% | 83% | 86% | 89% | 98% |
| | ERTMS implementation | Length of Permanent Operation (excluding operational test lines) of both ERTMS and GSM-R on rail network, as a proportion (%) of relevant CNC rail network km. | 11% | 11% | 12% | 13% | 71% |
| | Axle load (>=22.5t) | Length of Freight and combined line with a permitted axle load greater than or equal to 22.5 tonnes, as a proportion (%) of relevant CNC rail network km. | 78% | 78% | 78% | 82% | 98% |
| | Train length (740m) | Length of Freight and combined line with a permitted train length greater than or equal to 740m, as a proportion of relevant CNC rail network km. | 48% | 48% | 48% | 50% | 74% |
| Road network | Express road/ motorway | Road network km classified as motorway or express road, as a proportion (%) of CNC road section km. | 81% | 82% | 87% | 88% | 92% |
| Airports | Connection to rail | Number of core airports in CNC with a rail connection as a proportion (%) of the number of relevant core airports in the CNC. | 46% (50% - for main core airports) | 46% (50% - for main core airports) | 46% (50% - for main core airports) | 46% (50% - for main core airports) | 73% (92% - for main core airports) |
| Seaports | Availability of alternative clean fuels | Number of seaports offering (at least one of) LPG, LNG, liquid biofuels, or synthetic fuels as a proportion (%) of the total number of seaports in the CNC. | 0% | 0% | 0% | 0% | 33% |
| | Connection to rail | Number of seaports in CNC with a rail connection as a proportion (%) of the number of relevant core seaports [3] in the CNC. | 80% | 80% | 80% | 80% | 90% |

*Source: OEM CNC study, 2017*

[3] Excluding Heraklion and Lemesos, with no rail infrastructure in their respective territories.

## 2.4 Accomplished actions on the OEM Corridor

92 projects were accomplished since the adoption of the Regulation No.1315/2013 along the alignment of the Orient/East-Med CNC.

The **rail projects** finalised since December 2013 had an impact on the overall compliance of the rail corridor; 17 out of a total of 36 representing rail development projects. Among these, are rehabilitation projects of railway stations (Břeclav, Wien, Sofia, Pazardzhik and Burgas), ERTMS deployment projects, and several projects that partially tackled capacity bottleneck issues for the Praha - Česká Třebová section, the Leipzig node and the Bremen seaport hinterland connection.

Along the **OEM inland waterways** (7 projects completed), the five finalized works projects delivered two modernized locks and one port on the Czech part of River Elbe between Mělník and Pardubice. In Germany, upgrade works on IWW sections Magdeburg – Wolfsburg (Mittellandkanal) and Minden – Bremen (Weser) were achieved. Additionally, two studies, the IRIS 3 Europe study project and the elaboration of the German Overall future strategy on the River Elbe were completed. The projects did not affect Corridor indicators (KPI).

Eight **maritime projects** (6 works and 2 studies) were completed with no impact on related KPIs. The majority of implemented works contributed to capacity enhancements (Ports of Lemesos, Hamburg) and improvement of rail connections (Ports of Hamburg, Bremerhaven), while one project improved the VTMIS coverage at the Port of Burgas.

3 **RRT projects** were completed in the years 2014 and 2016, one being construction of a new intermodal terminal in the Plovdiv area.

The OEM **road infrastructure** increased its motorway / expressway compliance from 81% to 88% through the implementation of 24 projects (incl. 2 studies). Before 2014, it was compliant in Germany and Slovakia and became fully compliant by 2015 in Greece and Hungary. Also, in Bulgaria and Romania, recent works were accomplished contributing to a longer OEM motorway/expressway network. In total, the completion of 22 works projects contributed to the achievement or improvement of the motorway / express way criterion. The most important gap closed has been the border crossing Corridor section from Makó (HU M43) to Arad (RO A1). Also, the sections of D8 Lovosice – Usti nad Labem (CZ), A1 Timisoara to Lugoj (RO), A3 Dupnitsa – Blagoevgrad (BG) and A3 Sandanski – Kulata border (BG), A4 Orizovo – Harmanli (BG) and A1 Lamia – Raches (EL) were newly opened. Other projects related to capacity enhancements are those on existing German and Austrian motorways. Regarding the availability of alternative fuels, a significant increase of fuelling or charging stations was recorded (now >1000).

**Airport infrastructure** was developed through 15 projects, e.g. two projects improving the rail accessibility of the Vienna Airport. Construction works in the new Berlin Brandenburg Airport (BER) are on-going (5 projects). 8 design studies have been finalized, e.g. for the connection of Egnatia Odos Motorway with the Thessaloniki Airport.

## 2.5 Current and Future Corridor Infrastructure Compliance – challenges and need for action

The Study on the Orient/East-Med Corridor has led to the identification of critical issues hampering the operation of this major European transport connection in line with the provisions of Regulation No.1315/2013. The plan for the removal of physical and technical barriers presents assumptions on the compliance with Regulation No.1315/2013 by 2030, based on the expected contributions of the identified planned projects to the Corridor's development and highlights issues, where there is still need for actions.

### 2.5.1 Rail

The OEM rail alignment still shows at the end of 2016 significant barriers and bottlenecks, the most important being:

- ERTMS non-compliance on 4,944 km (87%) of the OEM rail network
- Train length: being a major issue along the entire Corridor, on 2,815 km (50%) a train length of 740m is not allowed.
- Minimum Axle load of 225 kN is major problem for Hungary, Romania and Greece, summing up to 952 km (17%) of the OEM rail network.
- A maximum operating speed of lower than 100 km/h is a barrier for freight trains in Bulgaria and its cross-border sections to Romania and Greece along a total length of 1,198 km (21%).
- Non-Electrification: 624 km (11%) in Germany, Romania and Greece are not electrified.
- System breaks: different voltage systems are applied along the countries, requiring loco changes or multi-system electrical locomotives.

Out of the 204 total non-compliant Corridor sections (in total 5,393 km), 61 sections (equalling 2,396 km) are covered by 157 studies and works projects, addressing at least one of the non-compliant parameters. Taking into account the list of on-going and planned Corridor projects to be implemented by 2030, still a significant part (828 km) of the rail network in 6 of the related Member States will be non-compliant by 2030, mainly due to the parameters of **train length** and **ERTMS** deployment (782 km).

For the other parameters (**axle load, speed and electrification**), those OEM CNC rail sections expected to be still non-compliant by the end of 2030 (based on national masterplans) are the following sections (approx. 100 km):

- Czech Republic: Děčín – Ústí n. Labem Střekov (Speed)
- Slovakia: Petržalka – Rajka (Speed)
- Bulgaria: Konyovo – Kermen (Speed)
- Greece: Thessaloniki – Thessaloniki port (Axle load, electrification)
- Greece: Tris Gefyres – Pireas (Axle load)

### 2.5.2 Inland Waterways

The OEM IWW network is related to the German and Czech waterways with the following issues in 2015:

- Permissible Draught: The requirement for the minimum draught of 2.5 m is fulfilled on 670 km (40%) of the OEM IWW network.
- Permissible height under bridges: The requirement for minimum height under the bridges (>5.25 m) is fulfilled on 1,206 km of waterways, representing 73% of the OEM IWW network.
- CEMT class IV: 1,627 km (98%)[4] are allowed for vessels of CEMT class IV or higher, except along Týnec nad Labem - Pardubice.
- RIS systems are deployed on 1,627 km of waterways (98%) of the OEM IWW network.

For 2030, it must be expected that certain parts of the OEM IWW network will still fail to meet the TEN-T requirements:

- The Czech sections Mělník - Usti nad Labem (71 km) and Mělník - Týnec nad Labem (97 km) are not compliant in terms of minimal draught;
- The Czech section Týnec nad Labem – Pardubice (32 km) is not compliant in terms of RIS implementation;
- The German Elbe sections Lauenburg – Wittenberge – Magdeburg - Schmilka (570 km) are not compliant in terms of minimal draught;
- The German Elbe section Lübeck - Lauenburg (Elbe-Lübeck-Kanal), 68 km, is not compliant in terms of minimum underpass height.

### 2.5.3 Inland ports

There are 10 defined OEM core river ports. The problematic parameter for all nine inland ports is the “Availability of alternative clean fuels”, which does not exist in any port.

The planned core inland port of Pardubice does not exist yet, while its implementation is delayed and works will not start before 2020. In addition, the core inland port of Praha-Holešovice is deemed to be out of operation for freight handling and, thus, the Praha core port might be re-defined. Based on the known projects, this situation will not significantly change in 2030, thus interventions are proposed. The full operation of Pardubice port by 2030 is doubted.

### 2.5.4 Seaports

The OEM seaports include 12 core ports, the German Ports of Hamburg, Bremerhaven, Bremen, Wilhelmshaven and Rostock, the Greek Ports of Pireas, Heraklion, Thessaloniki, Igoumenitsa and Patra, as well as Burgas and Lemesos in Bulgaria and Cyprus, respectively. Bremerhaven, Bremen and Hamburg ports also constitute core inland ports. The OEM Corridor includes one Motorways of the Sea (MoS) link in the Eastern Mediterranean Sea connecting the hinterland of the Greek Port of Pireas to that of the Port of Lemesos in Cyprus via the Port of Heraklion in Greece. By the end of 2016, the Ports of Igoumenitsa and Patra in Greece are still lacking connections to the country’s railway network, while all OEM ports lack the facilities to provide

[4] Although the CEMT resolution 1992-2 has classified waterways as Class IV if there is an unhindered operation of class IV standard ships with 2.5 meters draught, the competent authorities of Czech Republic and Germany, RVC Directorate of Waterways and WSV Waterway and shipping administration respectively, have classified the majority of their OEM IWW network as being compliant with class IV or higher, even as a fairway depth of 2.5 m is not in place, yet.

alternative fuels for maritime transport. In addition, limited capacity is an issue for several ports, both in terms of their individual handling capacity and that of their hinterland rail and road connections. Finally, Greece has yet to implement the National Single Window in accordance with Directive 2010/65/EU.

The bottlenecks identified for the OEM seaports will be partly alleviated by 2030. Compliance is doubted with regard to the missing rail connection to the Port of Igoumenitsa. Moreover, there is a distinctive lack of implementation projects concerning the provision of alternative fuels facilities for maritime transport, particularly in the south part of the Corridor. There is also still a need for the deployment of operational single window/e-maritime services in Greek ports to improve their performance and achieve interoperability.

### 2.5.5 Rail-Road Terminals

The analysis shows that only 4 of the 25 RRTs, namely Hamburg-Billwerder, Bremerhaven, Leipzig and Berlin-Großbeeren, are fully compliant with the requirements set out in Regulation No. 1315/2013 for "Capability for Intermodal (unitised) transhipment", "740m train terminal accessibility", "Electrified train terminal accessibility" and "Availability of at least one freight terminal open to all operators in a non-discriminatory way and application of transparent charges". Regarding the state of the RRTs, in Timişoara and Craiova, new terminals are planned to be built in order to replace the existing ones, for which no new investments are planned, although financing is not secured yet. No project is planned to replace the obsolete and inadequate to the needs terminal in Sofia. In Greece, the nominated RRT in Patra does not exist.

Compared to the numerous parameters that need to be improved, there are only 8 projects that tackle non-compliance, thus a number of projects are required for 17 RRTs (64% of OEM terminals) to fulfil the Regulation target and ensure an efficient and optimum integration of intermodal transport of goods on the Corridor.

### 2.5.6 Roads

The analysis of the OEM road network showed that as of the end of 2016 the length of sections that are non-compliant with the motorway/ express road criterion is 633 km or less than 12% of the total Corridor length. It is expected that by 2030, the non-compliant sections will be limited to only two with a total length of 137 km, for which no projects for upgrading to motorway/ express road were identified. Both are located in Bulgaria (Vidin – Montana and Vratsa – Mezdra).

Due to the high social relevance, specific attention is also required for speeding up the implementation of identified projects, which address (among other) safety problems. Sections with such projects are the Bruckneudorf – Nickelsdorf in Austria and Blagoevgrad – Sandanski in Bulgaria.

In the 2013 – 2016 period, the compliance to the availability of the alternative clean fuels requirement improved significantly. Specific projects to further address this are identified in DE, CZ, HU, and CY. Thus, no additional specific projects are deemed necessary.

The analysis on the availability of safe and secure parking areas along the Corridor shows an improvement of at least 7% compared to the 2013 status. It should be clearly noted that the actual number and location of rest areas along all sections of the Corridor meets the criterion set in the Regulation, i.e. to provide parking areas at least every 100 km. Some of the existing areas, however, either do not provide appropriated level of security, or information about security facilities is not available.

The adoption of TEN-T standards regarding the safety and security of parking areas seems necessary in order to guide further developments that are currently fully market driven.

Finally, it is explicitly recommended that special attention is paid to the deployment of intelligent transport systems, especially in those MS where basic IT infrastructure for data transmission is not yet in place. This will provide for the harmonization of currently fragmentized road tolling systems and provision of cross-border traffic information.

### 2.5.7 Airports

There are 15 core airports along the OEM Corridor (Hamburg, Berlin, Bremen, Hannover, Leipzig/Halle, Praha, Wien, Bratislava, Budapest, Timisoara, Sofia, Athina, Thessaloniki, Heraklion, and Larnaka).

Out of the six major core airports, 3 (Hamburg, Praha and Budapest) still need to be connected to "heavy rail" until 2050, i.e. can operate high-speed passenger trains. Praha and Budapest are covered by projects to solve these connection gaps. The Hamburg Airport is planning to carry out a study on the creation of a railway link from its northern catchment area, with unknown implementation date. Out of the entire set of core airports operating along the OEM Corridor, Bratislava, Timisoara, Sofia and Thessaloniki still miss the connection to rail. Bratislava is planned to be connected to rail by 2030. A multimodal train station has been planned for construction and completion by 2018 in the Timisoara airport; to present, there is no information on the actual construction works of the connecting rail line. Moreover, the progress to provide capacity for alternative fuels for aircrafts should be monitored in all Corridor airports, as no project is yet in place and this remains an "open issue".

## 2.6 Administrative and operational barriers

### 2.6.1 Rail barriers

As these barriers often cause significant competitive disadvantage for rail transport on the Orient/East-Med Corridor, through the meetings of an OEM **rail cross-border issues** Working Group, the following main barriers were identified:

**Table 3: Rail - identified admin/operational barriers and actions for intervention**

<table>
<tr><th colspan="2">Barriers</th><th>Actions</th></tr>
<tr><td rowspan="6">Cross-Border issues</td><td>Single track sections</td><td rowspan="6">1. Establishing an Action Plan on effective improvements of railways border crossing<br>2. Signing of Joint Ministerial Declaration on effective improvements eliminating the bottlenecks and facilitating international traffic on the OEM Rail Freight Corridor & significance of conclusion of cross-border agreements</td></tr>
<tr><td>Non-compliance of technical parameters</td></tr>
<tr><td>Double checking due to lack of principle of trust</td></tr>
<tr><td>Application of traditional national operational rules</td></tr>
<tr><td>Normative differences</td></tr>
<tr><td>Lack of coordination of operations (and modernisation/rehabilitation works)</td></tr>
<tr><td>Horizontal</td><td>ERTMS implementation</td><td>Implementation of ERTMS on-going/planned projects – existent Deployment Plan</td></tr>
</table>

### 2.6.2 Barriers in Inland Waterways

A number of administrative and operational barriers are defined for inland waterways of the OEM Corridor. Three main groups of barriers are distinguished: barriers in RIS implementation, workforce related barriers, operational barriers.

**Table 4: IWW - identified admin./operational barriers and actions for intervention**

| Barriers | | Actions |
|---|---|---|
| RIS implementation | Lack of sufficient funding | Implementation of Project for wider RIS deployment in CZ |
| | Limited personnel resources | |
| | Lack of international data exchange between DE and CZ (different tech. applications, legal problems) | |
| Workforce | Low inflow of personnel | Update and harmonisation of training programmes and qualifications requirements |
| | Differences in standards for professional training | |
| | Lack of harmonised system of professional qualifications reg. operational functions on board | |
| | Language barrier | Implementation of Riverspeak |
| Operational Barriers | Requirements for operation on parts of River Elbe (KSS certificate) | Regulatory intervention for mutual recognition of professional qualifications for IWT workers (Proposal for a Directive of the European Parliament). |
| | Required number of people in a ship crew | Harmonisation of requirements |
| | Restrictive operation times | Additional research to estimate economic viability of lock operation time extension |
| | Number of authorities and offices involved in certification | Simplification and harmonisation of procedures |

### 2.6.3 Barriers in Seaports

The key operational and administrative barriers identified in the majority of the 12 OEM ports are related to the multiplicity of actors involved and the related fragmentation of responsibilities and jurisdictions, the administrative, operational and legal framework complexity of maritime transport compared to other modes, as well as the lack of direct e-exchange of information and documentation.

**Table 5: Seaports - identified admin/operational barriers and actions for intervention**

| Barriers | Measures |
|---|---|
| Multiplicity of involved actors | Streamlining of procedures and establishment of an efficient coordination/cooperation modus operandi |
| Fragmentation of responsibilities and jurisdictions | |
| Administrative, operational and legal framework complexity | Harmonisation and simplification of procedures, certification of professional skills of transport personnel |
| Information exchange and documentation | Maritime "one-stop-shop" IT solutions |

### 2.6.4 Barriers in Roads

The big potential of innovations in road transport is limited by the fragmented implementation of different standards, unsatisfactory interoperability between countries and lack of cross-border continuity of services. Table 6 summarises the identified barriers for the road sector together with proposed measures to alleviate these.

**Table 6: Road - identified administrative barriers and actions for intervention**

| Barriers | Actions |
|---|---|
| Varying road charging agreements and lack of interoperability | Interoperable tolling systems |
| Lack of interconnected ICT systems | Harmonized cross-border traveller information services |
| Lack of sufficient number of safe and secure rest areas along long sections in CZ, HU, BG and EL | Provision of additional rest areas where necessary |

## 2.7 Urban Nodes Analysis

The OEM Corridor's 15 urban core nodes act as hubs for the integration of the Corridor's long distance traffic with the urban leg of TEN-T journeys and, most importantly, for the interconnections between the different modes within an urban conglomeration for both passenger and freight transport.

The OEM Road Corridor transits the majority of the 15 urban core nodes with the exception of Praha and Thessaloniki, but OEM road traffic can also by-pass the urban conglomeration in the German urban nodes, Budapest, Sofia, Thessaloniki and Athina. The construction of by-pass road arteries is either on-going or planned for Praha, Bratislava, Wien, Timisoara and Lefkosia and, once completed, an uninterrupted flow would be achieved along the Corridor by-passing urban centres. OEM rail arteries transit all urban nodes, where railway infrastructure exists, while these can also by-pass the nodes of Hamburg, Bremen, Hannover, Berlin, Thessaloniki and Athina. For the remaining urban nodes, the missing by-pass rail lines could be characterised as a bottleneck.

The analysis of the road and rail arteries within the urban nodes identified several issues of non-compliant parameters and capacity bottlenecks, mainly with regard to rail infrastructure. The majority of these, however, are being addressed by on-going or planned projects, while others, despite not being addressed by projects, are not deemed problematic by national infrastructure managers. In summary, persisting bottlenecks are the following:

- overburdened rail sections on the Stadtbahn and in Spandau in Berlin
- minimum speed (≥ 100 km/h) partly achieved in Bratislava
- train length (≤ 740 m) in Praha
- axle load (< 22.5 t) in Thessaloniki

Regarding core/nodes and last-mile connections, the following main bottlenecks are identified:

- missing motorway / express road connection to the Praha Uhříněves RRT;
- insufficient capacity of the Budapest airport-city centre road link;
- exhausted capacity and inappropriate location of existing RRT in Sofia;
- need for modernizing the Sofia railway node and the Sofia – Pernik railway line;
- last-mile connections of rail, seaport and airport nodes only possible through congested urban arteries in Thessaloniki.

With respect to the interconnection of modes within urban nodes, and with the exception of Thessaloniki and Lefkosia, no particular issues have been raised, apart from congestion in urban/local roads, which affects the performance of the long-distance services and raises traffic safety concerns.

Nevertheless, from a TEN -T infrastructure perspective, it can be assumed that upon completion of the infrastructure works, the integration of the OEM Corridor via a seamless connection of long-distance traffic with local traffic will be safeguarded within the OEM urban node areas, while the majority of urban nodes will foster intermodality with efficient last-mile connections.

## 2.8 Innovation and environmental impact

### 2.8.1 Innovation Deployment

In the OEM Corridor, there are somewhat 20% of the total projects which have been identified as innovative under the Methodology for Task 3b. Of the innovative projects, more than half have been categorised as *Catch-up innovation*, or otherwise known as projects being related to innovation which is transferable across the EU, typically already implemented in one part/country and due to its success – implemented in more (CEF or Horizon 2020). This is a common trend found among all Corridors.

When looking at the projects per project category, it can be primarily noted that there are innovative projects present in each project category of the project list. Looking further into the characteristics of innovative projects in the OEM Corridor, it is observed that *Data sharing* and *Safety* are common issues being addressed both as applications of projects and impacts. *Decarbonisation* is addressed by around a third of all innovative projects, with a vast majority of them being related to the *Use of alternative fuels*.

Taking a closer look at the costs for innovation, innovative projects account for solely 4% of the total cost of all projects in the Project List[5]. Analysing what enables and potentially "disables" innovative projects, it was found that funding is the most common enabler and barrier.

In light of the above, there is a clear need to further roll out innovation on all parts of the Corridor in order to further stimulate adaptation to climate change, decarbonisation and modal shift.

### 2.8.2 Climate Change Adaption

The Corridor has a temperate continental climate in the north, while it ends in a hot Mediterranean climate in the southeast. In parts of Bulgaria, Greece, Hungary, Romania and Slovakia, there is a high probability that the vulnerability of road pavement to heat stress will increase extremely in the upcoming century. The other parts of the Corridor will also experience some increased vulnerability.

It is estimated that Eastern Austria, Southern Romania, parts of Bulgaria and of Greece are most vulnerable for rail track buckling until 2100. The other parts of the Corridor will only encounter a small increase in rail track buckling vulnerability. In parts of the Czech Republic, Romania, Bulgaria, and Northern Greece, bridges are likely to become more exposed to bridge scour risk. There is a clear distinction between the northern and southern part of the Corridor when it comes to areas affected by drought. The northern part will likely become much wetter, while the southern part will experience more droughts in the upcoming century. Finally, along the coasts of the countries crossed by the Orient/East-Med Corridor, the sea-level will increase, with exception of the Black Sea coasts for which there is no data.

[5] This analysis includes only projects for which Total costs were provided.

### 2.8.3 Mitigation of Environmental Impacts and Decarbonisation

The OEM Transport Market Study from 2014 has been used to forecast data on freight and base-year data on passenger. In the *Business As Usual* scenario for 2030 (BAU)[6], a growth of freight transport is predicted. In the *Potential* scenario 2030[7], for freight transport, there are mostly modal shift effects from road to rail and to IWT.

Compared to the base year 2010, in the *BAU scenario*, the freight volumes for Road and Rail will double in size. IWW and Maritime are expected to increase by 5 million tonnes and 10 million tonnes, respectively. On the other hand, the total modal shift in the *Potential scenario* is 28 million tonnes from road to rail, while from road to IWW, it is 17 million tonnes.

Furthermore, on the OEM CNC, there are 28 projects contributing directly to decarbonisation. A number of successful examples of Decarbonisation were identified, the majority of which are related to increasing the usage of electricity as an alternative fuel by implementing it in the public transport and increasing the number of EV charging stations.

Most decarbonisation projects are transferable and hence successful practices can be initiated in other regions and/or countries. Scalability on the other side arises from the fact that the innovation in the specific case is made available for users. It relies on the fact that the demand increases by making the innovation at hand available.

## 2.9 Potential market uptake of IWT / Modal Shift

The market uptake is based on an investigation of the transport demand, critical needs, seasonal trends, traffic volumes, market related transport flows and prices, etc. To this end, this specific task identified the modes which possess the highest unused transport capacities on the OEM Corridor and their potential market uptake, based on a detailed analysis of transport flows and logistics requirements, in order to obtain a realistic view on market uptake.

Specific attention was paid to the last mile transport connections and the relevance of the nodes. The targeted modes are those which are most environmentally friendly, inland waterways, in particular.

The modal shift potential is mainly related to the inland waterway network; as it was shown in the final report of the 2014 study, the forecasted capacity in 2030 is limited on the railway network and a shift towards rail would further exacerbate capacity problems. A shift from road to rail has also been identified as a result of potential compliance to TEN-T standards 2030.

The inland waterway network of the OEM Corridor where additional capacity is available is notably related to the Elbe River, especially once bottlenecks related to the non-compliance of certain technical parameters are minimized. The inland waterway potential of the Danube River is referred in the analysis of the Rhine-Danube CNC that overlaps with the OEM Corridor.

The main objective of the 'analysis of modal shift potential' is to identify individual transport flows that, if jointly hauled, could bring enough volume to operate a liner service between two (or more) inland terminals. A top-down approach has been used to determine the multimodal market potential.

[6] The BAU scenario is based on the assumption, that none of the future projects included in the OEM Project list will be implemented until 2030 (status quo).
[7] The Potential scenario assumes the implementation of all projects in the OEM project list until 2030.

The total potential for the OEM Corridor for three alternative scenarios for 2030 was calculated. These constitute the current road volumes that can be containerised and shifted to inland waterways (including pre- and end haulage) on the river Elbe. A large potential is available, even in the case of the most efficient scenario for direct road transport, where it ranges from 3.3 mln tonnes to 59.2 mln tonnes. The current volume (2010) on the Elbe river is 18.7 mln tonnes.

## 2.10 Overall investment analysis

The OEM Corridor updated project list is composed by 415 projects, belonging to 9 countries and 9 different categories. A significant share of the projects is to be found in Rail, Maritime and Road categories, with these three modes accounting for 75% of the total.

Key figures are:

- 92 (48 OEM only) projects have been completed in 2014-2016
- 41 (14 OEM only) projects are to be completed during 2017
- 212 (57 OEM only) on-going projects, with 53 started in 2016
- 209 (69 OEM only) projects (50%) with end date in 2016-2020
- 275 projects overlap with other Corridors.

Investments:

- € 68 billion (cost information was made available for 376 projects).
- € 30 billion for OEM only projects.

The relative majority of the projects will be deployed in Germany, which alone accounts for 129, roughly a third of the grand total. The Czech Republic, Greece and Bulgaria follow with 61, 50, and 35 projects, respectively.

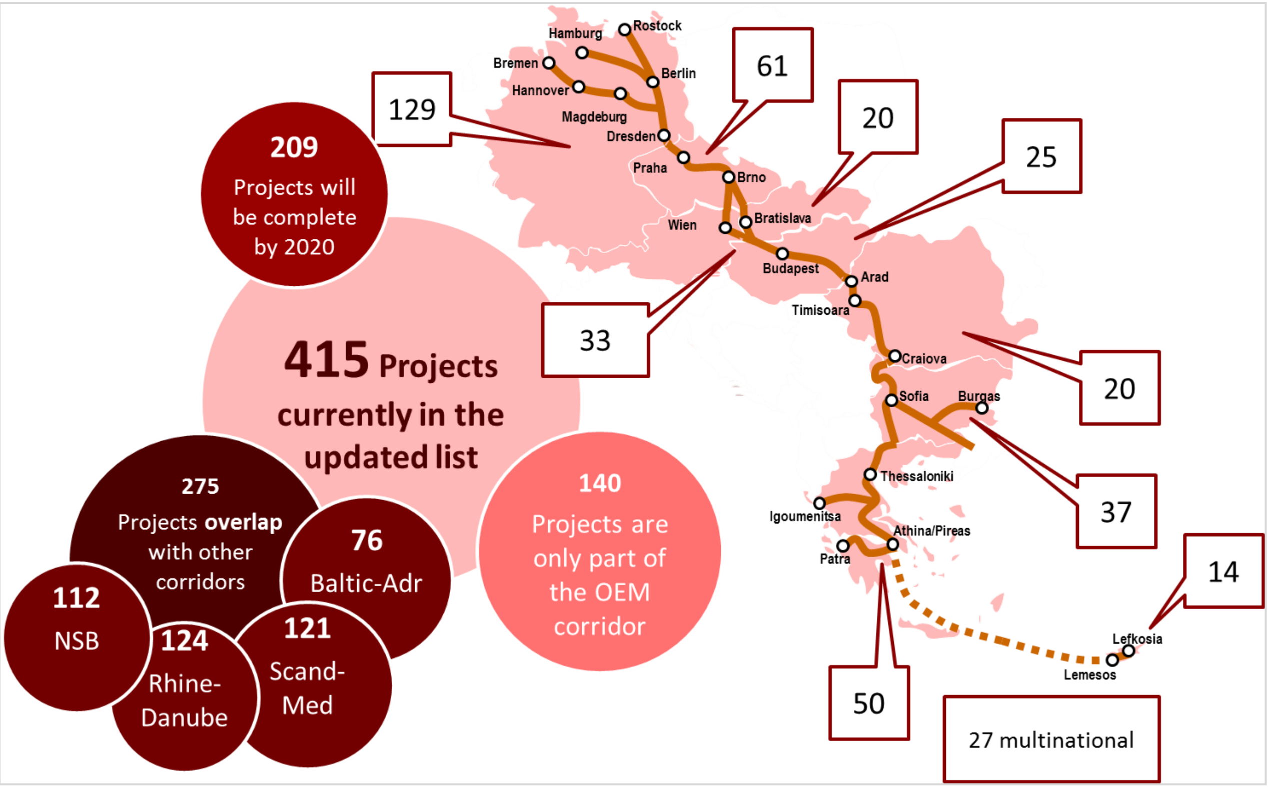
The economic impact of the Corridor projects can be expressed in different forms, among which total cost is noticeably the first and more impactful one: **€ 68.188.290.000** (sixty-eight billion Euro) is the estimated total investment needed to perform all the works and studies, with 82% of the projects falling in a cost class ranging from € 0-500 mln. More specifically, 107 fall within the <€10 mln class category, 115 in the € 10-5 0 mln class, 41 into the €50-100 mln cluster and 84 between €100 and €500 mln.

Figure 3 below gives an overview of the OEM CNC in terms of number of projects per Member State, overlapping projects with others CNCs and projects to be completed already by 2020, while Figure 2 provides an overview per mode in terms of number and cost.

**Figure 2: OEM project list in terms of modal categories and total cost in million €**


*Source: OEM CNC study, 2017*

**Figure 3: OEM project list and number of projects per MS**




*Source: OEM CNC study, 2017*

Data regarding project costs are available for 376 out of 415 projects, i.e. 91% of the total.

## 2.11 Estimation of socio-economic impact of the Corridor

A short-term macro-economic analysis on the impact of OEM CNC projects resp. investments on jobs and growth was performed based on an approach developed in the Fraunhofer Study "Cost of Non-completion the TEN-T Core Network (2016)"[8], whereby multiplying factors were derived that were linked with the recent list of projects and their total costs.

Those OEM CNC projects for which cost estimates are available and that are planned to be implemented over the period 2016 to 2030 amount to an investment of € 68.1 billion. The implementation of these projects will lead to an increase of GDP over the period 2016-2030 of € 517 billion, in total. Further benefits will occur also after the year 2030.

The investments will also stimulate additional employment. The direct, indirect and induced job effects of these projects will amount to 1,494,000 additional job-years created over the period 2016 to 2030. It can be expected that also after 2030, further job-years will be created by the projects.

[8] Schade W., Krail M., Hartwig J., Walther C., Sutter D., Killer M., Maibach M., Gomez-Sanchez J., Hitscherich K. (2015): "Cost of non-completion of the TEN-T". Study on behalf of the European Commission DG MOVE, Karlsruhe, Germany.

# 3 Conclusions and key aspects from the analysis

The **Orient / East-Mediterranean Corridor** is a long north-west to south-east corridor which connects Central and South-East Europe with the maritime interfaces of the North, Baltic, Black and Mediterranean seas. It runs from the German ports of Bremen, Hamburg and Rostock via the Czech Republic and Slovakia, with a branch through Austria, further via Hungary and Romania towards the Bulgarian capital of Sofia, with links to the port of Burgas and to Turkey, then to the Greek ports of Thessaloniki, Igoumenitsa, Patra and Pireas, ending with a "Motorway of the Sea" link to Cyprus.

It comprises railways, road, airports, ports, rail-road terminals and the Elbe-Vltava waterway (IWW) system (Brunsbüttel – Mělník – Praha/ – Pardubice; Germany and Czech Republic) with the IWW links from Magdeburg to Bremerhaven (Mittellandkanal and River Weser) and from Lübeck to Wolfsburg (Elbe-Seitenkanal and Elbe-Lübeck-Kanal in Germany). In Cyprus, no rail infrastructure is deployed. Corridor related maritime infrastructure exists in 4 countries, namely Bulgaria, Cyprus, Germany and Greece.

Two Rail Freight Corridors have been adapted to the same alignment, the RFC 7 "Orient / East-Med" on the central and southern section Praha – Budapest – Sofia – Athina and branches of the RFC 8 "North Sea Baltic" along the northern section between Bremerhaven / Wilhelmshaven / Hamburg and Praha.

The **9 Member States** involved are (in alphabetical order): Austria, Bulgaria, Cyprus, Czech Republic, Germany, Greece, Hungary, Romania, and Slovak Republic.

Several segments of the Orient/East-Med Core Network Corridor are coinciding with others of the 9 Core Network Corridors, such as:

- Rhine-Danube Corridor (approx. 1000 km, in CZ between Praha and Brno, along the road/rail routes Wien - Bratislava – Budapest – Drobeta – Calafat – Vidin),
- North Sea - Baltic Corridor (between Wilhelmshaven/Bremerhaven and Magdeburg resp. Hamburg and Berlin),
- Scandinavian-Mediterranean Corridor (Rostock – Berlin, Hamburg and Hannover nodes)
- Baltic - Adriatic Corridor (between Brno/Přerov and Bratislava resp. Wien).

In summary, the infrastructure of the Orient / East-Med Core Network Corridor is characterised by a North-South divide of typical infrastructure supply and quality, mirroring each Member State's economic conditions, also with respect to its year of accession to the European Union. An additional challenge is the Corridor's geographical alignment, especially in the southern Member States, where the relatively high costs of transport infrastructure crossing mountainous terrain is severed by a still relatively low transport demand.

Table 7 provides the background information on network characteristics and socio-economic statistics of the catchment area for the Orient/East-Med Core Network Corridor.

**Table 7: Background information on the Corridor**

| Scope | Unit | Baseline value (2010) | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|
| GDP (of crossed NUTS3 areas) | € mln (curr. prices) | 1.393.925 | 1.380.984 | 1.410.466 | 1.463.840 | t.n.a. |
| Employment (of crossed NUTS3 areas) | Persons | 29.935.910 | 30.498.900 | 30.865.400 | 31.074.300 | 31.661.700 |
| Population (of crossed NUTS3 areas) | | 67.918.633 | 70.435.156 | 66.544.068 | 66.650.205 | 70.749.354 |
| OEM Rail Network | km of align-ment | - | 5.851 | 5.851 | 5.850 | 5.884 |
| OEM Road Network | | - | 5.430 | 5.432 | 5.416 | 5.369 |
| OEM IWW Network | | - | 1.659 | 1.659 | 1.659 | 1.659 |

| OEM Corridor Nodes | Unit | Defined by Reg. 1315/2013 (Annex 2) | Nodes in operation |
|---|---|---|---|
| Core Seaports | **Number** | 12 | 12 |
| Comprehensive Seaports | | 7 | 7 |
| Core Inland waterway ports | | 10 | 9 |
| Comprehensive Inland waterway ports | | 16 | 16 |
| Core Airports | | 15 | 15 (thereof 6 major airports acc. to Art. 41) |
| Comprehensive Airports | | 7 | 7 |
| Core RRTs | | 25 | 24 |
| Comprehensive RRTs | | 11 | 11 |

*t.n.a. - temporarily not available data*
*Source: EUROSTAT, Panteia, October 2017*

## 3.1 Compliance with the technical infrastructure parameters of the TEN-T guidelines - 2016

Regarding the Corridors' infrastructure, Regulation No.1315/2013 puts forward explicit target values for technical infrastructure parameters that need to be met by 2030, the latest.

On the basis of the latter, a compliance analysis was performed with a view to compare the OEM current (end-2016) infrastructure parameters with the standards stipulated by the Regulation. The analysis identified compliance deficiencies on Corridor sections and nodes.

**Table 8 Generic supply-side key performance indicators for OEM (2016)**

| Mode | KPI | 2016 |
|---|---|---|
| Rail network[9] | Electrification | 89% |
| | Track gauge 1435mm | 100% |
| | ERTMS implementation | 13% |
| | Line speed >=100km/h | 78% |
| | Axle load >=22.5t | 82% |
| | Train length (740m) | 50% |
| Inland waterway network | CEMT requirements for class IV IWW | 98% |
| | Permissible Draught minimally 2.5m (min 1.4m) | 40% (60%) |
| | Permissible Height under bridges (min. 5.25m) | 60% |
| | RIS implementation (minimum requirements set out by the RIS directive are met) | 98% |
| | Availability of ≥1 freight terminal open to all operators... | 80% |
| Seaport | Connection to rail | 80% |
| | Connection to IWW CEMT IV (relevant to 3 out of 12 seaports: Hamburg, Bremen, Bremerhaven) | 100% |
| | Availability of alternative clean fuels | 0% |
| | Availability of at least one freight terminal open to all operators in a non-discriminatory way and application of transparent charges | 100% |
| | Facilities for ship generated waste | 100% |
| Inland ports[10] | Class IV waterway connection | 100% |
| | Connection to rail | 89% |
| | Availability of alternative clean fuels | 0% |
| | Availability of at least one freight terminal open to all operators in a non-discriminatory way and application of transparent charges | 89% |
| Road network | Express road/ motorway | 88% |
| | Availability of alternative clean fuels | n.a. |
| Airport | Connection to rail | 54% |
| | Availability of at least one terminal open to all operators in a non-discriminatory way and application of transparent, relevant and fair charges | 100% |
| | Capacity to make alternative clean fuels available to airplanes | 100% |
| | Availability of alternative clean fuels | 0% |
| Rail-Road Terminals (RRT) | Capability for Intermodal (unitised) transhipment | 79% |
| | 740m train terminal accessibility | 25% |
| | Electrified train terminal accessibility | 46% |
| | Availability of at least one freight terminal open to all operators in a non-discriminatory way and application of transparent charges | 71% |

*Source: OEM CNC study, 09/2017*

[9] KPI values are based on the recent length of operated OEM rail network.
[10] KPI values are based on the recently operated inland ports.

The infrastructure of the **railway network** along the OEM Corridor is still in considerable parts of the alignment not compliant with some of the technical characteristics thresholds set out by Regulation No. 1315/2013, particularly regarding the key infrastructure parameters train length and control system (ERTMS). For other technical characteristics such as operational (line) speed, axle load, electrification, the non-compliance along the Corridor is around or below 20%.

In summary, 87% of the OEM rail network is not compliant with the requirement for ERTMS[11] deployment; when considering ETCS baseline 2 only, the value accounts to 98% of network non-compliant to ERTMS (by end of 2016). In 50% of the network a train length of 740m is not allowed. Minimum Axle load of 225 kN is an issue in Hungary, Romania and Greece, summing up to 17% non-compliance rate of the OEM rail network. A maximum operating speed of lower than 100 km/h is a barrier for freight trains in Bulgaria and its cross-border sections to Romania and Greece, amounting to 21% of the OEM rail network, while only 11% of the network is not electrified.

The analysis of the **Rail-Road Terminals** along the OEM Corridor shows that only 4 of the 25 RRTs, namely Hamburg-Billwerder, Bremerhaven, Leipzig and Berlin-Großbeeren, are fully compliant with the TEN-T requirements. In Timişoara and Craiova, substitution of outdated terminals is planned, albeit still without secured financing. Sofia's terminal is deemed inadequate. The nominated RRT in Patra does not exist. Also for 17 other terminals, no or insufficient projects are known, hampering an efficient and optimum integration of intermodal transport of goods on the Corridor.

The analysed **OEM inland waterway network** comprises of the Rivers Elbe (Labe), Weser and Vltava, as well as the canals Elbe-Seitenkanal, Elbe-Lübeck-Kanal, and Mittellandkanal. River Danube is exclusively addressed in the analysis of the Rhine-Danube Corridor. Overall, around 1,627 km of IWW are compliant with the two TEN-T requirements, representing 98% of the OEM IWW network. The non-compliant section is the uppermost river section of Elbe / Labe between Týnec nad Labem and Pardubice.

- CEMT class IV: The majority of the OEM IWW network (98%) is allowed for vessels of CEMT class IV or higher, based on the requirement of navigability for ships of 9.5m horizontal width, disregarding other parameters (such as draught and underpass height) that are not necessarily to be met.
- RIS systems are deployed on the same section.

With regard to the additional parameters assessed:

- Permissible height under bridges: A minimum height under the bridges (>5.25 m) is fulfilled on 999 km of waterways, representing 60% of the OEM IWW network. Recent non-compliant section is the TENtec section "CZ/DE border – Magdeburg" (332 km) with three historic road bridges in Dresden (Albertbrücke, Augustusbrücke, Marienbrücke), which are non-compliant in the case of highest navigable water level. Other non-compliant sections are the Elbe section Týnec n.L. – Pardubice (32 km), the entire navigable Vltava river (94 km), the Elbe-Lübeck-Kanal (68 km) as well as the Weser river section Bremen – Minden (117 km).
- Permissible Draught: A minimum draught of 2.5 m is only fulfilled on 670 km (40%) of the OEM IWW network, whereas the free-flowing parts of Elbe are between Ústí nad Labem – Střekov and Hamburg. A so called Good navigation status of free-flowing IWWs (i.e. days with water depth >2.5 m) is achieved as

[11] The calculation of the KPI "ERTMS in operation" from this study does not distinguish between different ETCS levels (as this is part of the European ERTMS deployment plan and the related study by DMT consortium). Thereunder, CNC rail sections that are currently in operation with baseline <2 or no legal versions, are not counted as compliant sections.

follows: Ústí n.L. Střekov - CZ/DE border: 0 days; DE border – Magdeburg: 111 – 187 days; Magdeburg: 341 days; Magdeburg–Hamburg: 130 – 150 days

- Locks reliability (locks to be out of service) is problematic for the following stretches:
  - Germany: Biggest issue is lift Lüneburg-Scharnebeck,
  - Czech Republic: the main problematic locks are located on the Vltava sections, mainly within the city of Praha and at the Upper Elbe between Mělník and Přelouč.

The replacement of the Lüneburg-Scharnebeck lift is foreseen in the German Federal Transport Infrastructure Plan (BVWP 2030).

A jointly coordinated schedule is expected with the German study "Gesamtkonzept Elbe". During the Bonn meeting in September 2017, German IWW authorities stated that a minimum draught of 2.5 m cannot be met by 2030, due to the nature of the River Elbe along that section. Based on the agreement made in the "Gesamtkonzept Elbe" among all German stakeholders, the German authorities are putting efforts to render this section compliant to a draught level of at least 1.4 m. Key objective is to provide reliable operating conditions for inland waterway transport. Considering the latter, the OEM draught compliance rises from 40% to 64%.

RIS is fully implemented in Germany, whereas in Czechia it is only 90% due to the new section Týnec nad Labem – Pardubice, which is still not navigable. Furthermore, in the Czech Republic, basic RIS applications have been implemented, but certain LAVDIS services such as provision of Notices to skippers suffer from the lack of reliability of their operation. Overall, the on-going implementation of RIS applications or its coverage on the complete IWW network is delayed due to low benefit cost ratios and limited personnel resources.

There are 10 defined OEM core **river ports**. The planned core inland port of Pardubice does not exist yet. None of the 9 existing core OEM inland ports, namely Hamburg, Bremerhaven, Bremen, Hannover, Braunschweig, Magdeburg, Děčín, Mělník and Praha-Holešovice, is fully compliant with all of the requirements set out in Regulation No.1315/2013, regarding the connection with rail, connection with road, the availability of at least one terminal open to all operators in a non-discriminatory way and application of transparent charges, as well as the availability of alternative clean fuels. No further RIS development plans are known for the Czech core network ports (Děčín, Mělník and Praha-Holešovice); especially, the direct input to the service "Notices to skippers" is not established yet.

The main problematic parameter for the nine operating inland ports is the "Availability of alternative clean fuels", which does not exist in any port. In addition, the core inland port of Praha-Holešovice is deemed to be out of operation for freight handling and could lose its limited connection to rail.

A key requirement of Regulation No. 1315/2013 is a **maritime port** connection with the road and rail network. The Ports of Igoumenitsa and Patra in Greece are currently lacking connections to the country's railway network (80% compliance). All OEM seaports are fully compliant with the requirement to offer at least one terminal open to users in a non-discriminatory way applying transparent charges, while all ports also provide port waste reception facilities. The Ports of Bremerhaven, Bremen and Hamburg have waterway connections of CEMT class IV. An additional requirement of the Regulation is the provision of publicly accessible Liquefied Natural Gas (LNG) refuelling points for maritime transport. Such facilities are currently missing from all OEM ports.

**Road infrastructure** along the Corridor shows the highest level of compliance with technical requirements compared to the other modes' infrastructure. Currently, the largest part of the OEM road Corridor is either of motorway or express road class (88%), while the total length of conventional road sections is 633.8 km.

By the end of 2016, some 95% of the Corridor length is covered by stations for at least one type of alternative fuel, compared to some 89% in 2013. The total number of alternative fuel stations located at a less than 10 km distance from the OEM Corridor route exceeds 1 800.

LPG and CNG are widely available in all OEM countries, except Cyprus in the case of CNG, although the density of the stations along the Corridor differs from country to country. The number of infrastructure systems of publicly accessible stations to recharge electric vehicles is steadily increasing.

Progress of a minimum of 7% is reported in respect to the availability of safe and secure parking areas along the Corridor. The actual number and location of rest areas along all sections of the Corridor meets the criterion set in the Regulation, however, these either do not provide appropriate level of security, or information on security facilities is not available. In Romania, Bulgaria and Greece, there are still long road sections without any suitable facility.

Out of the six major core **airports**, 3 (Hamburg, Praha and Budapest) still need to be connected to "heavy rail", i.e. capable to operate high-speed passenger trains. In addition, Bratislava, Timisoara, Sofia and Thessaloniki airports still miss a connection to rail.

Concerning the availability of alternative clean fuels, currently, no fixed storage tank facilities for aviation biofuel are reported to be in use in the OEM airports.

Regarding the availability of alternative clean fuels for airport ground services (e-mobility, hydrogen, CNG, LPG); certain airports have recently introduced charging or fuelling stations. Natural gas (CNG) and liquid gas (LPG) are already being used at Hamburg Airport as low-emission fuels, while a Hydrogen Project was introduced earlier.

In 2013, a charging station for e-cars and a LPG fuelling station for the operation of 37 natural gas-powered vehicles were introduced in the Wien Airport.

The analysis of the OEM Corridor's infrastructure compliance with the technical parameters of the TEN-T guidelines is presented in detail in the "Final Report on the Elements of the Work Plan (Part 3a Infrastructure)", June 2017.

## 3.2 Accomplished projects

Since the adoption of Regulation No.1315/2013, **92 projects** were accomplished[12] along the alignment of the Orient/East-Med CNC **until December 2016**, divided per mode of transport as follows:

- Rail: 32 projects, € 5000 mln
- Rail ERTMS: 4 projects, € 125 mln
- Air: 15 projects, € 880 mln
- Road: 24 projects, € 2300 mln
- IWW: 7 projects, € 60 mln
- Maritime: 8 projects, € 420 mln
- Multimodal: 3 projects, € 140 mln

[12] Total investment: € 8.9 billion

Accordingly, supply related corridor indicators for rail increased between 1 and 5 %-points between 2013 and 2016, the largest increase noted for the electrification (now 88%) and axle load (80%) ones. Between the years 2013 and 2016, there has been a 7% increase in the express road/ motorway KPI and one additional airport has achieved rail connectivity. For the remaining modes (inland waterways, seaports, inland ports and Rail-Road Terminals), there have been no changes in the KPIs during this period.

In addition, 41 projects have been completed –or are expected to be completed by the end of year 2017 along the OEM Corridor, for a total value of € 8.7 billion.

Regarding the scope of work of the projects completed so far, the vast majority entailed studies and infrastructure works (rehabilitation, upgrade and new construction).

**Table 9: Scope of work of projects finalised in 2014, 2015 and 2016**

| Scope of work | Number of projects |
|---|---|
| Studies | 35 |
| Infrastructure works rehabilitation | 10 |
| Infrastructure works upgrade | 32 |
| Infrastructure works new construction | 24 |
| Maintenance equipment IWW | 0 |
| Rolling stock, vehicles, barges | 2 |
| Alternative clean fuels provision | 0 |
| Administrative procedures (IWW ports) | 10 |
| Telematics applications (RIS, ITS, ERTMS) | 8 |

*Source: OEM Project list 2017, status 05/2017. Note: For each project, multiple scopes might be assigned.*

A comprehensive summary of the accomplished projects per mode is given in section 9.

## 3.3 Demand for the Corridor

### 3.3.1 Traffic Demand and Forecast

The Multimodal transport market study (MTMS), performed in 2014, described the transport market characteristics of the OEM Corridor in its present condition and in the future.

It essentially intended to analyse the OEM Corridor-related transport system and assess the capacity and traffic flows on the respective parts of the infrastructure, covering the time period from 2010 to 2030. The time horizon of 2030 was selected as it represents a major milestone for European policy and, at the same time, provides a reliable basis for future results.

Within the 2nd update of the Work Plan in 2016, it was examined whether the same premises still hold compared to the figures of the MTMS of 2014. Therefore, the latest transport figures and the trend from 2010 are included.

Data from national sources such as national forecasting models and regional studies, as well as European sources such as the EU Reference scenario and the ETISplus databases have been employed.

The MTMS provides information on the macroeconomic framework as well as the Corridor-related demand flows creating the basis for the analysis.

The outcomes of the above activities led to the following results.

#### 3.3.1.1 Gross Domestic Product (GDP) and population

There are mixed results for population forecasts, since a decline is expected for 4 Member States. The development of GDP in the period 2010 – 2030 shows that for all countries in the OEM Corridor a positive growth is expected.

#### 3.3.1.2 The national transport volumes and demand scenarios

National forecasts and national transport figures are available through the project sources, as well as official national sources from the Corridor countries. One of the main conclusions is that forecasts, if available, are on a regional level within the country considered, but lack the regional detail in other countries. At best, a differentiation is obtained between domestic, import/export and transit traffic. This means that on the basis of this information, the OEM Corridor cannot be isolated from other corridors and any further analysis cannot be made at this stage.

For a number of countries, forecasts are either not available or are given in qualitative figures. This is limiting the scope of the potential for an overall in-depth analysis.

#### 3.3.1.3 Transport description of the OEM Corridor in 2010

The first level of Corridor traffic, that is transport within the Corridor catchment area, has been described for the base year 2010. For freight transport, the domestic transport has been included. Notably for road transport the domestic transport is carried out on short distances. This is one of the reasons why the volumes for road are relatively high. The short distance transport by road is explained by a high share of building materials, foodstuffs, agricultural products and final products.

This also concerns the last- or first mile transport related to long distance transport by rail or inland waterways, for example container transport. In the description and analysis, the short distance transport has been separated from long distance transport. On the longer distance, there is more competition between road versus rail and inland waterways.

#### 3.3.1.4 Integrated freight transport demand scenarios

The second level (origin and destination in the Corridor) and the third level (transit) of Corridor traffic for rail and road transport have been considered, in both, tonnes and tonne-kilometres. For rail, the first level traffic is subdivided in domestic and international traffic, and the second level in imports and exports. For road, the first level domestic traffic has been further split into domestic short distance and domestic long distance. The short distance transport is in general applicable for distances shorter than 80 kilometres.

Also, for inland waterways and maritime transport, forecasts for 2030 have been presented for land-land flows in the OEM Corridor. For inland waterways, in total, a growth of 25% is expected in the period 2010-2030, while a 14% for maritime transport.

The results for the forecasts are summarized in the table below.

**Table 10: Freight transport volume between the OEM regions for 2010, 2030 reference scenario; in 1,000 tonnes[13]**

| Mode | 2010 | 2030 reference scenario |
|---|---|---|
| **Road** | 415,483 | 746,158 |
| **Rail** | 189,711 | 379,966 |
| **Inland waterways** | 18,694 | 23,361 |
| **Maritime** | 74,995 | 85,578 |
| **TOTAL** | **698,884** | **1,235,063** |
| ***Rail share*** | *27.1%* | *30.8%* |
| ***IWW share*** | *2.7%* | *1.9%* |

*Source: OEM CNC study, 2017*

In the 2030 reference scenario [14], the share for **rail** is expected to grow from 27.1% in 2010 to 30.8%, whilst the share of **inland waterways** is expected to decrease from 2.7% in 2010 to 1.9% (despite increasing IWW transport volumes). If full compliance with TEN-T standards was achieved by 2030, the share of rail and inland waterways may be expected to increase. This is discussed further in section 5.3.7.

Investment in rail and inland waterway infrastructure is needed in order to attain a shift from road transport towards more environmental modes of transport.

#### 3.3.1.5 Integrated passenger transport demand scenarios

The passenger demand (in passenger traffic volume) for the period of 2010 to 2030 remains in the European reference scenario almost stable with a growth rate of 0.05% per year.

The analysis of the trend of 2010-2013 confirms the stable development of passenger transport, where there is a slight increase in car mobility, expected with increasing welfare levels.

### 3.3.2 Capacity issues

Capacity utilization of the OEM Corridor infrastructure has been analysed with a focus on the supply side of the infrastructure.

**Rail:** Capacity issues or potential future capacity bottlenecks exist on several sections of the OEM Rail Corridor, with the most important bottlenecks being:

- The section Dresden – Czech border is already highly used and freight transport volumes in the Elbe Valley increased between 6.5–11% during 2014- 2015. Out of the maximum 280 train slots per day, on average 126 freight trains, 17 long distance passenger trains and 56 regional trains, are travelling on this section. Given the forecasted growth in freight and passenger transport, there is a high probability that this section will constitute a bottleneck in 2030;
- The Praha – Česká Třebová line was at full capacity in 2010, and for the year 2030, freight transport volumes are expected to be doubled, confirming that this section is a significant bottleneck; existing capacity issues are partly addressed by projects for the section Pardubice – Česká Třebová.

[13] Aviation is not included as freight transport volumes are too low.

[14] The 2030 reference scenario is considering that none of the projects from the OEM Project list will be implemented until 2030 (status quo).

- For the rail sections to/from Budapest, a doubling of freight transport volumes is expected. According to the Hungarian railways, the planned improvements will be sufficient (i.e. upgrade of Budapest South Railway Bridge).
- The cross-border section Békéscsaba – Thessaloniki is rather long (1168 km, around 20% of the total OEM Corridor length) and runs on the territories of Hungary, Romania, Bulgaria and Greece. Currently, the characteristics of the railway lines are rather heterogeneous and many sections do not meet the requirements set by the Regulation No. 1315/2013, the technical barriers being often problematic, especially regarding train lengths and axle load or lack of ERTMS. According to the reference scenario for this section, volume growths for subsections are expected in 2030 in the range between 70% and 160%. The biggest growth is expected for the section Filiaşi – Arad in Romania. For the subsections in Bulgaria and Greece, a more modest growth (70%) is forecasted. Therefore, the Hungarian section Békéscsaba – Lökösháza HU/RO border and the Greek sections Domokos – Tithorea and Inoi – SKA (Sidirodromiko Kentro Acharnes) are lacking capacity. Nevertheless, certain existing projects address these issues by removing single track sections along the OEM (Békéscsaba – Lökösháza, HU/RO border – Curtici – Arad and Tithorea – Domokos), having positive effects on rail capacity.

Apart from expected demand, there are other factors that influence the future capacity of OEM rail infrastructure, such as the long border waiting times in rail freight transport and the capacity on mixed traffic lines. Single track sections do not necessarily imply capacity problems, as long as the number of trains does not exceed the line capacity leading to unsatisfying operational conditions. Long term planning should avoid single track sections.

All OEM **Rail Road Terminals** are linked with national rail and road networks, although the quality of "last mile" connections needs in certain parts to be improved and capacity problems solved. Regarding the state of development of RRTs, there are differences between the northern and southern Corridor parts, ranging from a dense network of terminal locations, albeit with limited capacities both in the terminals and the connecting rail and road network, to a lack of modern and efficient terminals with adequate capacity.

**IWW**: Being widely a free flowing river, the River Elbe is characterised in general by insufficient navigability conditions. Problems are heterogeneous and include unreliable draught conditions, incomplete network, limited underpass clearances, non-compliant lock chambers, capacity deficiencies, etc. Also, the Vltava River and the Elbe-Lübeck-Kanal between Lauenburg and Lübeck show similar problems.

One important bottleneck on the OEM IWW network is related to the ship lift Lüneburg-Scharnebeck (for CEMT Class V waterways). Due to the limitations in the length of lock chambers, only barges with a maximum length of 100 m can pass. The pushed convoys have to be decoupled for the passage and lifted or lowered individually. Furthermore, there is a problem with lock reliability, as at the moment, basic maintenance operations are on-going, resulting in longer waiting times. Currently, there is a project for the construction of a new lock in Lüneburg-Scharnebeck listed in the German Federal Transport Infrastructure Plan (BVWP 2030) under the category 'Vordringlicher Bedarf' (first priority), which would solve the above issues. However, its realisation date is unclear as the lack of human resources calls for the prioritisation of all inland waterways infrastructure projects, even if included in the "Vordringlicher Bedarf".

A major bottleneck for the Elbe waterway on the Czech side constitutes the 40 km long stretch of the river from Ústí nad Labem / Střekov to the CZ/DE border, which limits the navigability and hence its efficient use due to the significant fluctuation of the water level. Notably, navigation through this critical draught area is interrupted for approximately 3 to 6 months every year.

An additional issue is the insufficient capacity of the Praha-Smíchov lock chamber; this is addressed by a project planned for 2018.

**Seaports and hinterland connections:** The threshold of annual freight transhipment stipulated by the Regulation is exceeded by all OEM Corridor seaports. Capacity is a particularly prominent issue in the northern part of the Corridor. Several projects that include expansions and/or construction of terminals and additional facilities to accommodate growth in demand are expected to address the identified limited handling capacity at the Ports of Hamburg, Rostock and Lemesos, as well as the Greek Ports of Thessaloniki, Patra, and Igoumenitsa. With regard to hinterland connections, capacity issues have been identified at the Ports of Bremen, Bremerhaven and Hamburg. At the Port of Hamburg, several projects address the upgrade of both road and rail port and hinterland infrastructure, while there is an intense investment on the Bremerhaven port's railway system. In Cyprus, new link roads are foreseen to relieve congestion and improve access to both of the Port of Lemesos' two terminals. Finally, hinterland connection bottlenecks at the Port of Thessaloniki are being addressed by related projects to improve both the last mile connections, as well as the road and rail network within the port zone itself. Planned works are expected to relieve most capacity issues; nevertheless, the completion of a number of projects is foreseen beyond 2030.

**Road capacity:** As a general rule, congested road sections are located in urban agglomerations due to the overlay of international, regional and local traffic flows. Capacity bottlenecks are observed along several OEM Corridor sections with a total length of about 500 km, out of which some 40% are saturated motorway sections located in Germany, Czech Republic, Austria, Hungary and Cyprus. The remaining single-carriageway congested sections are located in Czech Republic, Hungary and Bulgaria. Capacity issues are addressed by planned projects for the completion of ring-roads (Praha, Wien, Budapest, Sofia, and Lefkosia) and upgrading or construction of new motorway sections in Czech Republic (D1), Austria (A5), Hungary (M15), and Bulgaria (A3 Struma).

### 3.3.3 Potential market uptake of environmental friendly modes

The modal shift potential is mainly related to free capacities of the OEM inland waterway network; as it was originally shown in the 2014 study, the forecasted capacity in 2030 is limited on the railway network and a shift towards rail would further exacerbate capacity problems.

In the 2nd Phase of the study, a potential shift from road to rail has also been identified as a result of potential compliance to TEN-T standards in 2030. Specific attention is paid to the last mile transport connections and the relevance of the nodes. The targeted modes are those which are most environmentally friendly, inland waterways, in particular.

Inland waterway transport is reliable, energy efficient and- most of all – has the capacity for expansion. It is considered "greener" than other transport modes due to its relatively low energy consumption and noise emissions. It is also considered highly safe, especially in the context of dangerous goods transport.

This is further analysed in section 4.1.

## 3.4 The identified projects to be realised by 2030

The project list compiled for the OEM forms the basis for the implementation of the Corridor by 2030. It depicts the way the Corridor is assumed to be developed in the future following the realisation of the on-going and planned projects in line with the provisions of Regulation No.1315/2013, while also the extent to which identified projects contribute to the Corridor's objectives.

The OEM Corridor updated project list is composed of 415 projects, belonging to 9 countries and 9 different categories[15]. A significant share of the projects is to be found in Rail, Maritime and Road categories, with these three modes accounting for 75% of the total. Key figures are:

- 92 (48 OEM only) projects have been completed in 2014-2016
- 41 (14 OEM only) projects to be completed during 2017
- 212 (57 OEM only) on-going projects, with 53 started in 2016
- 209 (69 OEM only) projects (50%) with end date in 2016-2020
- 275 projects overlap with other Corridors.
- Investments:
  - € 68 billion (cost information was made available for 376 projects).
  - € 30 billion for OEM only projects.

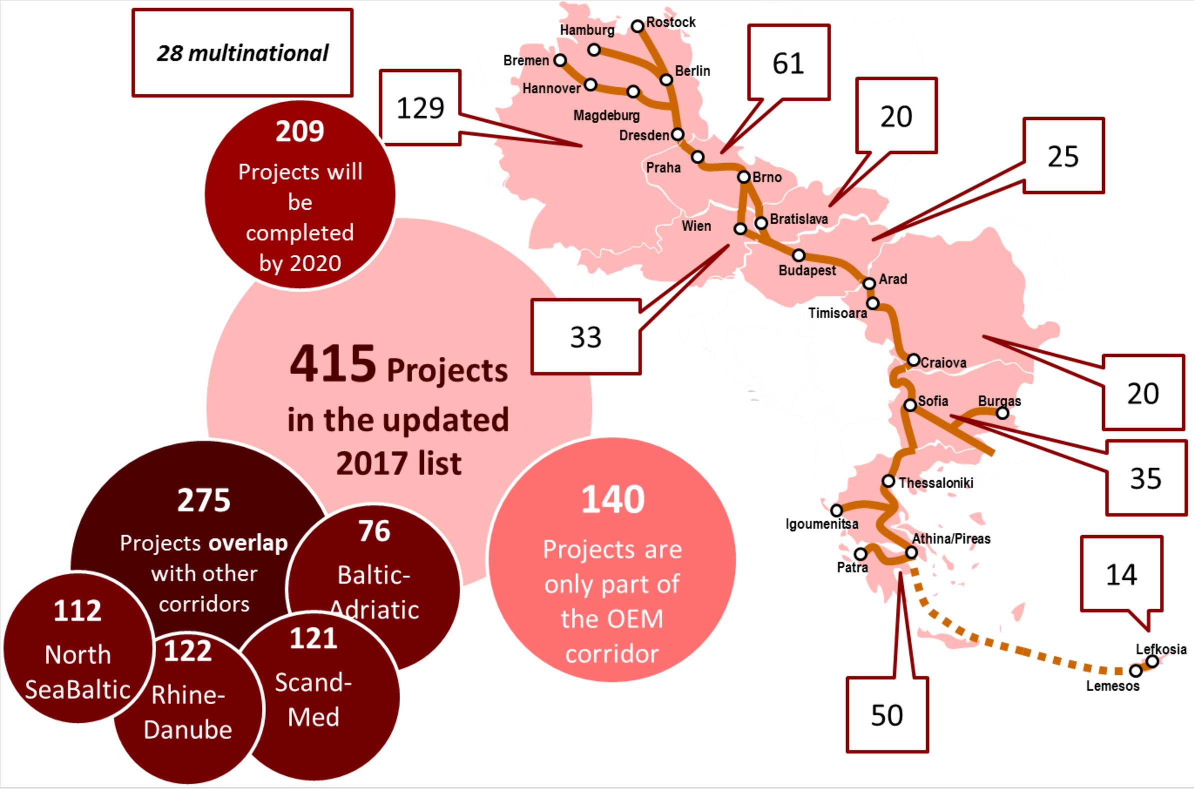
The relative majority of the projects will be deployed in Germany, which alone accounts for 129, roughly a third of the grand total. The Czech Republic, Greece and Bulgaria follow with 61, 50, and 35 projects, respectively.

The economic impact of the Corridor projects can be expressed in different forms, among which total cost is the first and more impactful one: **€ 68.188.290.000** (sixty-eight billion Euro) is the estimated investment needed to perform all the works and studies, with 82% of the projects falling in a cost class ranging from €0-500mln.

More specifically, 107 fall within the <€10mln class category, 115 in the €10-50mln class, 41 into the €50-100mln range and 84 between €100 and €500mln.

[15] 140 projects are only part of the OEM CNC.

**Figure 4: Number of projects per Member State and overlaps**




*Source: OEM CNC study, 2017*

140 out of the overall 415 projects (33%) are located on the Orient East Med Corridor exclusively. Among those Corridors the OEM is sharing projects with, the Rhine-Danube CNC is with 122 projects the most represented, followed by the Scandinavian Mediterranean with 121 projects.

74 Orient/East Med Corridor projects are related to a cross-border section. 28 projects were also marked as bilateral or multilateral projects.

59 projects refer to last-mile infrastructure between the Corridor lines and transhipment or interchange points (ports, terminals, airports, main stations). Urban nodes with particularly numerous last-mile projects are Hamburg (11 projects) and Bratislava (10 projects).

Finally, 166 OEM Corridor projects (40% of total) were identified to match the "pre-identified sections including projects", list of the Regulation No.1316/2013 Annex I, Part I. These pre-identified CEF projects constitute mainly rail, waterway and multimodal projects: 113 are allocated to Rail and Rail ERTMS category, followed by Road and Maritime.

The detailed analysis of the Project list compiled for the OEM can be found in the "Updated Final Report on Project List", June 2017.

## 3.5 Future challenges on the OEM Corridor

### 3.5.1 Rail network

#### 3.5.1.1 Rail development by 2030

There are 127 rail projects and 30 Rail ERTMS projects on the list, representing 38% of the grand-total. A high number of rail projects belong to Germany (26), Greece (23), Bulgaria (21), the Czech Republic (19), Slovakia (14), while Austria has only 12, Romania 8 and Hungary 4. Regarding the 30 Rail ERTMS projects, 5 belong to Austria 4 to Hungary, 4 to Czechia, 3 to Greece, 2 to Germany, while Slovakia and Bulgaria follow with 1 project each. 10 projects are multi-country.

The total cost of the above projects is € 39.7 billion (out of which € 38.1 billion for rail and € 1.7 billion for Rail ERTMS); however, it should be noted that information on cost is available for only 143 out of 157 projects. 58 Rail and Rail ERTMS projects belong solely to the OEM Corridor (not overlapping with other Corridors) of a total cost of € 18.5 billion (47% of OEM relevant Rail and Rail ERTMS projects).

The majority of the Rail and Rail ERTMS projects, 83 projects (53% of total), shall be finalised before the end of 2020, while 47 projects (30%) are expected to be finalised by 2030. The remaining 26 projects (17%) either have unknown implementation schedule or are planned for after 2030.

There are 93 rail projects and 20 Rail ERTMS projects on pre-identified CEF sections, the majority located in Bulgaria (21 Rail and 1 Rail ERTMS), Czech Republic (16 Rail and 3 Rail ERTMS), Greece (17 Rail and 3 Rail ERTMS), Slovakia (11 Rail projects and 1 Rail ERTMS), and Austria (11 Rail and 5 Rail ERTMS). Germany follows with 5 Rail and 1 Rail ERTMS, Hungary with 4 Rail projects and 3 Rail ERTMS projects, and lastly, Romania with 8 Rail projects.

55% of the Rail and Rail ERTMS projects regard rehabilitation and upgrade infrastructure works, while 33% relate to works which include new construction of infrastructure, including land acquisition and infrastructure works for increasing design speed, achievement of GC loading gauge, improvement of safety and installation of SCADA, ETCS (level 1) and GSM-R (mainly in Bulgaria and for the high speed lines in Germany and Czechia).

#### 3.5.1.2 ERTMS deployment

On 5 January 2017, the European Commission adopted the Implementing Regulation (EU) No.2017/6 on European Rail Traffic Management System European Deployment Plan (ERTMS EDP)[16] that replaces the old deployment plan of 2009. The reviewed ERTMS EDP adapts the geographical scope of deployment to the TEN-T Regulation, and sets new targets for ERTMS deployment on CNC's until 2023. These target dates are firm commitments made by Member States and Infrastructure Managers during the consultation and negotiations, led by Mr Vinck, European ERTMS Coordinator, between 2014 and 2016.

In 2023, the ERTMS European Deployment Plan will be updated again setting out the precise implementation dates for the remaining part of the Corridors between 2024 and 2030. ERTMS Coordinator proposed this two-step approach for defining the consistent deployment of CNC's by 2030, which was appreciated by all affected stakeholders. This approach ensures that the reviewed EDP sets out more realistic

[16] The ERTMS EDP can be found online under https://ec.europa.eu/transport/modes/rail/ertms/

dates and, therefore, can serve as the basis for business planning of railway undertakings.

The deployment of an interoperable Single European Rail Area has faced numerous barriers by implementing ERTMS over the last 10 years.

However, an ERTMS Deployment Action Plan, adopted by the Commission as a Commission Staff Working Document on 16 November 2017, has been officially introduced. It defines the actions to remove all identified obstacles with the responsible parties in the frame of well-defined timelines. This Action Plan is the last step in a thorough analysis of the ERTMS deployment in the European Union, followed by detailed negotiations with the Member States and the Rail Sector, including their commitment in terms of actions and execution times.

#### 3.5.1.3 Persisting Rail and RRT bottlenecks in 2030

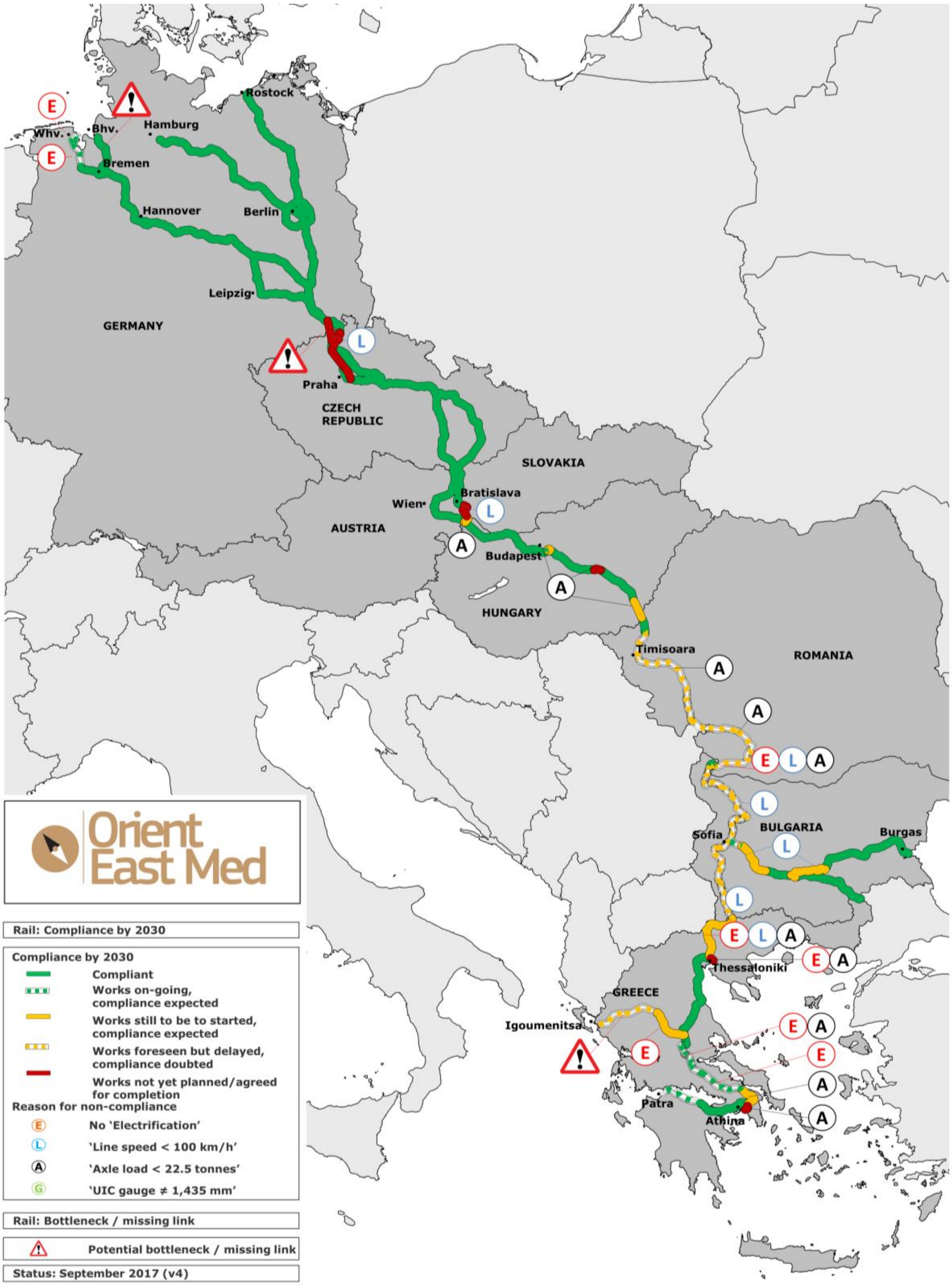
The investment projects for Rail and Rail-Road Terminals are expected to address the majority of existing bottlenecks in the OEM rail network by 2030. Modernisation works to reach the TEN-T standards are on-going along main parts of the Corridor; major development projects are concentrated on the northern section of the Corridor and Bulgaria, addressing capacity issues as well as studies and projects for high speed lines, while in the south, and more specifically Romania, on-going projects are mainly studies, while works are planned after 2020 and are still lacking secured financing.

Nevertheless, there are still certain critical bottlenecks that will not be alleviated before 2030, particularly with regard to the technical non-compliance of certain sections in Bulgaria, Czech Republic and Romania. A minor share of the projects though, does not have an indicated timing, thus, creating an element of uncertainty, which would hinder an implementation in the short-term.

Out of the 204 total non-compliant Corridor sections (in total 5,393 km), 61 sections (equalling 2,396 km) are covered by 157 studies and works projects, addressing at least one of the non-compliant parameters. Taking into account the list of on-going or planned Corridor projects to be implemented until 2030, a significant part (828 km) of the rail network in 6 of the related Member States will still be non-compliant by 2030; a number of sections are not yet addressed by national masterplans and are expected to remain non-compliant by 2030.

Finally, the planned construction of a high-speed line Dresden – Ústí nad Labem – Praha (DE/CZ, 140 km) is expected not to be operable in 2030.

**Figure 5: OEM rail compliance map for 2030** [17]




*Source: OEM CNC study, November 2017*

[17] The compliance map depicting the situation in September 2017 has been modified on request of the Bulgarian MTITC in November 2017 for the Bulgarian sections Sofia – Elin Pelin, Septemvri – Plovdiv - Mihaylovo and RP Krumovo - Dimitrovgrad – Svilengrad as well as Stara Zagora – Kalitinovo. –

The updated overview of the OEM railway Corridor identified the following **critical cross-border sections**:

The existing Dresden – Praha rail line (DE-CZ) is already highly used. Several studies for pre-planning services for the new high-speed rail line between Dresden and Praha have been conducted in the last years by joint action of Saxony and Czech Republic. In April 2016, a European grouping of territorial cooperation (EGTC) has been founded by Saxony, Czech Republic and adjacent districts in order to promote the planning. In the German Federal Transport Plan 2030 (BVWP 2030), the project is still listed under the category 'potentially required measure', but is expected to be upgraded within the next months.

In addition, immediate measures are required for the problematic long section Békéscsaba – Thessaloniki (HU-RO-BG-EL). In close cooperation with RFC7, the attention was raised for the implementation of soft measures which can immediately affect the operational travel times, engaging in the process the relevant stakeholders. This process has been initiated through the organisation of dedicated Rail Cross-Border Working Groups; the activities of identification of major issues and possible solutions are on-going. Besides this, the Corridor analysis revealed the need for coordination of infrastructure development works at cross border points.

By 2030, the most notable improvements for the OEM rail network include the electrification and axle load KPIs almost reaching 100%, whereas large absolute increases are expected in the ERTMS implementation, from 13% to 71%, and 740 m train length, from 50% to 74%.

**Table 11: Compliance of rail parameters 2016 and 2030 prospects**

| # | Mode | KPI | 2016 | 2030 prospect |
|---|---|---|---|---|
| 1 | Rail network[18] | Electrification | 89% | 98% |
| 2 | | Track gauge 1435mm | 100% | 100% |
| 3 | | ERTMS implementation | 13% | 71% |
| 4 | | Freight Rail Line speed ≥ 100 km/h | 78% | 87% |
| 5 | | Axle load ≥ 22.5t | 82% | 98% |
| 6 | | Train length ≥ 740m | 50% | 74% |

*Source: OEM CNC study, 2017*

**ERTMS deployment** is at an advanced stage in the middle of the OEM axis, whereas in the German and Bulgarian/Romanian part, it is lagging behind. Greece has been heavily investing in its Corridor section for many years and might be able to complete ERTMS by 2025. The "Wien hub" in Austria is the frontrunner and will most probably finalise the deployment by 2017, significantly contributing to the development of this area.

Detailed actions on how to accelerate ERTMS equipment implementation along the CNCs are described in the separate European Deployment Plan by the European ERTMS Coordinator.

[18] Calculation is based on distances of operated sections and might in future slightly deviate.

**Table 12: Non-compliant rail sections by 2030**

| State | From | To | Length (km) | Non-compliant parameter |
|---|---|---|---|---|
| DE | Major part of DE rail network along OEM | | 1330 | ERTMS |
| CZ | Entire CZ rail network along OEM | | 798 | Train length |
| SK | Entire SK rail network along OEM | | 103 | Train length |
| SK | Bratislava Petržalka | Rajka SK/HU | 13 | Line speed |
| HU | Budapest Ferencváros | Szajol | 104 | ERTMS |
| | Szolnok | Szajol | 13 | Axle Load |
| | Békéscsaba | Lökösháza | 32 | ERTMS |
| RO | Arad | Craiova | 443 | ERTMS, Axle load, Train length |
| | Craiova | Rac. Golenti | 101 | Electrification, ERTMS, Axle load, Train length |
| | Rac. Golenți | New Europe Bridge RO/BG | 3 | ERTMS |
| BG | New Europe Bridge RO/BG | Vidin | 13 | ERTMS (installed, not operated) |
| | Vidin | Mezdra | 267 | ERTMS, Train length, Operating speed |
| | Sofia | Kulata BG/EL | 209 | ERTMS, Train length, Operating speed |
| | Konyovo | Kermen | 9 | Operating speed |
| | Plovdiv | Skutare | 16 | Train length |
| | Kalitinovo | Zimnitsa | 84 | Train length |
| | Svilengrad | Svilengrad East | 18 | ERTMS |
| EL | Kulata / Promahonas | Thessaloniki | 136 | Single track section [19] |
| | Thessaloniki | Thessaloniki port | 7 | Axle load |
| | Thessaloniki Old Freight Station RRT | Thessaloniki port | 1.5 | Electrification, ERTMS, train length |
| | Athina R.S./ Tris Gefyres | Pireas | 12 | Train length, Axle load |

*Source: OEM CNC study, 2017*

[19] Single track section might form a capacity bottleneck, but is compliant with TEN-T regulation.

### 3.5.2 Rail-Road Terminals (RRT)

#### 3.5.2.1 RRT development by 2030

Regarding the RRT projects, out of a total of 20 projects estimated to account for € 671 mil, only 5 projects are only on the OEM Corridor (estimated cost € 40.9 mil – 6% of total OEM relevant RRT projects).

**Table 13: Compliance of RRT parameters 2016 and 2030 prospects**

| # | Mode | KPI | 2016 | 2030 prospect |
|---|---|---|---|---|
| 7 | Rail Road Terminals (RRT)[20] | Capability for Intermodal (unitised) transhipment | 79% | 88% |
| 8 | | 740m train terminal accessibility | 25% | 38% |
| 9 | | Electrified train terminal accessibility | 46% | 54% |
| 10 | | Availability of ≥ + freight terminal open to all operators in a non-discriminatory way and application of transparent charges | 71% | 79% |

*Source: OEM CNC study, 2017*

#### 3.5.2.2 Persisting RRT bottlenecks in 2030

The analysis shows that only 4 of the 25 RRTs, namely Hamburg-Billwerder, Bremerhaven, Leipzig and Berlin-Großbeeren, are fully compliant with the requirements set out in Regulation No. 1315/2013 for "Capability for Intermodal (unitised) transhipment", "740m train terminal accessibility", "Electrified train terminal accessibility" and "Availability of at least one freight terminal open to all operators in a non-discriminatory way and application of transparent charges". Regarding the state of the RRTs, in Timişoara and Craiova, new terminals are planned to be built in order to replace the existing ones, for which no new investments are planned, although financing is not secured yet. No project is planned to replace the obsolete and inadequate to the needs terminal in Sofia.
In Greece, the nominated RRT in Patra does not exist yet.

**Table 14: Rail-Road Terminals - KPI values per country (2016)**

| MS | Number of Core RRTs (in operation) | Availability of ≥1 terminal open to all operators in a non-discriminatory way and application of transparent charges. | Capability for Intermodal (unitised) transhipment | 740m train terminal accessibility | Electrified train terminal accessibility |
|---|---|---|---|---|---|
| Austria | 2 | 100% | 100% | 0% | 100% |
| Bulgaria | 2 | 0% | 0% | 0% | 100% |
| Czechia | 5 | 40% | 100% | 20% | 20% |
| Germany | 9 | 100% | 100% | 44% | 56% |
| Greece[21] | 2 | 100% | 100% | 50% | 50% |
| Hungary | 1 | 100% | 100% | 0% | 0% |
| Romania[22] | 2 | 0% | 0% | 0% | 0% |
| Slovakia | 1 | 100% | 100% | 0% | 0% |
| **Total** | **24** | **71%** | **79%** | **25%** | **46%** |

*Source: OEM CNC study, 2017*

[20] This compilation does not consider the still non-existing RRT of Patra (EL).
[21] Idem.
[22] The existing non-compliant RRTs are planned to be replaced by completely new terminals by 2030.

Compared to the numerous parameters that need to be improved, there are only 8 projects that tackle non-compliance, thus a number of projects are required for 16 RRTs (64% of OEM terminals) to fulfil the Regulation target and ensure an efficient and optimum integration of intermodal transport of goods on the Corridor.

**Table 15: Non-compliant Rail/Road terminals by 2030**

| State | Terminal | Non-compliant parameter | Action |
|---|---|---|---|
| DE | Bremen | 740m train terminal accessibility | Feasibility check to achieve full compliance to the Regulation |
| | Hannover | Electrification and 740m train terminal accessibility | |
| | Braunschweig | | |
| | Magdeburg | | |
| | Rostock | | |
| CZ | Děčín | Electrification | Feasibility check to achieve full compliance to the Regulation |
| | Mělník | Electrification and 740m train terminal accessibility | |
| | Praha-Uhříněves | 740m train terminal accessibility<br>Availability open to all operators in a non-discriminatory way and application of transparent charges | |
| | Pardubice | Electrification and 740m train terminal accessibility<br>Availability open to all operators in a non-discriminatory way and application of transparent charges | |
| | Přerov | Electrification and 740m train terminal accessibility<br>Availability open to all operators in a non-discriminatory way and application of transparent charges | New terminal planned to be built |
| SK | Bratislava | Electrification and 740m train terminal accessibility | |
| HU | Budapest-Soroksár | Electrification and 740m train terminal accessibility<br>Availability open to all operators in a non-discriminatory way and application of transparent charges | Feasibility check to achieve full compliance to the Regulation |
| RO | Timişoara | Existing terminals do not comply with any of the parameters | New terminals planned to be built to replace the existing ones |
| | Craiova | | |
| BG | Sofia | 740m train terminal accessibility.<br>Availability open to all operators in a non-discriminatory way and application of transparent charges | Feasibility check to achieve full compliance to the Regulation |
| EL | Thessaloniki Old Freight Station | 740m train terminal accessibility | Feasibility check to achieve full compliance to the Regulation |

*Source: OEM CNC study, 2017*

### 3.5.3 Inland waterways

#### 3.5.3.1 IWW and Inland Ports development by 2030

There are 24 projects representing a mere 6% of the total. Their total cost amounts to € 2.2 bln, 3.2% of the grand total (figure excluding costs for 2 projects). 19 projects belong solely to the OEM Corridor, with a total cost of € 1.97 bln. Fifteen of these projects are located solely in Czechia (all OEM), 5 in Germany (4 OEM) and 1 in Hungary (R-D CNC).
The remaining 3 projects concern multiple countries and are assigned to the Rhine-Danube Corridor, whereby two projects concern RIS deployment and involve all countries crossed by the EU inland waterway. Most projects (13/8 OEM) are expected to be completed by the end of 2020, ten (all OEM) by 2030, while for one OEM project, the end date is unknown. The majority of projects (13) involve infrastructure works and upgrades. The remaining 11 are divided between 5 new construction works and 4 studies concerning potential future expansions of inland waterways and ports. The other two projects concern infrastructure rehabilitation and traffic control of waterways.

#### 3.5.3.2 Persisting IWW and Inland Ports' bottlenecks in 2030 (incl. RIS)

For 2030, it is expected that certain parts of the OEM IWW network will still fail to meet the Corridor objectives, as shown in the following table.

**Table 16: Non-compliant IWW sections by 2030**

| State | IWW | From | To | Length (km) | Non-compliant parameter |
|---|---|---|---|---|---|
| CZ | Elbe | Schmilka (DE/CZ border) | Ústí nad Labem | 41 | Draught 2,5m |
| | Elbe | Ústí nad Labem | Mělník | 71 | Draught 2,5m |
| | Elbe | Mělník | Týnec nad Labem | 97 | Draught 2,5m |
| | Elbe | **Týnec nad Labem** | **Pardubice** | **32** | **RIS,** Draught 2,5m |
| | Vltava | Mělník | Praha | 64 | Minimum underpass height 5.25m |
| | **Vltava** | **Praha** | **Štěchovice** | **28** | **Draught 2,5m** |
| DE | Elbe-Lübeck-Kanal | Lübeck | Lauenburg | 68 | Minimum underpass height 5.25m |
| | Elbe | Lauenburg | Wittenberge | 115 | Draught 2,5m |
| | Elbe | Wittenberge | Magdeburg | 116 | Draught 2,5m |
| | Elbe | Magdeburg | Schmilka (DE/CZ border) | 332 | Draught 2,5m |

*Source: OEM CNC study, November 2017*

It must be noted, that only the CEMT IV class and RIS deployment are TEN-T requirements, while minimum draught and minimum underpass height are sub-criteria of the CEMT IV requirement, which might be exempted due to local conditions according to CEMT resolution and due to Art. 15 (3) lit. a Regulation No.1315/2013. According to the conclusions of the Bonn meeting of Mr Grosch in September 2017, the minimum draught requirement of 2.5 m will not be met by 2030. Instead efforts of the German inland waterway authorities will continue through the implementation of the Overall development strategy for the German Elbe River and its floodplains

(Gesamtkonzept Elbe / "GKE")[23] to achieve a reduced minimum draught target of 1.4m. In this regard, bilateral talks between Czech and German IWW authorities were ongoing in late 2017.

Based on such an exemption, most of the IWW sections listed in Table 16 will meet the criteria related to CEMT category IV by 2030; if planned interventions are implemented in time:

- all Czech sections for reduced draught (1.4m – 2.2m) and underpass height (5.25 – 7.0m), except the southernmost Vltava section Praha - Štěchovice (64 km), whose draught (1.2m) is not intended to become compliant by 2030.
- The German Elbe section Magdeburg – Schmilka (332 km) is not compliant in terms of underpass height of 5.25m in the case of highest navigable water level; The GKE's aim is to achieve a three-layer container traffic between Hamburg and Dresden Alberthafen, and a two-layer traffic through Dresden towards Czechia.

**Figure 6: Compliance Map 2030 of the OEM IWW network**


*Source: OEM CNC study, 2017*

23 Bundesministerium für Verkehr und digitale Infrastruktur / Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit (2017): **Gesamtkonzept Elbe** - Strategisches Konzept für die Entwicklung der deutschen Binnenelbe und ihrer Auen, 17 Januar 2017, http://www.gesamtkonzept-elbe.bund.de/

**Figure 7: Compliance Map 2030 of the OEM IWW network with respect to reduced draught standard**


*Source: OEM CNC study, November 2017*

The core inland port of Praha-Holešovice is deemed to be out of operation for freight handling and, thus, the location of the Praha core port might be re-defined. Based on the known projects, this situation will not significantly change in 2030. The full operation of the yet unbuilt Pardubice port by 2030 is doubted.

**Table 17: Non-compliant IWW ports by 2030**

| State | IWW Port | Non-compliant parameter |
|---|---|---|
| CZ | Praha-Holešovice | Connection with rail<br><br>Availability of alternative clean fuels<br><br>Availability of at least one terminal open to all operators in a non-discriminatory way and application of transparent charges |
| | Pardubice | Full operation of port doubted<br>(all parameters non-compliant) |
| | Děčín, Mělník | Availability of alternative clean fuels |
| DE | Hamburg, Bremerhaven, Bremen, Hannover, Braunschweig, Magdeburg | Availability of alternative clean fuels |

*Source: OEM CNC study, 2017*

There is a clear need to support the perspective that on-going digitalisation will increase inland waterway transport volumes on the Elbe River. The entire Elbe corridor provides optimal framework conditions as a research area and field laboratory for digital solutions.

**Table 18: Compliance of IWW and Inland port related parameters 2016 and 2030 prospects**

| # | Mode | KPI | 2016 | 2030 prospect |
|---|---|---|---|---|
| 11 | Inland waterway network | CEMT requirements for class IV IWW | 98% | 100% |
| 12 | | Permissible Draught (min 2.5m) | 40% | 51% |
| … | | Permissible Draught (min 1.4m) | 60% | 98% |
| 13 | | Permissible Height under bridges (min. 5.25m) | 60% | 76% |
| 14 | | RIS implementation (% of km on which the minimum requirements set out by the RIS directive are met) | 98% | 98% |
| 15 | Inland ports[24] | Class IV waterway connection | 100% | 100% |
| 16 | | Connection to rail | 89% | 90% |
| 17 | | Availability of alternative clean fuels | 0% | 0% |
| 18 | | Availability of at least one freight terminal open to all operators in a non-discriminatory way and application of transparent charges | 89% | 90% |

*Source: OEM CNC study, 2017*

[24] KPI values only consider existing ports.

### 3.5.4 Maritime Ports

#### 3.5.4.1 Maritime Ports development by 2030

74 maritime projects have been recorded, accounting for 18% of the sum. The vast majority belongs to Germany, with 47 projects assigned to the North-Sea Baltic and Scandinavian Mediterranean CNCs. The remaining 27 belong only to the OEM Corridor, and include those submitted by Greece (15), Bulgaria (6) and Cyprus (6).

Their total cost amounts to approximately € 4.259 bln (€1.154 bln for pure OEM projects), the latter figure excluding 6 projects (none pure OEM), for which no information on cost was available. Over a third of the total (38% - 12 OEM only) is expected to be completed by 2020, whereas a similar share (36% - 8 OEM only) is expected to be completed by 2030. Only 5 projects (1 OEM only) are expected to be completed after 2030 (7%). For a significant share (19% / 14 projects-6 OEM), completion dates are unknown to present. Finally, 14 projects (all OEM only) refer to pre-identified CEF sections / CEF projects.

The majority of projects (39) relate to works developing port infrastructure and terminals to improve capacity, including dredging works and maintenance activities to improve accessibility and navigability, followed by those targeted at the improvement of road and rail connections (18), both last mile and within port zones. Fewer projects are related to the deployment of various types of ITS, e-maritime and telematics services (12) and the provision of alternative fuels facilities (5). Indicatively, seaport projects include among other:

- Expansion projects at Hamburg and Rostock (DE), Thessaloniki, Heraklion, Patra, Igoumenitsa (EL) and Lemesos (CY).
- Projects addressing missing rail connections at the Ports of Patra and Igoumenitsa (EL); projects improving rail connections at Ports of Hamburg, Bremerhaven (DE), Burgas (BG), and Thessaloniki (EL).
- Projects to upgrade road links to the Port of Lemesos’ two terminals (CY) and Hamburg (DE); project for a new road link for the Port of Thessaloniki (EL).
- Projects addressing the provision of alternative fuels facilities at the Ports of Hamburg, Bremen and Bremerhaven, Rostock (DE), Thessaloniki (EL) and Lemesos (CY).
- Projects for the deployment of VTMIS at the Ports of Burgas (BG) and Heraklion (EL).
- Projects for the deployment of a Port Community System (PCS) at the Ports of Burgas (BG) and Lemesos (CY).
- Projects for the further development of ITS systems at Ports of Hamburg and Rostock (DE).

In addition, 5 MoS projects will be implemented with a total cost of € 128.2M, out of which 2 belong solely to the OEM with a total cost of €54.8 mln. All MoS projects are expected to be completed by 2020, with the exception of one (Scan-Med), for which the completion date is unknown. OEM MoS projects constitute studies that deal with the adoption of LNG clean fuel at ports and the introduction of onshore power supply as propulsion alternative for ships.

In parallel to the OEM study and the Coordinator’s Work Plan, Brian Simpson, the European Coordinator for Motorways of the Sea, delivered the second version of the Motorways of the Sea (MoS) Detailed Implementation Plan (DIP)[25].

[25] The DIP can be found under https://ec.europa.eu/transport/sites/transport/files/detailed_implementation_plan_mos.pdf

### 3.5.4.2 Persisting maritime bottlenecks in 2030

The integration of the 12 seaports into the OEM Corridor is vital for achieving the optimisation of the multimodal transport chain, as well as creating opportunities for modal shift towards more environmentally friendly modes along the Corridor. OEM ports are and will be facing to a varying degree several challenges, such as congestion, problematic or non-existent hinterland connections, delays due to administrative burdens, pollution, growing need for more advanced applications and systems, etc. Constituting the major gateways of the Corridor, there is a need to increase efficiency in the seaport sector, which would inevitably result in increasing environmental benefits and minimising negative externalities.

Given that very few maritime projects have been completed, and several of the planned projects have yet to secure financing, interventions are required to meet the increasing need for efficiency, competitiveness and sustainability in accordance with the main priorities of the European Commission's maritime policy for the future.

Key persisting bottlenecks for OEM seaports are mainly related to intermodality, and, more specifically, the existence and/or efficient operation of the ports' rail hinterland connections that will ensure the seamless intermodal transport along the supply chain of the Corridor. Compliance by 2030 is doubted for the Port of Igoumenitsa (CEF pre-identified), whose rail connection is considered within the missing link of the western extension of the railway network of Greece, Igoumenitsa-Ioannina-Kalambaka. The latter is addressed by two projects, the completion of the required studies and the construction of works, albeit with no secured financing and estimated completion date for the works, year 2030. The construction of the new line and its connection to the port have long come up against the challenges of unfavourable mountainous terrain and related high investment costs; nevertheless, the Igoumenitsa-Ioannina-Kalambaka line will fill in a key missing link for the country as well as the Corridor, further fostering intermodality and enhancing modal shift potential.

Moreover, although all Corridor ports require the provision of alternative fuel facilities, substantial progress is mainly observed in the Northern OEM Ports, and more specifically, the German Ports of Hamburg, Bremen/Bremerhaven and Rostock. In Germany, a first LNG-powered hopper barge is expected to commence operation between the Ports of Bremerhaven and Bremen during 2017.

On the other hand, southern ports are still in the preparatory stage, with the majority of Greek ports and the Port of Lemesos presently involved in related studies in order to acquire a maturity level that would allow for the subsequent implementation of works related to ports' infrastructure for bunkering operations. Along the same lines, the Ports of Pireas (EL) and Lemesos (CY) are also participating in conceptual studies necessary for the introduction of onshore power supply as propulsion alternative for ships. Therefore, there is a need for related port authorities to actively pursue the uptake of such innovative technologies with the design/realization of related projects in the coming years.

Based on the above infrastructure gaps, the target values for the two related KPIs are not expected to be met by 2030 due to the missing rail connection to the Port of Igoumenitsa and the absence of concrete plans for the deployment of alternative fuels facilities at the Ports of Wilhelmshaven, Burgas, as well as the Greek ports.

**Table 19: Compliance of maritime parameters 2016 and 2030 prospects**

| # | Mode | KPI | 2016 | 2030 prospect |
|---|---|---|---|---|
| 19 | Seaports | Connection to rail | 80% | 90% |
| 20 | | Connection to IWW CEMT IV (relevant to 3 out of 12 seaports: Hamburg, Bremen, Bremerhaven) | 100% | 100% |
| 21 | | Availability of alternative clean fuels | 0% | 33% |
| 22 | | Availability of at least one freight terminal open to all operators in a non-discriminatory way and application of transparent charges | 100% | 100% |
| 23 | | Facilities for ship generated waste | 100% | 100% |

*Source: OEM CNC study, 2017*

Additional bottlenecks hindering interoperability relate to the deployment of Traffic Management Systems and e-maritime services, with Greece being the only OEM MS that has yet to implement the National Single Window system of the country in accordance with Directive 2010/65/EU, while only pilot Port Community System (PCS) modules have been developed in three of the country's seaports (Pireas, Patra and Igoumenitsa). The deployment of Vessel Traffic Management Information Systems (VTMIS) also constitutes an issue for Greek ports, particularly for the Ports of Heraklion and Thessaloniki, where it has yet to be implemented.

In conjunction with the above, Greek ports and the Port of Lemesos in Cyprus need to implement MoS quality standards to establish a potential viable maritime connection through Crete, which constitutes the final leg of the OEM Corridor. Reference is made to the Motorways of the Sea (MoS) Detailed Implementation Plan.

### 3.5.5 Roads

#### 3.5.5.1 Road and ITS development by 2030

The identified 79 road projects, out of which 27 belong solely to the OEM, account for € 18.3 billion in total. The estimated investments for pure OEM projects are € 8.66 billion, or some 28% of the total estimated Corridor investment needs. Three of these projects miss cost estimation. The majority of road projects (54%) are planned to be completed by 2020. The remaining 30 projects, for which the estimated completion date is known, are expected to be implemented by 2030. The relative share of pure OEM projects that are planned to be completed by 2020 is somewhat lower at 48% (13 projects out of 27).

Out of the total, the number of studies is merely 13 (3 for OEM only), while 7 (2 for OEM only) projects include both studies and works. Deployment of ITS is the subject of 9 projects in Bulgaria, Cyprus, Czech Republic, Germany and Slovakia. There are 3 projects in total for the deployment of alternative fuels in Cyprus, Czech Republic and Hungary, respectively. None of these ITS projects refer only to the OEM. The highest number of projects (20 joint and 13 OEM only) relate to new construction only, out of which 11 (6 OEM) projects are for constructing new motorway sections, as follows: 2 projects in Austria (none OEM only), 1 in Bulgaria, 1 in Cyprus, 3 in Germany (none OEM only) and 4 in Greece. Remaining projects regard rehabilitation or upgrade works or a combination of rehabilitation, upgrade and new construction works.

### 3.5.5.2 Persisting road bottlenecks in 2030

**Figure 8: Compliance Map 2030 of the OEM motorway / express road network**



*Source: OEM CNC study, November 2017*

The majority of still non-compliant motorway/express road sections are addressed by projects in all respective countries and the expected level of compliance by 2030 is 96%. However, clear implementation schedule and/or financing sources have not been set up for a big part of these investments, as for instance for Lugoj – Calafat section in Romania (256 km). Persisting gaps in terms of motorway/ express road standards for 2030 are only expected in Bulgarian parts of the Corridor, as presented in Figure 8 and Table 20.

The supply of alternative fuels is expected to further improve by the provision of more different types of fuel. Strategies and/or national-scale projects for the deployment of alternative fuel facilities are planned in Germany, Czechia, Hungary and Cyprus. The level of safety and security of the rest areas along the Corridor should be further enhanced.

**Table 20: Road compliance parameters 2016 and 2030 prospects**

| # | Mode | KPI | 2016 | 2030 prospect |
|---|---|---|---|---|
| 24 | Road network | Express road / motorway | 88% | 96% |

*Source: OEM CNC study, 2017*

Although road capacity has not been considered as a KPI, the issue is addressed in several projects aiming to enhance capacity on congested road sections. Several projects aiming to enhance capacity on congested road sections are identified. Inadequate capacity influences negatively traffic safety and thus, congestion, especially on road sections adjacent to urban nodes, requires further attention.

Special attention must be also paid to the deployment of intelligent transport systems, which should play a major role in increasing the efficiency of road use, improving safety and enhancing the environmental performance of vehicles along the Corridor and within urban nodes. Where basic IT infrastructure for data transmission is not yet in place, the Member States should speed up its deployment, so to provide for the instalment and operation of relevant transport applications.

No progress is observed in the integration of road charging schemes in operation along the OEM CNC, which remain fragmentised. In the light of limited public financing to maintain high quality roads and the current patchwork of national road charging systems that hampers seamless transportation, measures are required for the establishment of interoperable systems.

**Table 21: Non-compliant road sections by 2030**

| State | From | To | Length (km) | Non-compliant parameter |
|---|---|---|---|---|
| BG | Vidin | Montana West | 100.9 | motorway/ express road |
| | Mezdra | Botevgrad A2 | 37.4 | motorway/ express road |

*Source: OEM CNC study, 2017*

### 3.5.6 Airports

#### 3.5.6.1 Airport development by 2030

There are 37 airport projects on the list (8 OEM only), representing 9% of the grand-total. The vast majority of them belong to Germany, which accounts for 25 projects (none OEM only), followed by Hungary (5/2 OEM) and the Czech Republic (4 OEM only). Austria, Greece and Romania have submitted one project each, with the one of Austria belonging to the Baltic-Adriatic Corridor. The total cost of the projects is €2.75 bln (€ 733 mln for OEM only), with information on cost available for 30 projects. Four of the projects are located on a pre-identified CEF section (3 OEM only) or represent a pre-identified CEF project, while 7 (5 OEM only) serve last mile connections.

#### 3.5.6.2 Persisting airport bottlenecks in 2030

Connection of main airports to the rail network is fundamental to achieve the intermodality and interoperability objectives obligatory set by the TEN-T regulation until 2050, except where physical constraints prevent such connection. Hamburg airport, located within the urban area is connected with electrified (DC 1200V) suburban rail only; however, a technical feasibility study has been planned for the realisation of a new rail link, albeit with unknown implementation date. A multimodal train station has been planned for construction and completion by 2018 in the Timisoara airport; to present, there is no information on the actual construction works of the connecting rail line.

Moreover, the progress to provide capacity for alternative fuels for aircrafts should be monitored in all Corridor airports, as no project is yet in place and this remains an "open issue".

**Table 22: Airport compliance parameters 2016 and 2030 prospects**

| # | Mode | KPI | 2016 | 2030 prospect |
|---|---|---|---|---|
| 25 | Airports | Connection to rail | 46% (50% - for main core airports) | 73% (92% - for main core airports) |
| 26 | | Availability of at least one terminal open to all operators in a non-discriminatory way and application of transparent charges. | 100% | 100% |
| 27 | | Availability of alternative clean fuels | 0% | 0% |

*Source: OEM CNC study, 2017*

**Table 23: Non-compliant airports by 2030**

| State | Airport | Non-compliant parameter |
|---|---|---|
| DE | Hamburg | Connection with heavy rail * |
| All | All 9 OEM core network airports | Availability of alternative clean fuels ** |

*Source: OEM CNC study, 2017*

*) Connection with rail is only required by 31 December 2050 according to TEN-T regulation No.1315/2013 Art. 41 (3).
**) The regulation requires from core airports by 31 Dec 2030 only the capacity to make alternative clean fuels available.

### 3.5.7 Innovation projects

The category termed "innovation" includes those projects with innovation components. Notably, the innovation projects related to infrastructure (e.g. ERTMS installation, or an upgrade of a railway station) might also be found in the category of the related transport mode. Their scope of work has been classified in three categories: "Alternative Clean fuels", "Telematics application" and "Sustainable freight transport services". As a result, 22% (92) of the overall OEM projects have been identified as projects with innovation components, with 17 of them only being part of the OEM Corridor. 52 (10 OEM only) of these, or 57% of the total, are related to Telematics applications, such as ERTMS and ITS among several others. The Alternative Clean Fuels category is the second largest of the cluster with 19 projects (3 OEM only).

A brief analysis of the projects with innovative components highlighted the following:

- Out of 52 projects related to Telematic applications, 5 are related to ERTMS implementation
- The remaining 47 projects include ITS (road), RIS (IWW), SESAR (airport) or other telematics applications, except ERTMS;
- 23 out of these 47 are related to road transport,
- 5 are RIS projects under IWW projects,
- 3 (SESAR, ITS and other telematics application) are under airport projects.

Articles 3, 32 and 33 of the TEN-T regulation define innovation elements such as: "telematics applications (except ERTMS), sustainable freight transport services and new technologies and innovation". Therefore, since such projects include one or more transport modes (rail, IWW, road, etc.), only 20 projects are classified in the category "innovation" in the project list (5 of these are only part of the OEM Corridor), including among other:

- 5 Alternative clean fuel projects
- 8 Telematics applications (ITS) projects
- 3 Other telematics applications projects

Although no KPIs have been defined for these projects, they are considered to have an impact on the capacity increase of the respective mode, as well as the reduction of GHG emissions and enhancement of multimodality. A larger number of projects are allocated to more CNCs than solely the Orient East Med Corridor; they are often grouped under common project category.

## 3.6 Administrative and operational barriers

Administrative and operational barriers often cause significant competitive disadvantage for an efficient, competitive and reliable transport on the Orient/East-Med Corridor.

### 3.6.1 Rail Barriers

The realisation of the CNCs meeting all the TEN-T requirements are long-term projects; since - in many cases - major infrastructure bottlenecks that need to be removed require major investments over very long periods of time. At the same time, operationally, administratively and politically, there is a need to achieve **results which are tangible and visible in a shorter period of time**.

Two objectives could be reached with the realisation of quick wins: on the one hand it would be possible to show tangible results at short notice for railways and the real positive effect on the important investments which would be supportive for the upcoming MFF negotiations, while on the other hand, the existing railway infrastructure could be made more competitive against other transport modes through an efficient and interoperable use. This would significantly contribute to a better modal share and the decarbonisation of transport.

There were a number of actions taken towards identifying potential barriers through the organisation of the **rail cross-border issues** Working Group, comprising of all main stakeholders and decision makers, such as Ministries, IMs, private and public freight and passenger operators, and resulting in the following main identified administrative and operational barriers:

- **Single track sections** with high traffic (especially in cross-border points) causing long waiting times in stations for both passenger and freight trains;
- The non-compliance of technical parameters (e.g. length of tracks in RRTs, profile of tunnels) can cause additional, secondary operational problems;
- Border-control and customs clearance in both sides on the same cross-border point;
- Schengen border – **principle of trust** does not work, resulting in time-consuming double-checking, although Schengen/Non-Schengen status should be irrelevant;
- Certain traditional national **operational rules** are existing with no specific purpose at cross-border points that should be jointly identified and eliminated (non-sense rules);
- Normative differences between Corridor countries, although common regulations (UIC; TSI; COTIF) exist, these are not applied similarly, thus harmonization needed;
- Lack of coordination of operations and current modernisation and rehabilitation works along the Corridor, especially between neighbouring national IMs;
- Lack of consistent and updated information exchange system for capacity planning, train operations and document transfer across cross-borders;
- Information gaps and barriers in communication, which have high impact on the planning of activities, personnel and rolling stock, as well as on current operation of international freight trains;
- ERTMS implementation: projects are still in planning phase in all countries along the OEM Corridor, the overall status of implementation being still only 12% (as a percentage of line length); progress in implementation has been achieved mainly in Austria, Czechia and Bulgaria.

This issue is described in more detail in section 5.

### 3.6.2 Inland Waterway Barriers

A number of administrative and operational barriers are defined for the OEM Corridor inland waterways. Three main groups of barriers are distinguished: *barriers in RIS implementation*, *workforce related barriers* and *operational barriers*.

For the implementation of RIS in Germany and Czechia, the barrier is the lack of sufficient funding and the absence of data exchange between Germany and Czechia. The latter is caused by different technological applications and legal problems, especially because of data privacy issues. There are also a number of workforce related barriers. In Czechia, these include shortage of qualified personnel, the difference in the standards for professional training, language barriers with neighbouring countries and the lack of a harmonised system of professional qualifications related to operational functions on board a vessel. The second is one of the reasons for the high number of accidents. Language barriers and lack of a harmonised system of professional qualifications is also an issue in Germany. The language barrier is suggested to be improved by the implementation of "Riverspeak".

In terms of operational barriers, for both countries the licence for Local knowledge requirements (LKR) is a key issue. A solution for this was provided on the 18th of

February 2016. The proposed measures consist of a regulatory intervention for mutual recognition of professional qualifications for IWT workers at EU level, with minimum competence requirements for boatmen and boatmasters. Furthermore, this allows Member States to organise exams and issue authorisation for all LKR in Europe, whilst leaving the responsibility for defining the criteria and exam content to Member States concerned by the river stretches for which LKR is required.

The remaining operational barrier refers to the permitted minimum number of people in a ship crew and the limited lock operating times in the Czech Republic. The latter requires additional research in order to verify that extending their operating times is economically viable. In Germany on the other hand, the fact that there are national German regulations and European ones to be followed as well as requirements from the different federal States make the process more bureaucratic and hence not efficient. One of the problems declared[26] by operators was that too many authorities and offices are involved in certification. This results in confusion about responsibilities and leads to unnecessarily high costs.

### 3.6.3 Seaport Barriers

Administrative and operational barriers hinder the effective and seamless operation of ports, as well as their full integration into the intermodal chain, resulting in port congestion and long transit and waiting times. This is a crucial element that affects the total time and cost of transport, with a direct influence on the reliability and competitiveness of the port services offered. Administrative and operational issues are also the cause of key interoperability bottlenecks. A review of the 12 OEM Core ports together with consultation with relevant stakeholders identified that the key operational and administrative barriers currently prevailing are related to the multiplicity of actors involved and the related fragmentation of responsibilities and jurisdictions, the added administrative and operational complexity that distinguishes maritime transport against other modes, as well as the issue of information exchange and documentation. Therefore, progress on strengthening operational efficiency must be made through the harmonisation and simplification of procedures, the establishment of an efficient coordination/cooperation modus operandi and increased transparency embraced by all stakeholders involved, as well as the deployment of innovative "one-stop-shop" administrative tools.

### 3.6.4 Road Barriers

Road tolling systems along the Corridor remain fragmentised and non-harmonized. The systems for the provision of real-time traffic and weather information are not yet capable of offering cross-border traffic information. Thus, it is explicitly recommended that special attention is paid to the deployment of intelligent transport systems, especially in the MS where basic IT infrastructure for data transmission is not yet in place.

Provision of safe and secure parking areas is also an issue to be considered. Although the provision of such facilities is market-driven, some regulation might be needed especially in setting clear definitions of the "safe and secure parking" notion. This would facilitate disputes between road hauliers and insurance companies and might trigger private initiative in offering adequate parking services.

[26] Panteia, 2014

**Figure 9: Road – Compliance Map of IRU registered commercial parking areas**


*Source: IRU/OEM study 2017*

Finally, in the analysed period, waiting times of heavy goods vehicles at border crossings increased visibly. This is only partially related to the charging systems, in most of the cases the reasons being thorough police and customs checks and/or inefficient organization of procedures. The latter implies a need for urgent optimization of procedures in order to minimise financial and economic losses associated with delays in supply and longer transportation times.

## 3.7 Urban nodes

Fifteen (15) Core Urban Nodes are identified by Regulation No.1315/2013, Annex II along the Orient/East Med Corridor, namely Hamburg, Bremen, Hannover, Berlin, Leipzig(-Halle) (DE), Praha (CZ), Bratislava (SK), Wien (AT), Budapest (HU), Timisoara (RO), Sofia (BG), Thessaloniki, Athina, Heraklion (EL), and Lefkosia (CY). OEM nodes of Germany, Czechia, Slovakia, Austria, Hungary and Romania are also multi-modal connecting points with other CNCs.

Apart from being the main generators of traffic flows along of the OEM Corridor, they essentially constitute hubs for the interconnections between the Corridor's different transport modes for both passengers and freight, and, consequently, their critical importance lies in their ability to foster intermodality, one of the key CNC objectives. Notably, within their wider urban region, a number of the OEM Corridor's key core nodes/access points, that is, 7 maritime/inland ports, 14 rail/road (and 6 tri-modal terminals) and 14 airports, are connected among themselves, as well as to the urban/regional network and the other CNCs.

The OEM Road Corridor transits the majority of the 15 urban core nodes with the exception of Praha and Thessaloniki, but OEM road traffic can also by-pass the urban conglomeration in the German urban nodes, Budapest, Sofia, Thessaloniki and Athina. The construction of by-pass road arteries is either on-going or planned for Praha, Bratislava, Wien, Timisoara and Lefkosia and, once completed, an uninterrupted flow would be achieved along the Corridor by-passing congested urban/local roads of densely populated areas. OEM rail arteries transit all urban nodes, where railway infrastructure exists, while these can also by-pass the nodes of Hamburg, Bremen, Hannover, Berlin, Thessaloniki and Athina. For the remaining urban nodes, the missing by-passing rail lines could be characterised as a bottleneck.

Some of the total 183 on-going and planned projects identified within the boundaries of the 15 urban nodes (NUTS3) are expected to address non-compliant parameters of urban rail sections as well as increase line capacity; in certain cases, lower max speed and train length are not deemed problematic by national infrastructure managers.

Pertaining physical/ technical urban bottlenecks that must be alleviated relate mainly to last-mile connections:

- missing motorway / express road connection to the Praha Uhříněves RRT;
- insufficient capacity of the Budapest airport-city centre road link;
- exhausted capacity and inappropriate location of existing RRT in Sofia;
- need for modernizing the Sofia railway node and the Sofia – Pernik railway line;
- last-mile connections of rail, seaport and airport nodes only possible through congested urban arteries in Thessaloniki.

In light of the above and from a TEN-T infrastructure perspective, it can be assumed that upon completion of the works, OEM Corridor lines within the respective urban boundaries will be in their majority compliant, while the urban nodes' fabric structure will allow for the integration and seamless connection of the OEM long distance traffic with the urban leg of TEN-T journeys. The latter, together with the implementation of efficient last-mile connections will reinforce the urban node's multimodal dimension and contribute to the full development and functioning of the OEM Corridor by enhancing intermodality, safeguarding a seamless intermodal transport along the OEM supply chain and also create potential for modal shift.

Finally, congestion in the urban nodes areas that influences negatively the performance of the long-distance services and traffic safety requires further attention. Without doubt, TEN-T Corridor objectives must be linked to those of sustainable urban mobility planning, in line with European policies in the area of urban transport (i.e. 2013 Urban Mobility Package) aimed at creating a culture for clean urban mobility. Hence, the development of OEM urban nodes must coordinate with related Sustainable Urban Mobility Plans (SUMPs), clean low-emission transport measures, deployment of innovative Intelligent Transport System solutions, etc.

Apart from Lefkosia, there is appropriate coverage of LPG/CNG refuelling stations in OEM urban nodes for road transport, while a sufficient number of electric recharging stations are available in all urban nodes. The supply of alternative fuels infrastructure is problematic for maritime and inland ports located within urban nodes. In addition, a number of ITS and telematics applications projects have been submitted, the majority concerning the road sector including certain urban nodes (i.e. CROCODILE 2.0, C-Roads platforms).

Finally, OEM Corridor issues' links with SUMPs, including innovative technologies and soft measures to promote shift to public transport and lower emission transport modes, is an area that should be further explored, underpinned by cooperation among national authorities and relevant regional/local planners, as well as Member States.

The detailed analysis behind the conclusions presented in sections 3.5-3.7 can be found in the "Final Report on the Elements of the Work Plan (Part 3a-Infrastructure)", June 2017.

## 3.8 Wider elements of the Work Plan

Parallel to the realisation of the required infrastructure implementation by 2030, there is also a vital need to render CNCs "forerunners" of a sustainable, smart and innovative European transport system in line with related EU Policies. In this respect and based on forecasts for 2030, the potential cumulative effects to the *environment*, *economy* and *society* of all OEM projects for the Corridor, resulting from the construction and operation of each individual infrastructure, are estimated.

The Corridor's potential performance of rolling out innovative solutions is primarily examined, followed by an approximation of the effects induced by the increase of economic activity in terms of growth and additional employment. The impact of the predicted modal shift to more sustainable modes as a direct result of the completion of the Corridor is estimated in terms of emission's reduction, while a risk assessment to climate change threats is performed and adaptation measures identified. Finally, given the distinct lack of financing securization for a significant share of OEM projects, the financial sustainability of these is appraised with a view to identify funding gaps as well as the potential for other forms of financing.

### 3.8.1 Innovation Deployment

Innovative projects refer to projects across the EU Member States which involve the use of new technologies improving in some manner parts of the current transport system. In the OEM Corridor, around 20% of the projects have been identified as "innovative". Of the innovative projects, more than half have been categorised as *Catch-up innovation*, or otherwise known as projects being related to innovation which is transferable innovation across the EU, typically already implemented in one part/country and, due to its success, implemented in others too (e.g. CEF or Horizon 2020). This is a common trend found among all CNCs. In the OEM, the distribution of the innovation deployment projects indicates a pyramid, where at the tip lies a radical innovation project (only one) and at the bottom the catch-up innovation projects, indicating the need to roll out innovation on all parts of the Corridor.

Looking at the projects per project category, it is primarily evident that there are innovative projects present in each modal category identified in the project list. Road and Maritime hold the highest number of projects, whilst Rail and Rail ERTMS the lowest, due to the absence of Alternative Fuel projects (not applicable for rail), as well as the ERTMS definition.

Cost-wise, innovative projects account for solely 4% of the total cost of all recorded OEM projects. The latter demonstrates that innovation in itself is not costly compared to the infrastructure projects.

With regard to the characteristics of innovative projects for freight transport services, the majority of the projects address Data Sharing and Safety & Security, together. This demonstrates that the OEM still needs improvement in these two areas. There are no projects concerning the Integration of remote areas. For passenger and private transportation, most projects also deal with Data Sharing and Safety & Security, as well as Decarbonisation, while there are no Cybersecurity projects. Regarding project impacts, Safety improvement and Transport efficiency are the two most common ones. Decarbonisation, for all modes of transport, is addressed by around a third of the total, with the vast majority being related to the use of alternative fuels. Finally, funding is found to be the most common enabler for facilitating the success of an innovation project or accelerating the market uptake of its results.

This following paragraphs provide an analysis of the results of the analysis of deployment of innovation in the 9 TEN-T Core Network Corridors (CNC). It comes as the result of an independent assessment prepared by all Corridors' study teams on the basis of a methodology previously agreed, with the objective to provide an overview on the status of innovation deployment in the various Corridors, giving horizontal insights.

The share of innovation projects of the OEM corridor is in line (22%) with the Corridor average of 23%. The innovation projects were categorized according to their contribution in the framework of the TEN-T regulation: Telematics applications, Sustainable freight transport initiatives, Safety improvement, Contribution to development of European technological industry and Transport efficiency improvement through data sharing. Notably, all 5 policy objectives are being addressed by projects in all Corridors. With the exception of the issue of 'Contribution to the development of European technological industry', most policy issues are addressed by at least 10% of the innovative projects in most Corridors. Hence, it can be concluded that there are no major 'gaps' identified, only CNC where increased attention to specific topics may be considered. This is also observed for the OEM Corridor.

Regarding the specific issue of the contribution of innovation projects to transport decarbonisation, a more detailed assessment was performed. The results show that most innovation projects that have an impact on transport GHG emissions do so through the deployment of alternative fuels. This figure makes it very clear that innovation projects in all CNCs are leading efforts for the use of Natural Gas and Biofuels in transport, and that a large number of projects for electricity and hydrogen are also being implemented.

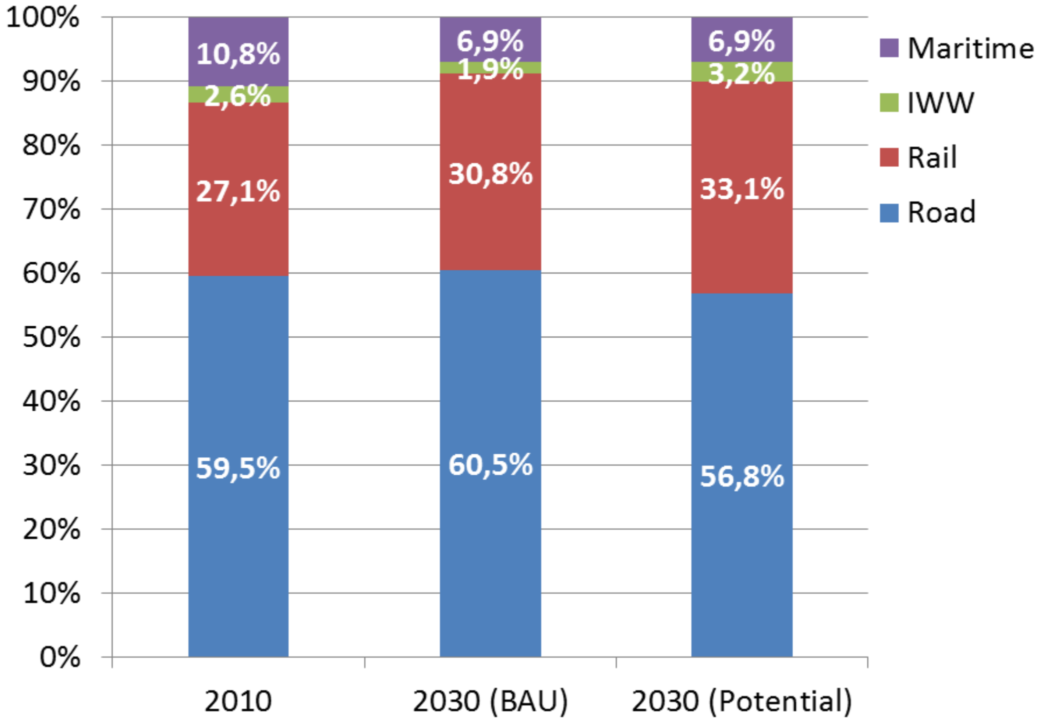
CNC innovative projects show a very high level of transferability, meaning that the TEN-T can potentially be positioned as a space for deploying transport innovations in a larger scale, helping project promoters better develop their innovations before transferring them to wider environments. The OEM Corridor has an average number of projects that are transferable and an average number that is scalable compared to the other 8 Corridors.

### 3.8.2 Mitigation of environmental impacts, decarbonisation

The potential model shift has been analysed for 2030 according to two scenarios – "BAU" (Business As Usual) and "Potential" as a result of the implementation of the OEM project list.

Following the trend of the baseline year 2010, Rail and Road transport volumes will increase and as a result Maritime and IWW transport volumes will decrease. For the Potential scenario for which the EU is aiming for, IWW and Rail shares will increase, whilst Road transport volumes will decrease and Maritime transport ones will remain the same (cf. Figure 10). This would have an effect on the emissions produced, as illustrated in Figure 12.

**Figure 10: Forecasted freight modal share for 2030 scenarios**

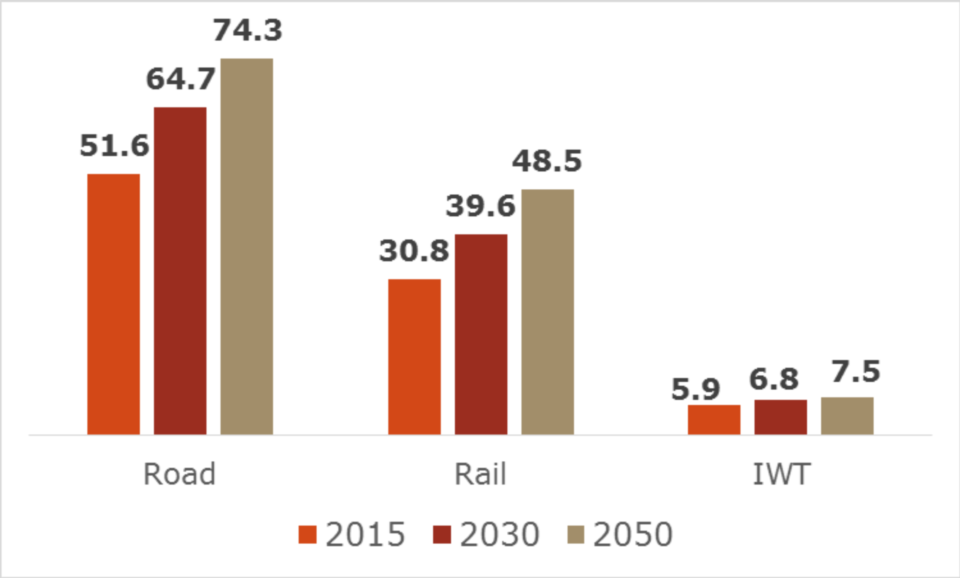



*Source: Panteia/OEM CNC study, 2017*

Taking the Potential scenario, the values per mode for 2015, 2030 and 2050 are used to calculate the modal shift and emissions for the different modes. For the period 2015 – 2050, the emissions for Road and Rail will decrease at the same time, as for both modes, passenger and freight traffic volumes will increase in the same period. The emissions from rail will slightly rise in 2030 but would decrease in 2050. For Inland waterway transport (IWT), they will remain at current levels.

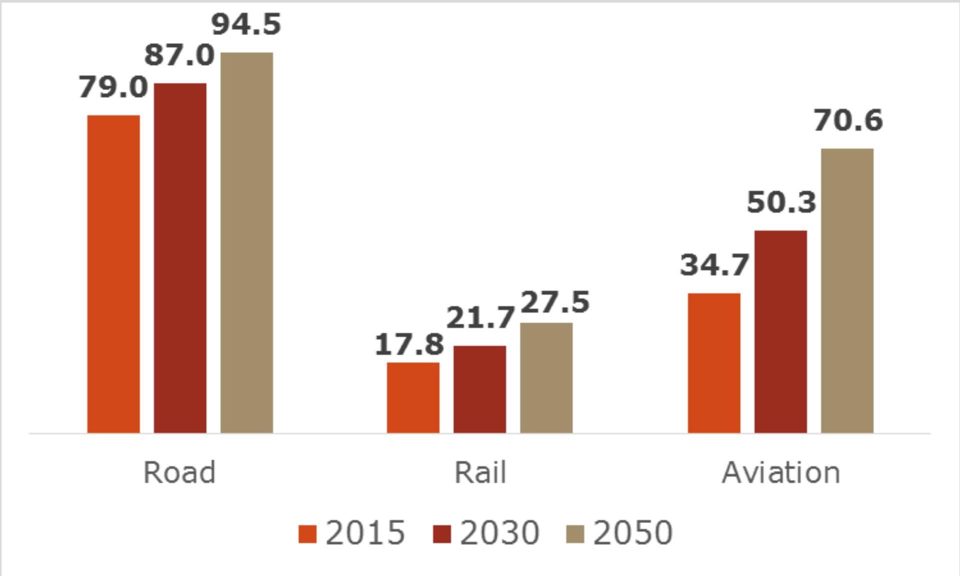
As a result of modal shift and various decarbonisation initiatives, energy efficiency is forecasted to increase over the time period between 2015 and 2030, and emission factors are estimated to fall. Most of the 2030 decrease in $CO_2$ is attributed to greater efficiency in the passenger road sector, whereby relatively low expected growth is outweighed by increases in efficiency. In the freight sector and aviation, traffic growth outweighs efficiency gains. This is illustrated in the figures below.

**Figure 11: Freight (bln tonnes-km) per mode of transport**



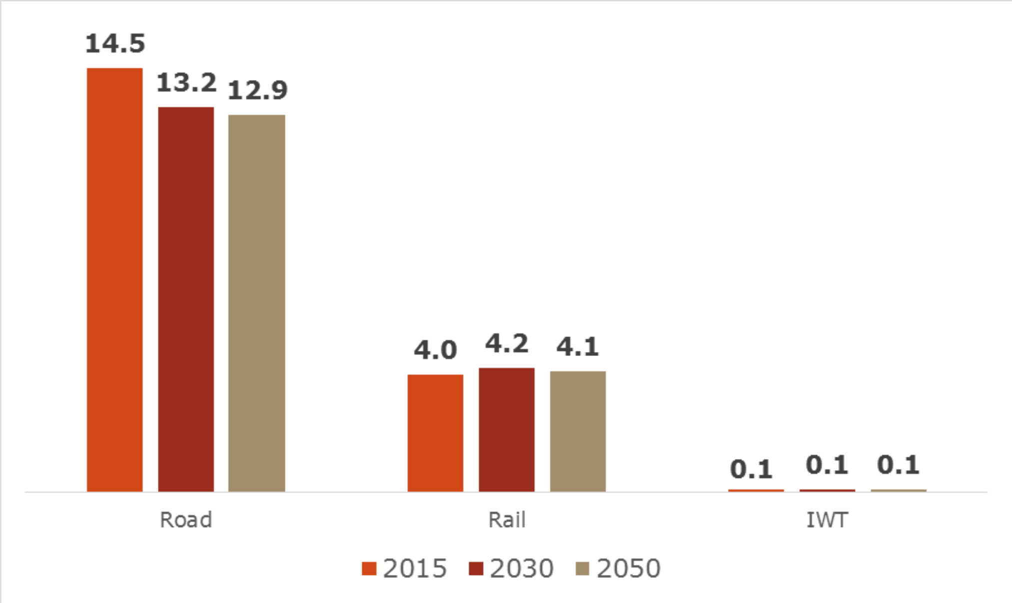

*Source: Panteia/OEM CNC study, 2017*

**Figure 12: Passengers (bln pkm) per mode of transport**




*Source: Panteia/OEM CNC study, 2017*

**Figure 13: Emissions from freight and passenger transport (mln tonnes $CO_2$ equivalent)**




*Source: Panteia/OEM CNC study, 2017*

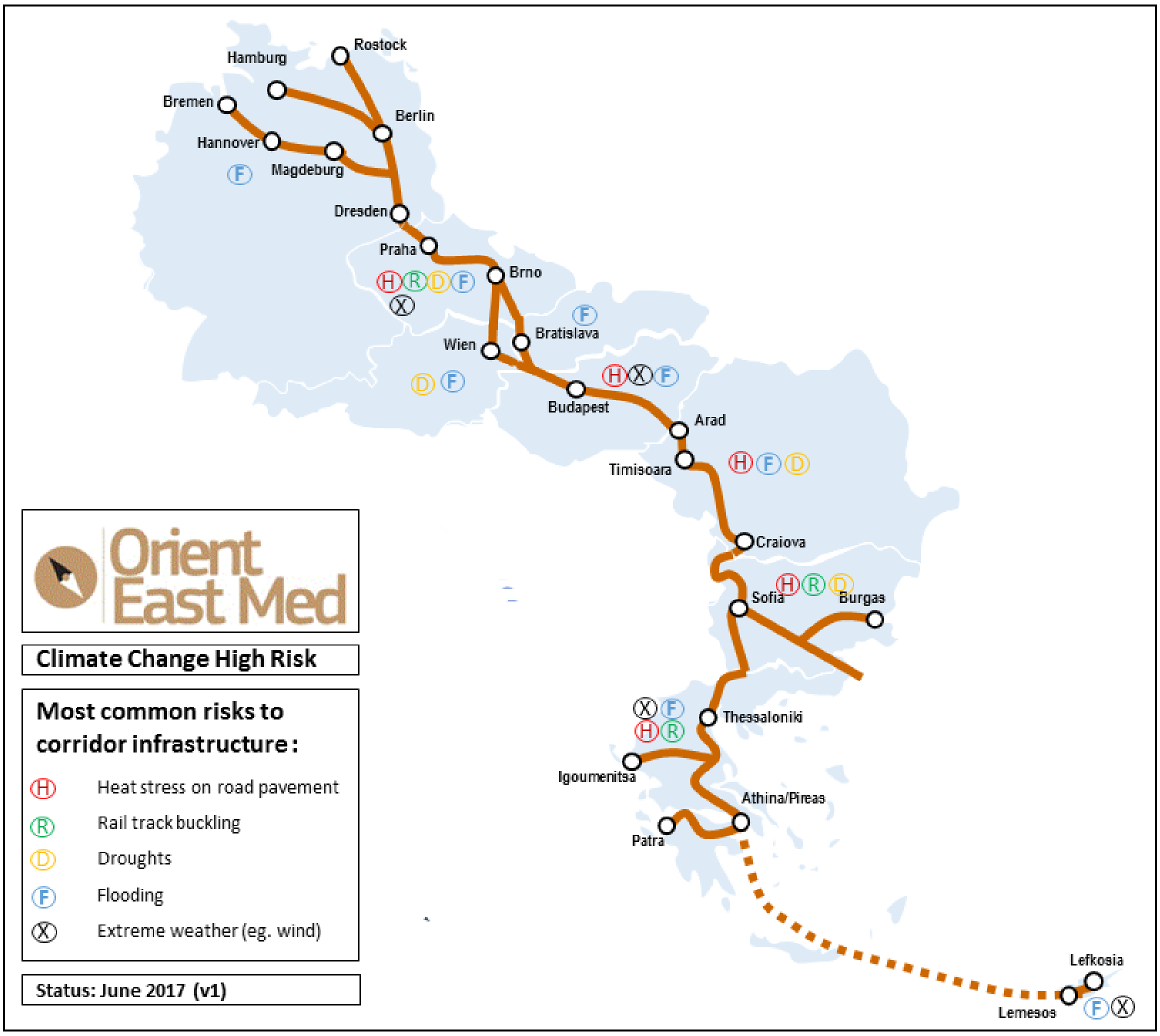
### 3.8.3 Climate Change Adaptation

The OEM Corridor has a temperate continental climate in the north, while ending in a hot Mediterranean climate in the southeast. This means that for parts of Bulgaria, Cyprus, Greece, Romania and Hungary, the vulnerability of road pavement to heat stress is expected to increase extremely in the upcoming century. The other parts of the Corridor will also experience some moderate increase in vulnerability. Rail track buckling is estimated to have an effect in Czechia, Bulgaria and Greece, whilst the remaining parts of the Corridor will encounter only a small increase.

Furthermore, the northern part will likely become increasingly susceptible to heavy rains and flooding, while the southern part will experience more droughts in the upcoming century. The latter, in combination with increased summer temperatures, will also result in increased risk of forest fires. Risk of river and flush floods is expected to increase substantially in the northern part of the OEM, as well as Hungary. Sea-level increase is also expected. This will most likely occur along the coasts of the northern and southern coastal countries of the Orient/East-Med Corridor, namely in Germany, Greece and Cyprus. Figure 14 presents an overview of the main risks identified in each OEM country.

Adaptation measures are taken by a number of countries. Among other, the railway sector in Greece includes works on new alignments expected to significantly reduce vulnerability against floods as well as rail track buckling. In Bulgaria, steel bridges are replaced by concrete ones in order to deal with rail buckling. In Hungary, guidelines for drainage design were revised and transport information systems are under development aiming to prevent and reduce potential damages caused by floods.

**Figure 14: Climate Change Main Risks per OEM country**




*Source: OEM CNC study, 2017*

The detailed analysis of the Wider Elements of the Work Plan is presented in the "Final Report of the Elements of the Work Plan (Part 3b - Wider elements)", August 2017.

## 3.9 Infrastructure investments and funding

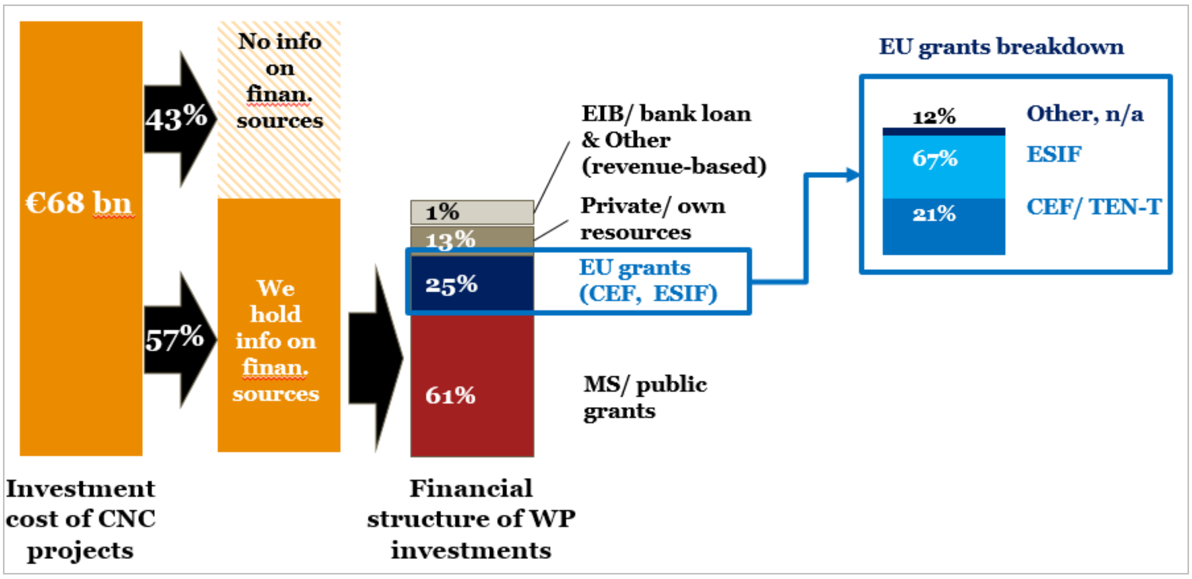
### 3.9.1 Financial requirements

Within the OEM Corridor, an analysis was carried out to identify the funding sources of projects listed within the CNC project list with a view to determine the presence of funding gaps and the potential for other forms of financing than public grants.

Financial sustainability is a crucial factor in the assessment of a project, and more so when analysing a long project pipeline for a multinational transport Corridor, as is the case of the OEM. It should be taken into account that the funding possibilities of the European Commission are not infinite, and that mechanisms representing an alternative to grants (whichever the source), do contribute in a positive way to the complete development of the European transport network. The analysis presented in the following aims at giving an outline of the number of projects that can be financed in ways alternative to grants: examples of these alternative methods include, but are not limited to, the European Fund for Strategic Investments or private bank loans.

The analysis was performed excluding the studies (57 projects). 188 projects, or 57% of the total number of considered projects in the list, present complete financial information and hence were eligible for the analysis. Approved financing accounts for €4 billion, or 41% of the total, while the remaining €5.8 billion, or 59% of the total, is still not approved (i.e. "potential").

**Figure 15: Analysis of the funding and financing sources**




*Source: OEM CNC study, 2017*

Would the EU funding ratio (25%) be applied to the entire OEM Project List investment amount, it can be expected that over the next years, €17.1 bln will be demanded from project promoters and Member States. Out of these €17.1 bln, and if the same rate of funding is approved (i.e. 41%), the total amount of EU funds to be deployed would be in the region of €7 bln over a period of 23 years. Of the 188, approximately 12% was identified as financially sustainable. It was also deemed that an additional 32% of the projects could be financially sustainable, if properly structured (i.e. potentially financially sustainable).

Financial sustainability does not necessarily mean that a project must generate revenues from user payments. Indeed, a project is financially sustainable if:

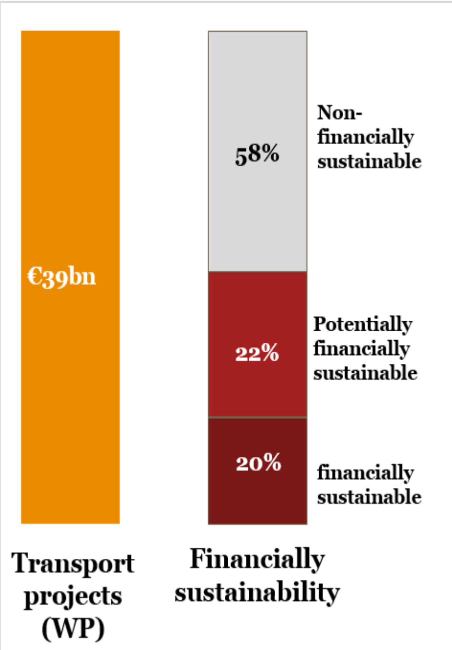
a. user payments exceed the operating costs (revenue generating);
b. the project receives availability payments (i.e. the public sector recognises to the infrastructure manager a pre-identified amount, which is paid during the operating phase on the basis of the infrastructure being compliant to a pre-determined set of KPIs, and irrespective of the demand/users of the infrastructure);
c. a combination of the two options above;
d. the project is not sustained by any cash-flows. However, it is part of a wider intervention and contributes to increasing a system's efficiency, ability to respond to increased demand, etc.

To be considered, a project may still require certain grants in order to be financially sustainable. The difference between non-financially sustainable projects and financially sustainable ones is that in the latter, the promoter could cover at least part of the investment costs with bank loans or by involving the private sector that invests own resources for a future benefit.

The analysis in this case requires a careful screening of the project's detailed information in order to make an educated guess on whether the project appears to fall into any of the above categories. In some cases, the experience in the transport sector comes at help (i.e. railway station developments are often sustainable, as leasing contracts with retail stores can be used to repay investment costs; ports and airports upgrades are generally financially sustainable; etc.).

**How to structure a financially sustainable project**

**Figure 16: Financial Sustainability of OEM projects**




It is possible that potentially financially sustainable projects are structured in such a way that they ultimately become unsustainable. These generally refer to the following cases:

- Projects relative to one infrastructure can sometimes be broken down into smaller sub-projects that are not financially sustainable. However, the entire project may be structured as financially sustainable with a unique management. This is often the case with motorways, which are broken down into small sections; this way, they can access EU grants more easily, but fail to be managed as a single infrastructure and, therefore, be sustainable.
- Projects from the same promoter can be aggregated in a structure to be overall sustainable. This is often the case with small projects with no direct financial benefits, but that enhance the operations and the business activities of e.g. ports, airports, stations, etc. These projects can often be supported with corporate loans.

# 4 For the OEM, it would not be possible to provide an assessment of the amount of investment that can be

**taken over by the private sector with the information at disposal; an estimate on the number of projects that could be at least partially sustained with other-than-grants resources can be however provided (**

## 4.1 Progress of Corridor Development

Since the adoption of Regulation No.1315/2013, **92 projects** were accomplished along the alignment of the Orient/East-Med CNC **until December 2016**, divided per mode of transport as follows:

- Rail: 32 projects, € 5000 mln
- Rail ERTMS: 4 projects € 125 mln
- Air:15 projects, € 880 mln
- Road: 24 projects, € 2300 mln
- IWW: 7 projects, € 60 mln
- Maritime: 8 projects, € 420 mln
- Multimodal: 2 projects, € 140 mln

Accomplished projects on the OEM Corridor include all modal categories, as shown in Figure 27.

**Figure 27: Number of accomplished projects per mode and year**

*Source: OEM CNC study, 2017*

Accordingly, supply related Corridor indicators for rail increased between 1 and 5 %-points between 2013 and 2016, the largest increase noted for the electrification (now 88%) and axle load (80%) ones. Between the years 2013 and 2016, there has been a 7% increase in the express road/ motorway KPI and one additional airport has achieved rail connectivity. For the remaining modes (inland waterways, seaports, inland ports and Rail-Road Terminals), there have been no changes in the KPIs during this period.

**In addition, 41 projects have been completed** –or are expected to be completed by the end of the year 2017 along the OEM Corridor, for a total value of € 8.7 billion. The chart below gives an indication of the ratio between the number of projects and the total investment per category.

Figure 28: Projects expected to be completed in 2017).

Consequently, the projects can be divided in two macro-categories: the on-going ones and those who have yet to start. The first category includes 212 projects, for a total value of approximately € 28 billion. The second category, of interest in this part of the analysis, as the funding possibilities can be effectively explored – and exploited, is composed by 203 projects accounting for € 40 billion. Out of these, 83 are pure OEM actions, thus only impacting the OEM CNC, while 120 are shared with one or more other CNCs. The total investment value of pure OEM projects which still have to start is € 17.3 billion, with the remaining € 22.7 billion accounting for projects shared among the OEM and at least another CNC.

It is interesting to indicate the share of projects –in both the aforementioned categories- which have already secured complete funding well before their commencement. In order to proceed with this assessment, it is first necessary to exclude studies, as they are usually funded through different mechanisms than works, and their impact is rather small: the number of studies in the set of future OEM projects is 24, with 179 projects remaining to be further analysed.

The number of projects which already have secured complete financing is 84 out of 179, almost 50%, corresponding to an investment of € 18.7 billion. Of these 84 actions, 32, accounting for € 3.1 billion, are only part of the OEM Corridor. Therefore, the number of projects that are deemed eligible for innovative financial instruments is 72, equalling to 22% of the analysed projects.

### 4.1.1 Project funding under CEF (2014 – 2017)

During the first 4 years of the CEF implementation period, a very intensive period of new infrastructure and study projects launching on the OEM Corridor took place:

- The total investments supported by CEF on the OEM Corridor amounted to €2.83 billion.
- The CEF financing grant amounted to € 1.95 billion.
- ITS, ERTMS and railway noise reduction improvements accounted for € 24.7 million.

The above figures refer explicitly to the 78 projects, including 30 studies, 20 mixed projects (studies + works) and 28 infrastructure works, partly funded by CEF that belong to the OEM Corridor.

Those projects will contribute to the removal of 24 bottlenecks, the improvement of 4 cross-border links and the set-up of 282 clean fuel filling stations (48 CNG, 16 LNG, 217 e-loading and one $H_2$ filling station).

An important pipeline of mature projects has been identified and has translated into a huge success of all calls for proposals. This has led to a fast and efficient use of the available CEF financial means.

Results from the 2016 CEF Call have also been published in the summer of 2017, with 29 of the funded projects on the OEM Corridor, for a total of approximately € 450 million. A distinction can be made between those projects which only contribute to the development of the OEM Corridor and those that are shared among two or more Corridors – OEM included. Out of the 29 projects that were financed, 14 are "OEM-only" projects and account for € 420 million, while 15 are shared with other Corridors.

Of the 29 projects financed:

- 8 projects are **multinational**, none of which is a pure OEM project
- There are 11 **studies** (4 OEM only), 8 **mixed** (6 OEM only) and 10 **works** (4 OEM only) projects
- 8 **Rail** projects (all OEM only)
- 15 **Road** projects (3 OEM only)
- 1 **Multimodal**, non OEM only project
- 4 **Maritime** projects (2 OEM only)
- 1 **IWW**, OEM only project

Finally, 9 proposals addressing the OEM Corridor were submitted under the 2017 CEF Transport Blending Call at the first cut-off date in July 2017.

### 4.1.2 Infrastructure funding and innovative financial instruments

The development of Core Network Corridors requires, inter alia, a critical mass of investment to take place within a short time- framework; therefore a careful examination of the potential financial sources has to accompany the corridor planning. Some key criteria to be appraised are reported herein.

The projects to be developed can be ranked in three different categories from the point of view of funding and financing needs:

a. For several revenue generating projects "closer to the market" in terms of development (technological components, including large infrastructure of key European Interest, brownfield upgrade) or service provision (terminals for freight / passengers, enhancement of infrastructure capacity / performances), a substantial component of the project funding can come from own resources (e.g. equity) and financing resources gathered by the project promoters on the market (e.g. in the form of equity, loans or bonds). The private investors would need to recover their initial costs of capital and receive a reward for the risk born (the higher the risk, the higher the return required).
   The project may look at conventional lending from public and private banks, alternative financing from institutional investors (e.g. bonds) and at financial instruments for instance to cope with the unbalances of cash-flow during its construction and rump-up phase until a sustainable flow of revenues is secured, and also to address particular risks and market failures and secure lending with long maturity. Financial instruments could be provided in the form of credit enhancing and guarantees (be it a specific legal guarantee or a financial guarantee to ease access to financing).
b. Hard-infrastructure, greenfield, risky, long-term projects such as the majority of cross-border railway connections as well as inland waterways navigability improvements might require a substantial public support through public funding, even if innovative approaches can apply to project development and/or to specific components of the investment. Public funding can be structured in different ways (also depending on the budgetary constraints of the public authorities), such as lump sum subsidy (grant), fiscal incentives, operational deficit coverage and availability payment schemes.

c. In a variety of intermediate cases, the project will require a more limited funding component in order to reinforce its financial viability – these projects could be supported through a blending of funding (e.g. grants) and financing.

   In this respect, beside the national budget, the funding contribution can effectively come from the EU centralized managed funds, such as the Connecting Europe Facility (CEF) and from decentralized managed funds such as the European

Structural and Investment Funds (ESIF), while the financing resources may come from the EU financial instruments, such as the CEF Debt Instruments and financial products available under the European Fund for Strategic Investment (EFSI).

For all these 3 different categories of projects, public intervention with different degree of intensity is justified on the ground that these projects of high socio-economic and EU added value substantially address overall public service obligations, suboptimal investment level, market failures and distortion due to externalities (positive, for the projects supported, including in terms of strategic added-value, and negative for competing modes), and, therefore, call for the transfer of resources.

When considering the project funding structure in a comprehensive and multimodal setting, earmarking of revenues and cross-financing solutions, applying "Polluter-pays" and "user-pays" principles ought to be duly explored.

A project can be fully developed through project financing if the revenue stream (secured by public and/or private funding), exceeds the investment and operational costs (CAPEX, OPEX). Such an approach calls for a careful risk sharing between the Member States (project management) and private partners.

Notwithstanding the project self-financing potential linked to user fees, a cautious and innovative approach aimed at exploiting the project' life-cycle and defining clear responsibilities and risk sharing between project promoters, sponsors and implementing bodies is more and more needed to deliver projects on time, cost and quality and to fully exploit the potential, while minimising future liabilities on public budgets.

A pre-condition for project financing is a conducive regulatory and legal environment, in order to set the appropriately incentives to enhance the public and private sector involvement in the delivery of infrastructure investment.

## 4.2 Impact to jobs and growth

A preliminary macro-economic analysis on the impact of OEM CNC projects resp. investments was performed based on two methods.

Based on a few CNC project samples[27], the number of generated direct construction-related jobs by total investment costs spent was estimated, being roughly 1 direct job per € 1 million investment.

Based on another approach developed by the Fraunhofer Study "Cost of Non-completion the TEN-T Core Network (2016)", multiplying factors (see Table 24) were derived, that were linked with the list of projects and their total costs.

**Table 24: Job & Growth Multipliers for TEN-T CNC projects**

| Categories | Type of investment | | | Unit of measurement |
|---|---|---|---|---|
| | Average | Cross-border | Innovation | |
| GDP Multiplier | 4.35 | 16.8 | 17.7 | bn€-GDP / bn€-INV |
| JOB Multiplier | 16,300 | 37,000 | 38,700 | FTE-JobY / bn€-INV |

*Source: Fraunhofer Study on the Cost of non-completion of the TEN-T (2015)*

Those OEM CNC projects for which cost estimates are available and that are planned to be implemented over the period 2016 to 2030 amount to an investment of € 68 billion. The implementation of these projects will lead to an increase of GDP over

27 This value is based on job numbers of approx. 10 projects, including a seaport works project in Cyprus and two project clusters in Greece for rail investments.

the period 2016-2030 of € 517 billion, in total. Further benefits will occur also after the year 2030.

The investments will also stimulate additional employment. The direct, indirect and induced job effects of these projects will amount to 1,494,000 additional job-years created over the period 2016 to 2030. It can be expected that also after 2030, further job-years will be created by the projects.

A more detailed description is provided in section 8.

## 4.3 Pilot initiative - the Rail Border Two Hour Goal

During the three Corridor Forums Working Group meetings on border-crossing rail transport, which were held in April 2016, April 2017 and October 2017, with strong cooperation with the Rail Freight Corridor "Orient/East-Med" (RFC 7), the Coordinator set up the strategic goal of reducing significantly the freight trains border waiting times and achieving the so called "Two-Hour Goal".

Freight trains, operating along the OEM Corridor from Greece to Germany, have to pass six border crossing points. At each, time-consuming technical and logistical procedures by Infrastructure managers, railway undertakings and authorities are required, resulting in prolonged border crossing waiting time and significant decrease of the average train's O/D speed below 30 km/h.

In August 2016, the European Court of Auditors (CoA) [28] complained on the poor performance of rail freight transport in terms of volume and modal share, also due to the very low average commercial speed of freight trains of approx. 18 km/h on many international routes. The paper underlined that cooperation between Rail IMs is crucial for a significant increase of both the speed and competitiveness of rail freight transport and that extra funding on rail infrastructure will not solve the problem.

On the 21st June 2016, in Rotterdam, at the OEM CNC Coordinator's initiative, a **Joint Ministerial Declaration** "On effective improvements to eliminate bottlenecks and facilitate international traffic on the Orient/East-Med Rail Freight Corridor" was signed by representatives of the Transport related national Ministries of Germany, Austria, Czechia, Slovakia, Hungary, Romania, Bulgaria and Greece. These 8 EU Member States committed officially to set measures in order to reduce each rail border transit time to a maximum of 2 hours by mid-2018.

The initiative's aim is to simplify the cross border technical and administrative operations, to enhance and harmonise coordination of infrastructure works, capacity and path arrangements and to improve governance and communication.

The initiative was developed in the context of EU policies and Regulations, coordinated with all involved stakeholders (e.g. RFCs and its bodies, UIRR, – International Union for Road-Rail combined transport, ERA), taking into account the other existing initiatives which may partially and explicitly address the cross border issues, such as ongoing projects[29] and studies, the TAF TSI **Master** Plan 2013, the **ERTMS Memorandum of Understanding** between the EC and the European Railway Associations (CER – UIC – UNIFE – EIM – GSM-R Industry Group – ERFA) concerning the strengthening of cooperation for speeding up the deployment of ERTMS(July 2008), and the **Shift2Rail** European rail initiative focused on research and innovation (R&I).

[28] European Court of Auditors: Rail freight transport in the EU: still not on the right track – Special Report No. 2016-08; http://www.eca.europa.eu/Lists/ECADocuments/SR16_08/SR_RAIL_FREIGHT_EN.pdf

[29] e.g. **SMART-RAIL project**: «*Smart Supply Chain Oriented Rail Freight Services*» –project funded under the H2020 Programme of the European Commission

# 5 Inland Water Transport: Potential market uptake

## 5.1 Objective

The objective is that a general overview and information about the target markets in transport and logistics is defined, based on the definition of the catchment area, socio-economic characteristics and macroeconomic indicators of the OEM Corridor countries and OEM regions. In particular, Gross Domestic Product (GDP), population and urbanisation are the basis for the forecasted transport demand. The market uptake is based on an investigation of the transport demand, critical needs, seasonal trends, traffic volumes, market related transport flows and prices, etc.

This specific task:

- identifies the modes which possess the highest unused transport capacities on the OEM Corridor and the potential market uptake,
- based on detailed analysis of transport flows and logistics requirements,
- in order to obtain a realistic view on market uptake.

Specific attention was paid to the last mile transport connections and the relevance of the nodes. The targeted modes are those which are most environmentally friendly, inland waterways, in particular. This analysis is based on the consortium's vast industry and market knowledge, as well as current research findings and conclusions.

The modal shift potential is mainly related to **the inland waterway network**; as it was shown in the final report of the 2014 OEM study, the forecasted capacity in 2030 is limited on the railway network and a shift towards rail would exacerbate capacity problems. A shift from road to rail was also identified as a result of potential compliance to TEN-T standards 2030.

The inland waterway network of the OEM Corridor where additional capacity is available is notably related to the Elbe river. The inland waterway potential of the Danube is referred in the analysis of the Rhine Danube Corridor that overlaps with the OEM Corridor.

## 5.2 Competitive analysis

The main objective of the 'analysis of modal shift potential' is to identify individual transport flows that, hauled together, could bring enough volume to operate a liner service between two (or more) Inland Terminals. A top-down approach has been used to determine the multimodal market potential. Hereafter, the step-by-step methodology and the specifications behind the model are laid out. Several selection criteria have been used in order to further determine the continental multimodal potential:

- All regions that are connected to the CEMT class IV inland waterway network (TEN-T + all other waterways) have been selected. This includes both interconnected and isolated waterway regions. Moreover, non-connected regions that are within a range of 100 kilometres from a CEMT IV waterway have been also included.

- Containerized goods have been selected. These goods are suitable for container transport; however, not all goods necessarily need to be transported in containers. It is mostly goods that are currently being transported by road, but this, for example, excludes specifically living animals and the already captive IWT markets of crude oil, coal, iron ore and dry bulk, sand and gravel.

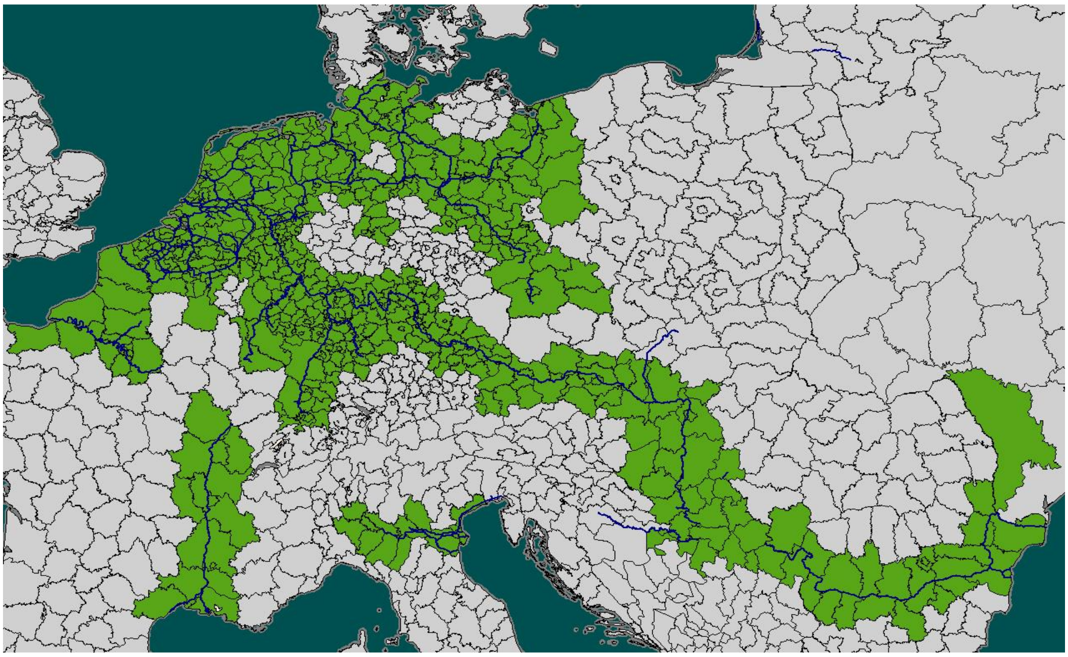
- Two distance criteria have been applied:

  1. Regarding the selection of relevant regions for a potential model shift to IWT, the regions that have been selected have access to the IWT network using pre-/end haulage over a distance of maximum 100 km.

  2. The O/D transport distance for road haulage should be at least 200 km. If the origin and destination are both located directly along waterways ("wet locations") already at transport distances from 20 km, IWT can be competitive compared to road haulage. However, if locations are situated away from waterways (i.e. "dry locations"), pre-/end haulage is needed resulting in an increase of break-even distance. For dry-dry locations the break-even distances are between 180 and 200 km[30]. The potential should however be a direct result of comparison of the intermodal vs. road transport costs; therefore, no pre-selection was made on distance classes for road haulage. Short distance transport by road (i.e. between Slovakia and Czech Republic) is thus also considered in this multimodal analysis.

On the basis of the assumptions and criteria mentioned above, the scope for the continental container transport model has been determined. The scope is illustrated in Figure 17 by a selection of NUTS-3 regions (in green) with relatively close access to the European inland waterway network. For road transport, the ETISplus road matrix has been used (year 2010).

**Figure 17: Overview scope market potential continental container market (NUTS-3 regions)**



*Source: PANTEIA; OEM CNC study, 2017*

The selection results in a more refined road O/D matrix presenting information for the following variables:

[30] Based on extensive research on door-to-door cost for several types of transport chains for IWT for the situation in the Netherlands, a country with a high-density waterway network. Source: NEA and Policy Research Corporation, 2006, Market Study IWT.

- Origin (NUTS-3 level);
- Destination (NUTS-3 level);
- Tonnage transported of containerized goods between selected regions;
- Region types[31]: IWT-connected regions both on isolated and on interconnected waterways;

The resulting selection of transport flows between O/D pairs was assigned to the existing network to help identify the study areas for continental multimodal potential. The service network for the transport of continental containers via IWT has been designed following from upon existing and, possibly, planned barge services[32].

Based on the availability of inland container terminals[33], combined with existing and planned barge services, a hub and spoke network is foreseen as the most promising to link O/D's and branches of the network. This approach uses the possibility to connect multiple branches and individual/separate barge services together through a hub and spoke network.

## 5.3 Potential intermodal transport vs. direct trucking

In order to determine the potential modal shift from direct trucking to intermodal transport via barge for continental containerized cargo for every O/D pair selected in the scope, a comparison must be made in whether intermodal transport is less costly than direct trucking. When this is demonstrated, there is a potential for modal shift.

### 5.3.1 Terminals on the network

The cost model is set up by assigning a selection of (inland) container terminals to the IWT networks (closed + EU Interconnected), where containers can be transhipped from inland shipping to road transport and vice versa. It should be noted that planned inland container terminals have also been taken into account. For the simplicity of the model, in certain NUTS-3 regions with a high density of (inland) container terminals, some terminals have been added. For neighbouring terminals within the same NUTS-3 region, the differences in transport costs to and from all destinations in that region are considered to be relatively small.

### 5.3.2 Waterway and ship characteristics

For determining Inland waterway transport costs for all container barge services, the characteristics of each waterway corridor / channel / river has been taken into consideration. The following assumptions are valid:

- The dimensions of the vessel are based on either the barge services or the maximum permissible vessel dimensions according to PC Navigo software.
- The amount of locks on the route, according to PC Navigo software.
- The flag of the vessel, having influence on the costs structure of the vessel. Costs information is obtained from the yearly Panteia costs models (costs per hour)[34]. Trip times differ depending on fairway characteristics: sailing upstream implies different speeds than sailing downstream, and so do load factors, vessel sizes, etc.
- A ship is assumed to load 70% of its container capacity.

[31] The ETISplus O/D-matrix can also present the tonnage transported from/to maritime regions for road transport. However, given that this study focuses on the potential shift of *continental* road transport, this transport flow has not been taken into account.

[32] ETISplus terminal database (2010), completed with information from IDVV, VNF, NPI (Navigation, Ports et Intermodalité) and Schiffahrt, Hafen, Bahn und Technik.

[33] Ibid

[34] Panteia (2014): Kostenontwikkeling binnenvaart

- Two third of the containers on board are assumed to be laden, others are assumed to be empties that need to be repositioned. This way, also empty return loads are taken in to account.

**Box 1: Information about PC Navigo**

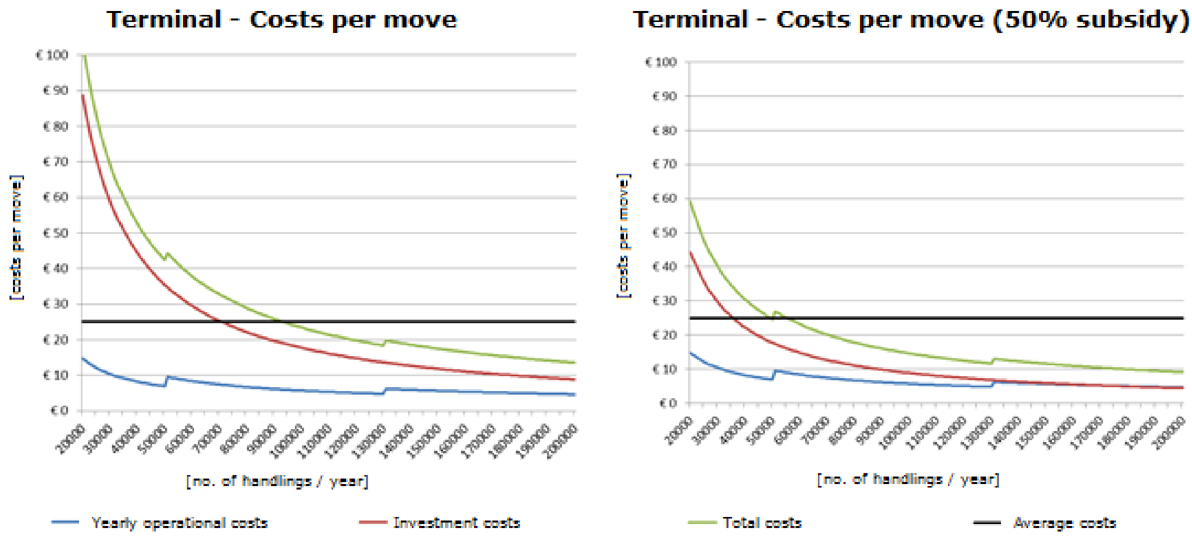
| |
|---|
| *PC-Navigo is a voyage planner and navigation system for the inland waterways. Depending on which version is used (Europe, Benelux, Netherlands, Germany, France) voyages can be planned and during navigation the GPS provides position information and velocity. The software contains all operating hours, dimensions, communication data, VHF channels and other information about all bridges and locks in the waterways network. The program checks for stoppages or limitations that may block a passage. Many bridges and locks have pictures that can be shown to provide information about the local situation. The voyage planning process shows all details of navigation hours, the progress one can make, and the total time of the planned voyage. Bridge clearances; although the assumption is made that container vessels can pump ballast water in order to create clearance to pass "low" bridges.* |

*Source: PC Navigo (2015), www.pcnavigo.com/en/pc-navigo-2/really-long-uitleg/*

### 5.3.3 Handlings costs and rental container

Based upon the network of barge services, the number of transhipments made per O/D pair has been determined. Each transhipment (move) is multiplied by € 25. No distinction is made between terminals or the various countries. For additional transhipments, besides the origin or destination, an additional transhipment of € 25 per move has been added, e.g. for terminals with hub functions in the network. In general, two moves are needed at terminals with a hub function (ship – shore and shore – ship). HaCon and KombiConsult indicate € 20 - € 32.5 as a range for handling costs.[35]

**Figure 18: Handling costs in IWT**




*Source: Hub en Spoke in de Containerbinnenvaart (2014), Panteia et al.*

[35] This includes subsidy by governments on terminal investment costs. See: KombiVerkehr – Entwicklungskonzept, HaCon et al. (2011).

The costs for the rent/use of containers are assumed to be € 15 per container[36]. HaCon and KombiConsult indicate € 12 to € 20 for the rental of containers per trip[37].

### 5.3.4 Pre- and end haulage

Costs for Pre-/End haulage to and from the container terminals in the network have been based on distances of the road network in ETISplus. The model uses the distance from industrial areas within NUTS-3 regions to/from the terminals. The costs for pre/end haulage are determined by the cost function based on these distances. It should be noted that variable costs add up from € 0.47 per kilometre to € 0.65 per kilometre. The costs for trucks are based on the variable and fixed costs for trucks plus fixed costs for drivers originating from the country where the terminal is situated. Information about costs originates from Panteia costs models. A different time-distance relation is specified in the costs-function, making direct road transport cheaper than intermodal road transport for the same distance.

### 5.3.5 Intermodal costs – Lowest costs algorithm

The model calculates the cheapest path out of all possible options (about 2,500,000,000) to transport continental containers per O/D including access and egress transport.

### 5.3.6 Direct trucking scenarios

For direct trucking per O/D pair the model chooses the lowest costs based upon several truck and driver combinations. For international traffic, the cheapest truck and the cheapest driver of the two countries involved is selected. For more detail on costs, see Panteia costs models[38].

For road transport, the (direct) transport costs have been calculated for three alternative scenarios, namely:

1. No return load - **low road efficiency** (50%)
2. Return load in 80% of the cases, 20% no return load (EU average based on Eurostat statistics) – **medium road efficiency**
3. Return load in 100% of the cases – **high road efficiency** (100%).

Comparison of intermodal transport costs vs. direct trucking scenarios yields a range of results.

### 5.3.7 Potential continental containerized cargo via IWT

It is automatically calculated per O/D whether intermodal transport via barge is less or more expensive than direct trucking. When the alternative of intermodal transport via barge is less expensive for a specific O/D, the amount of cargo (in tonnes) following from the transport of continental cargo by road transport for that specific O/D (NUTS-3 level), as selected in ETISplus based on the scope, is shifted from road transport to intermodal transport by barge.

The sum of individual O/D relations leads to a total potential of continental containerized cargo to be shifted to intermodal transport, which can be illustrated in maps or specified through matrices (for the various scenarios). Based upon the cost functions for intermodal transport by barge and direct trucking, including the criteria and assumptions mentioned above, the selection of freight flows from the ETISplus continental road transport matrix follows automatically.

[36] Panteia et al. (2014) – Hub en Spoke in de Container Binnenvaart, Annex Report.
[37] KombiVerkehr –Entwicklungskonzept, HaCon et al. (2011)

The total potential for the OEM Corridor for the three alternative scenarios is given in Table 25. These are the current road volumes that can be containerised and shifted to inland waterways (including pre- and end haulage) on the river Elbe. A large potential is available, even in the case of the most efficient scenario for direct road transport.

Table 26 presents information on the maximum potential per scenario and per commodity group for the Elbe river.

**Table 25: OEM Corridor volume that can be shifted to IWT (in million tonnes)**

| Regions | Low modal shift potential | Medium modal shift potential | High modal shift potential |
|---|---|---|---|
| **OEM Corridor** | 59.2 | 23.1 | 3.3 |

*Source: PANTEIA; OEM CNC study, 2017*

**Table 26: OEM Corridor volume that can be shifted to IWT (in million tonnes) per commodity group**

| Regions | Low modal shift potential | Medium modal shift potential | High modal shift potential |
|---|---|---|---|
| **Agricultural and food products** | 14.8 | 5.2 | 0.8 |
| **Energy products and chemicals** | 10.4 | 4.3 | 0.5 |
| **High end building materials** | 8.7 | 2.5 | 0.3 |
| **End products & other** | 25.3 | 11.1 | 1.7 |
| **Total OEM Corridor** | **59.2** | **23.1** | **3.3** |

*Source: PANTEIA; OEM CNC study, 2017*

The table below presents the volumes of transport on the OEM Corridor; from the total road transport volume of 415.5 mln tonnes, about 260 mln tonnes are related to the Elbe region (Germany and the Czech Republic). This means that 59.2 mln tonnes from this volume can be containerised and shifted from road to inland waterways in the low modal shift potential scenario[39].

**Table 27: Freight transport volume between the OEM regions for 2010, 2030 reference scenario and 2030 compliance with TENT; in mln tonnes**

| | 2010 | 2030 reference | 2030 TEN-T implementation |
|---|---|---|---|
| **Road** | 415.5 | 746.2 | 701.3 |
| **Rail** | 189.7 | 380.0 | 407.5 |
| **Inland waterway** | 18.7 | 23.4 | 40.7 |
| **Maritime** | 75.9 | 85.6 | 85.5 |
| **Total** | **698.8** | **1235.2** | **1235.0** |
| ***Rail share*** | *27.1%* | *30.8%* | *33.0%* |
| ***IWW share*** | *2.7%* | *1.9%* | *3.3%* |

*Source: PANTEIA; OEM CNC study, 2017*

[39] The Potential scenario takes into consideration the effects from the implementation of the projects on the OEM Project list.

## 5.4 Regulatory restrictions

The required measures (infrastructural and other) to fulfil the maximum potential are related to lifting the capacity bottlenecks in the inland waterway network.

Also, intermodal services have to be established in order to absorb the extra demand.

Notably, the only way in which inland waterway transport can accommodate the flows originating from road is by efficient intermodal (synchromodal) transport.

# 6 Rail: Reducing barriers in Corridor-wide rail operation

## 6.1 Cooperation with Rail Freight Corridor

### 6.1.1 Background

In 2010, the Regulation (EU) No. 913/2010 concerning a European rail network for competitive freight entered into force. It was elaborated with the overall purpose to increase the attractiveness and efficiency of rail freight transport along international transport routes, in order to increase its competitiveness and modal share on the European transport market. The Rail Freight Corridors (RFC) are intended to deal with three main challenges:

- Strengthening cooperation between infrastructure managers on key aspects such as allocation of train paths, deployment of interoperable systems and rail infrastructure development;
- Finding the right balance between freight and passenger traffic along the RFCs, giving adequate capacity for freight in line with market needs and ensuring that common punctuality targets for freight trains are met;
- Promoting intermodality between rail and other transport modes by integrating terminals into the corridor management process.

According to Regulation (EU) No. 1315/2013 ("TEN-T Regulation"), sentence 46, "the core network corridors should be in line with the rail freight corridors set up in accordance with Regulation (EU) No. 913/2010 …". Currently, there are nine implemented RFCs, for which the alignment will be further adapted over time (until 2020) to fit with "their" corresponding Core Network Corridors.

### 6.1.2 RFCs overlapping with Orient/East-Med CNC

The Orient/East-Med Corridor includes sections of two rail freight corridors.

Rail Freight Corridor No. 7 (Praha – Wien/Bratislava – Budapest – București – Constanta/ – Vidin – Sofia – Thessaloniki – Athina) mainly covers the southern part of the OEM CNC (CZ from Praha to southeast, AT, SK, HU, RO, BG, GR). Efforts are made to extend the RFC7 to Germany, expected for 2018.

Rail Freight Corridor No. 8 (North Sea ports of Antwerpen, Rotterdam, Amsterdam, Wilhelmshaven, Bremerhaven and Hamburg spreading in central Germany through Aachen – Hannover/Berlin – Warszawa – Terespol (Poland-Belarus border) / Kaunas / Falkenberg – Praha / Wroclaw – Katowice) covers the northern part of the OEM CNC, approx. 900 km.

### 6.1.3 Coordination with RFCs

Article 48 of the TEN-T Regulation states that "adequate coordination shall be ensured between the core network corridors and the rail freight corridors provided for in Regulation (EU) No. 913/2010, in order to avoid any duplication of activity, in particular when establishing the work plan or setting up working groups."

As a basis for any cooperation and sharing of work, it is therefore necessary to outline the scope and structure of these two corridor frameworks. The main characteristics and differences are shown in Table 28 below.

**Table 28: Comparison CNC/RFC scope and structure**

| Topic | Core Network Corridor | Rail Freight Corridor |
|---|---|---|
| **Legal basis** | Regulation (EU) No.1315 / 2013 | Regulation (EU) No.913 / 2010 |
| **Main objectives** | Infrastructure development | Harmonisation of business and technical conditions |
| **Transport modes & types** | Multimodal (rail, road, aviation, inland waterways and ports); Passenger and freight | Rail transport, Freight only |
| **Governance structures** | EU Coordinator (+ Advisor)<br>Secretariat (consortium) | Executive Board<br>Management Board |
| **Stakeholder involvement** | Corridor Forum<br>(2x annually) | Advisory group<br>(2x annually) |

*Source: based on RFC7 presentation (Wien, 5/4/2017)*

In 2016, DG MOVE outlined a "Model for cooperation between Rail Freight Corridors and TEN-T Core Network Corridors". This model promotes an easy and transparent flow of information, defines potential topics of information to be exchanged, and proposes mutual consultation for studies or projects carried out in the scope of the CNC or RFC. As it is stated, the "CNCs and RFCs can develop their cooperation on the basis of this model. Where cooperation is already in place and satisfactory to all parties, this shall be taken into account."

For the Orient/East-Med CNC, the cooperation with RFCs is based on the following action fields:

- Areas of joint interest, e.g. Border crossing, Projects to level up joint RFC/TEN-T freight core corridor sections, Coordination of maintenance and construction works;
- Tools of cooperation: Corridor Fora, bilateral exchange of information, working group meeting(s);
- Harmonised approach and sharing of information with parallel TEN-T Corridors (especially OEM): OEM working groups on cross-border issues in Budapest (8-9/3/2016), in Wien (5/4/2017) and in Brussels (19/10/2017), Rotterdam declaration;
- Follow up and support the implementation of the Action Programme of Orient/East-Med Rail Freight Corridor (Annex to the "Joint Ministerial Declaration On effective improvements to eliminate bottlenecks and facilitate international traffic on the Orient/East-Med Rail Freight Corridor), 21/6/2016.

During the 2015-2017 Corridor Forum Meetings, the communication with the Management Board of Rail Freight Corridor 7 continued. This group is an important transnational player for the successful implementation of the Work Plan with an already active participation of their representatives; the cooperation with Rail Freight Corridor North-Sea Baltic (RFC8) was minimum.

### 6.1.4 Cooperation model

The development of cooperation with the Rail Freight Corridors has been made on different levels and directions, taking into consideration the new members that need to join the RFC's Governance Structure, following the alignment. This accession shall take place gradually until 2020 at the latest, in order to allow ample time to harmonise the applied rules and processes already implemented among RFC participant members.

A model of cooperation has been developed based on European Regulation to facilitate and harmonize the activities, aimed at facilitating the achievement of the objectives of both the RFCs and CNCs and at avoiding duplication of work through effective exchanges of information and consultations. The cooperation model covers important aspects such as information flow, data exchange, need for mutual consultations and implementation.

### 6.1.5 Forms of interaction

In addition to the consortium's knowledge of the Implementation plan of Rail Freight Corridor 7 and the Corridor Fora, additional joint working meetings have been organised with the representatives of the RFC7 Management Board and other stakeholders (railway undertakings) in three sessions, in Budapest, Wien and Brussels. The three working groups organised focused on cross border issues offering the opportunity for more in-depth analysis and identification of major reasons for delays, as well as measures to be taken for eliminating them.

#### 6.1.5.1 Working Group meetings on rail border crossing issues

For all Working Group meetings, the European Coordinator for the Orient/East-Med TEN-T Core Network Corridor (OEM CNC), Mr Mathieu Grosch, invited interested members of the OEM CNC Corridor Forum as well as representatives of the Railway Undertakings (RU) and international organisations.

The 1st Working Group meeting on Cross-Border issues in Rail Transport was organised with the support of the HU MoT in Budapest, and took place during Tue 8 – Wed 9 March 2016 in the premises of the Ministry. The meeting was held back to back with a Meeting of the Orient/East Med Rail Freight Corridor (RFC 7), whereas the RFC7 representative was involved in the Working Group meeting.

The 2nd WG meeting was organised in Wien, with the support of the Austrian MoT on the 5th of April 2017, followed by a High-Level meeting on the 6th of April.

The 3rd and final WG meeting was held in Brussels, with the support of DG MOVE, on the 19th of October 2017 and focused on the State of implementation of the RFC 7 Action Programme, next steps and conclusions. In this WG, the International Union for Road-Rail Combined Transport (UIRR) was invited to present the intermodal perspective on cross border issues.

In all meetings the attendance was high, taking into account the international importance of the issues to be discussed. Mr Grosch welcomed in all occasions over 40 participants from Ministries of Transport (DE, CZ, AT, HU, RO, BG, and EL), Regions (Sachsen), Rail Infra Managers (MÁV, CFR) and Railway Undertakings (CFR Marfa, CFR Calatori, DB Cargo, Rail Cargo, LTE, CER). All stakeholders were interested in presenting their issues, resulting in multiple speakers and presentations.

The goal of the WG meetings was to learn and discuss the recent situation and future needs for border-crossings in rail transport along the OEM Corridor. An example was analysed in detail, in the 1st WG meeting, that is, the Schengen border between Hungary and Romania.

The conclusions and results of the 1st Work Group meeting contributed to the next step for improving the rail cross border issues, namely the signing of the Joint Ministerial Declaration at the TEN-T Days in Rotterdam in June 2016, on effective improvements to eliminate bottlenecks and facilitate international traffic on the Orient/East-Med Rail Freight Corridor, that is supplemented by an Action Program (AP) of the Rail Freight Corridor. (See section 5.2 – Pilot initiative.)

In the 2nd and 3rd Working Group meetings, the RFC7 representatives presented their findings and the implementation of the RFC Action program. To understand the Cross-

Border issues from the perspective of all key stakeholders was the starting point for the identification of the necessary immediate soft measures and next steps.

The overall objectives of the OEM CNC WG meetings were:

- To continue the exchange of information between TEN-T Coordinator (incl. EC staff) and stakeholders;
- To continue and update the existing exchange of information in technical, organizational and economic topics, important for the evolution of the TEN-T Core Network Corridor;
- To enable direct expert discussions and knowledge transfer (good practices) and to maintain the direct dialogue between railway infrastructure managers and railway users;
- To analyse, and respectively to propose the development of project prioritisation in order to ensure track capacity and smooth operation, and to identify the implications;
- To enhance the mutual understanding of a common corridor;
- To clarify and follow up on the measures and decisions already taken during the previous Working Groups meetings;
- To update on intermediary actions and results on the cross-border operations, infrastructure works, capacity and governance as defined in the implementation report of the AP;
- To agree on a long-term vision for solutions for specific barriers and bottlenecks and dissemination of best practices;
- To better define the required investment and the eventual EU support;
- To follow up on the actions to be implemented by June 2018 on reducing the average border-crossing times up to 2 hours.

## 6.2 Pilot initiative – the Rail Border Two Hour Goal

During the three Corridor Forums Working Group meetings on border-crossing rail transport, which were held in April 2016, April 2017 and October 2017, with strong cooperation with the Rail Freight Corridor "Orient/East-Med" (RFC 7), the Coordinator set up the strategic goal of reducing significantly the freight trains border waiting times and achieving the so called "Two-Hour Goal".

Freight trains, operating along the OEM Corridor from Greece to Germany, have to pass 6 border crossing points. At each, a time-consuming technical and logistical procedure by Infrastructure managers, railway undertakings and authorities is required, resulting in prolonged border crossing waiting time and significant decrease of the average train's O/D speed below 30 km/h.

In August 2016, the European Court of Auditors (CoA) [40] complained on the poor performance of rail freight transport in terms of volume and modal share, also due to the very low average commercial speed of freight trains of approx. 18 km/h on many international routes. The paper underlined that cooperation between Rail IMs is crucial for a significant increase of both the speed and competitiveness of rail freight transport and that extra funding on rail infrastructure will not solve the problem.

[40] European Court of Auditors: Rail freight transport in the EU: still not on the right track – Special Report No. 2016-08; http://www.eca.europa.eu/Lists/ECADocuments/SR16_08/SR_RAIL_FREIGHT_EN.pdf

On the 21st June 2016, in Rotterdam, at the initiative of the CNC OEM Coordinator, a **Joint Ministerial Declaration** "On effective improvements to eliminate bottlenecks and facilitate international traffic on the Orient/East-Med Rail Freight Corridor" was signed by representatives of the Transport related national Ministries of Germany, Austria, Czechia, Slovakia, Hungary, Romania, Bulgaria and Greece. These 8 EU Member States committed officially to set measures in order to reduce each rail border transit time to a maximum of 2 hours by mid-2018.

The overall aim is to simplify the cross border technical and administrative operations, to enhance and harmonise coordination of infrastructure works, capacity and path arrangements and to improve governance and communication.

**Main implementation steps (planned) towards reaching the initiative's goal:**

1. The Joint Ministerial Declaration signed on the 21st of June 2016 by the 8 EU Member States, committing officially to reduce each border transit time to max. 2 hours by mid-2018. The related Action Program includes more than 20 activities, among others: Cross border technical and administrative operations, coordination of Infrastructure works, capacity and Path arrangements and improved Governance and communication.
2. RFC7 Action Programme: - implementation on-going, PI – Cross border operations
   - Waiting time on border crossing
   - Harmonisation of operational and administrative rules
   - Mandatory technical checks
   - Required number of buffer wagons
   - Reauthorisation of the locomotives
   - Change of locomotive at the border (optimisation)
   - Calculation of braking percentages
3. TAF TSI Master Plan, followed up by yearly reports on degree of implementation. According to Article 5, Section 1, of Commission Regulation (EU) No. 1305/2014 relating to the Telematics Applications for Freight subsystem (TAF TSI), the European Union Agency for Railways (ERA) shall assess and oversee its implementation. The Agency has established the 'TAF TSI Implementation Cooperation Group' in order to evaluate the reports of the sector.
4. ERA and the Member States are organising a number of the Regional Workshops for TAF TSI. The aim is to inform rail sector companies on the state of the art of TAF TSI deployment, the IT tool supporting the implementation, the medium and long-term planning and how TAF TSI is becoming a reality in railway operations.
5. RNE Path Coordination System (PCS, formerly PATHFINDER) - PCS is a web application provided by RailNetEurope to Infrastructure Managers (IMs), Allocation Bodies (ABs) and Path Applicants, which handles the communication and co-ordination processes for international path requests and path offers.
6. European Deployment Plan and National Implementation Plans - The ERTMS European Deployment Plan (EDP) sets deadlines for the implementation of ERTMS and its aim is to ensure the progressive deployment of ERTMS along the main European rail routes. The currently applicable EDP is included in the Commission Implementing Regulation (EU) No.2017/6 of 5 January 2017 on the European Rail Traffic Management System European deployment plan. This Regulation lays down the timetable for the deployment of the ERTMS on Core Network Corridors (CNC).
7. Introduction of the new critical performance criteria "commercial speed" of railway freight along the OEM Core Network Corridor, which is intended towards

putting the importance of all potential quick-wins cross border initiatives in a larger "customer minded and competitiveness" perspective. Volumes and commercial speed are of outmost importance for the efficiency of the Corridor, calling for a pragmatic approach. Therefore, actions have been initiated by RNE towards the definition of new set of KPIs together with the RUs.

## 6.3 Proposed actions for achieving the Two-hour goal

### 6.3.1 Approach

The Consultant has performed a critical review of the state of implementation of the Rotterdam Declaration on improving border crossing freight rail traffic. For this, a thorough assessment of the results presented in the High-Level meeting of April 2017 by RFC7 representatives was performed.

The proposed activities to finalize the implementation of the Rotterdam declaration, presented below, were elaborated by the Consultant. Their appropriateness and feasibility were discussed with two railway experts during informal interviews.

The analysis is based on the Consultant's experience, results of existing studies analysing the cross-border issues (e.g. CREAM), RFC7 views and presentations, conclusions derived from the results of the X-border questionnaire including a number of proposals to go ahead to make progress on the items identified. The Consultant also took into consideration the real operational/administrative items raised by the RUs to develop the list of actions.

### 6.3.2 General Findings

The Consultant is stressing the fact that the cross-border matter is a complex one, taking into consideration the multitude of actors and issues that originate from different fields such as infrastructure development, lack of resources of commercial actors (RUs locomotives), complicated operational process (different from border to border, exploitation rules of operators, national legislation, etc.), data processing and information exchange, etc.

The issue of administrative and operational barriers for border-crossing freight trains is well known and was tackled during the past years in several ways. Various detailed analyses were done by each market player (RUs and IMs). Therefore, reasons for delays are widely identified and recognised and clear actions need to be taken, where joint efforts for implementation are required, especially for simple measures such as the usage of existing tools or signing of bilateral agreements.

The Consultant considers that the real challenge for going forward is convincing the stakeholders to cooperate. In practice, all actors agree that there are no technical or other barriers to implementation of the measures but a real or apparent unwillingness of one or the other stakeholder to become active.

### 6.3.3 Proposed activities

In the following section, selected proposals are given according to a standardized structure.

#### 6.3.3.1 Implement customised solutions for each border crossing point

Description: It has been clear that each border crossing needs customised solutions and implication of certain actors, therefore **only bilateral agreements per border section** can bring faster results. Surely, experience and lessons are transferable between border points, but detailed technical/administrative/operational issues differ (Task forces solution should be supported – according to RFC7 task forces have been established in September 2017).
Through this activity, responsibilities can be clearly defined between stakeholders with deadlines and implementation schedule which could lead to faster results.

Reference to Related AP items:

| | |
|---|---|
| I1a | **(Reasons for) Waiting time on border crossing** |
| I2a | **Mandatory technical checks** |
| II1d | **Joint support letters for infrastructure projects** |
| II1e | **Infrastructure development needs** |
| II2 | **Effects of temporary speed restrictions** |
| II4b | **Extra costs of realigning train paths** |

Quotation from survey answers:

- *"Border Station in Curtici is rejecting trains because of overfill. Trains are then parked along the corridor in Hungary. "*
- *"In Hegyeshalom and Rajka the lack of waiting tracks where the trains could be parked until the other RU will take it over, while in Curtici this also important, but more important is the border control as this border crossing is the border of Schengen area (Hungary) and Romania, and this control takes from 1 hour until 12 hours depending on the traffic frequency (personal trains circulating, etc.)"*
- *"Curtici: Reduce waiting time for Schengen control; Rajka: increase capacity; Hegyeshalom: increase capacity by repairing broken tracks"*

#### 6.3.3.2 Increase level of information shared between stakeholders

Description: Stakeholders have been recording numerous information gaps and barriers in communication which have high impact on the planning of activities, personnel and rolling stock as well as in current operations. Therefore, as an immediate step, it is proposed to enhance the IT tools usage/digitalisation including the following activities:

- Involvement of all stakeholders in defining the electronic information exchange needed for each activity: RUs – IMs – even authorities.
- Harmonisation/consistency in usage of existing tools for delivering real-time train data concerning international passenger and freight trains, path request coordination system, etc. (e.g. RNE The Path Coordination System (PCS), RNE Train Information System (TIS), RNE Customer Information Platform (CIP), IMComm, etc.).
- In-depth analysis of existing studies and reports on current systems and application/implementation stage.
- Finding solutions for sharing of costs of implementation, maintenance and usage of such tools.
- Implement mandatory usage of specific tools, where applicable.

Reference to Related AP items:

| | |
|---|---|
| I1a | **(Reasons for) Waiting time on border crossing** |
| I4 | **Change of locomotive at the border** |
| II1b | **Information on infrastructure works** |
| II2 | **Effects of temporary speed restrictions** |
| II4a | **Lately announced capacity restrictions** |
| II4b | **Extra costs of realigning train paths** |
| III1 | **Access to information on international traffic** |
| III2a | **Train Information System data exchange** |
| III2b | **Punctuality data** |
| III2c | **Train Performance Coordination** |
| III3a | **PCS development** |
| IV2b | **Performance indicators** |

Quotation from survey answers:

- *"Increase data availability in RNE TIS at MAV Network (low data completeness, confusing ETA-Information)"*
- *"All RU's should use HERMES messages."*
- *"Exchange of information between the involved in the transportation RUs regarding the arrival and departure of the train."*
- *"Insufficient Information available in case of deviations from planned path"*
- *"IT development."*
- *"Introducing the electronic letter of carriage"*

#### 6.3.3.3 Coordination with ERA

Description: The development of the role of the European Railway Agency from the past years has high impact on interoperability, therefore, direct implications in operations and through the scope of its activities the Consultant considers its involvement vital in the following aspects:

- Harmonisation of different national operational and administrative rules e.g. breaking rules, buffer wagons, special consignments, mandatory technical inspection.

The Agency could support the Member States to perform an analysis on the existing national rules that can be harmonised or eliminated and replaced with international regulation as immediate objective for all technical aspects and information exchange systems.

Reference to Related AP items:

| | |
|---|---|
| I1a | **(Reasons for) Waiting time on border crossing** |
| I2a | **Mandatory technical checks** |
| I2b | **Required number of buffer wagons** |
| I3 | **Reauthorisation of the locomotives** |
| I5 | **Calculation of braking percentages** |
| II1b | **Information on infrastructure works** |
| III1 | **Access to information on international traffic** |
| III2a | **Train Information System data exchange** |
| III2b | **Punctuality data** |
| III3a | **PCS development** |
| III3b | **Deadline for requesting reserve capacity** |
| III4 | **Schedules along the Corridor for the cancellation fees** |
| IV2b | **Performance indicators** |

Quotation from survey answers:

- *"IMs are not willing to accept train from neighbour IM unless path for remaining journey is available"*

### 6.3.3.4 Development of regulation on trusted handover

Description: Another immediate measure recommended is the development of regulation on trusted handover issue, which can be achieved by introducing either:

- *Incentives or/and*
- *Guidelines for structure*

Analysis is needed on the recorded times for hand-over processes for activities such as double technical checks, or lack of consistency in between checks (different checks at different borders, or in between RUs).

Reference to Related AP items:

| | |
|---|---|
| I1a | **(Reasons for) Waiting time on border crossing** |
| I2a | **Mandatory technical checks** |
| I2b | **Required number of buffer wagons** |
| I3 | **Reauthorisation of the locomotives** |
| I4 | **Change of locomotive at the border** |
| IV2b | **Performance indicators** |

Quotation from survey answers:

- *"We should extend the Agreement of technical Transfer Inspection for waggon exchanges (ATTI) to all our cooperating Partners"*
- *"Common technical control with the other RU."*

### 6.3.3.5 Improve cooperation

Description: As an immediate action, the signing of MoU between RUs/IMs is proposed, which may eliminate the reluctance for cooperation and could stress the fact that **each measure will need a strong, co-operative effort by all stakeholders.** The Consultant considers that this action can have an impact on the planning and use of the capacity and overall performance of the Corridor.

Reference to Related AP items:

| | |
|---|---|
| I1a | **(Reasons for) Waiting time on border crossing** |
| I2a | **Mandatory technical checks** |
| IV2b | **Performance indicators** |

Quotation from survey answers:

- *"The technical checks are quite time-consuming. For example: ONLY the break-test itself lasts for 40-60 minutes."*
- *"A trusted handover procedure is not possible with a Romanian railway company."*

#### 6.3.3.6 Coordination of infrastructure works

Description: Regarding the aspect of existing infrastructure development works, the OEM Corridor faces the challenge of dealing with numerous national projects, which are designed to achieve the requested infrastructure standards of the railway lines as well as to eliminate current bottlenecks, whereby there is a tendency of dealing with the freight traffic in a different manner than passenger traffic, creating delays and missing solutions such as **availability of diverting routes**. Lack of **coordination of infrastructure works** is, again, an important issue acknowledged by all stakeholders (including MS), which can be promptly tackled through improving the communication system and the continuous update of information flow on current developments of projects, expected completion dates and, most obviously, delays. The needs of freight traffic are often neglected when measures or investments are being made by IMs.

Reference to Related AP items:

| | |
|---|---|
| I1a | (Reasons for) Waiting time on border crossing |
| II1b | Information on infrastructure works |
| II1d | Joint support letters for infrastructure projects |
| II1e | Infrastructure development needs |
| II3b | Capacity restrictions plan |
| II4a | Lately announced capacity restrictions |
| IV2b | Performance indicators |

Quotation from survey answers:

- *"The lack of interoperability between Bulgaria and Greece is one of the obstacles "*

### 6.3.4 Conclusion

All existing initiatives in this field should be well coordinated, synchronised and clustered in order to produce the expected results and impacts until the 1st of July 2018, in the medium term. A bundling of efforts is needed to mobilize the limited resources to tackle the issues at hand.

Based on the recommendations of the CoA, for the CNC development and Corridor projects, it would be advantageous to introduce a regular assessment of rail freight performance by the help of corridor-tailored indicators, such as rail freight volumes, number of freight trains and average commercial speed of rail freight transport on representative relations. Setting up a specific KPI for commercial speed has to be planned at the earliest possible.

# 7 Clustering of Corridor projects

## 7.1 Key objective criteria to cluster investments

The clustering/mapping of investments will be based on the analysis of common defined KPIs (Task 1.4), projects' data gathered under Task 2 and the analysis carried out under Task 3 concerning the update of the Work Plan.

The proposed methodology is based on the evaluation of all projects and related investments on a case-by-case basis, weighing up the different benefits of a project with the requirement for financial return on investment, and examining its socio-economic and financial viability via well-established and widely applied tools, such as the Multi-criteria Analysis (MCA).

Multi-Criteria Analysis enables both quantitative and qualitative criteria to be considered rendering a final project score. It should be, however, emphasised that MCA does not provide a definitive solution, rather a rational and structured basis for guiding decision-making. The application of the MCA ensures that the project economic characteristics are not the only rating criterion, while other critical aspects, such as regional cohesion, environmental impacts, policy, etc. can also be applied. MCA provides a logical approach, whereby any criteria (both quantitative and qualitative) and their relative importance can be taken into account.

The exercise will evaluate two main aspects: Project Maturity for the implementation (financial, technical and administrative) and Project Relevance as the ability to unlock the potential of all transport modes and significantly contribute to achieving Corridor development and objectives as defined by the Trans-European Transport Network (TEN-T) policy as part of EU's common transport policy.
More specifically:

- **Project maturity:** analysed by assessing the level of progress ("not started" / "in progress" / "concluded") on specific project steps, such as (1) Planning stage / pre-feasibility studies / Strategic Environmental Assessment (SEA); (2) Preliminary project analysis/ Feasibility studies; (3) Environmental Impact Assessment (EIA) / Detailed Design / Detailed Implementation Plan / Administrative Permits and Licences.
- **Project relevance:** related to the purpose of the intervention and its capacity to meet **TEN-T and EU** priorities, as set by Regulation No.1315/2013 and 1316/2013 (reflected by the technical parameter and bottlenecks tackled by the intervention).

The above-mentioned criteria have been evaluated through the analysis of data currently available in each CNC Project list. Furthermore, it shall be underlined that projects already completed as well as projects comprising only Studies have been excluded from this assessment.

## 7.2 Assessment of Project relevance

Project relevance has been assessed through the identification of project clusters, reflecting the need to classify Corridor Projects into homogenous categories with respect to the requirements of the Regulation No.1315/2013 and map them accordingly. Each Cluster is conceived as a set of projects capable to address different levels of technical requirements and likely to produce a certain level of impacts on the CNC infrastructure per each transport mode.

More specifically, the above-mentioned clustering exercise is based on the transport mode. For each project, related to a specific transport mode, 4 clusters have been identified, which mainly reflect the project relevance according to TEN-t priorities stated by the TEN-T Regulation.

In order to maintain their visibility, "new technologies and innovation projects[41]", resulting from the innovation project mapping performed under task 3b of the study, have been assessed in a separate clustering exercise, therefore, evaluated independently from the relevant transport mode.

Obviously, the main aim of the clustering exercise is to allocate each project to one of the four defined clusters, based on the agreed criteria; the highest relevance belongs to Cluster 1 and decreases linearly up to Cluster 4, which presents the projects with the lowest relevance. Furthermore, project clustering has a progressive approach, that is, projects belonging to Cluster 1 cannot be considered for Cluster 2 and so on; Cluster 4 represents a residual cluster, containing all those projects that don't fall in any of the other 3 clusters. The table below shows the clusters identified for both transport mode related projects as well as innovation ones.

**Table 29: Identification of project clusters**

| Transport mode/ Innovation projects | Clusters | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4* |
| **Innovation projects**<br>*New technologies & Telematic applications* | ✓ Low Carbon & Decarbonisation/Clean fuels *(Art. 33. a & b 1315/2013, Annex I.I. 1316/2013)* | ✓ Telematics applications others than ERTMS, RIS, SESAR, ITS, VTMIS (ex. E-maritime services, data sharing etc. cooperation systems) *Art. 33d Reg.1315/2013* | ✓ Safety & Security, noise mitigation<br>*(Art. 33 letter c Reg. 1315/2013)* | |
| **Transport Mode**<br>*Rail & ERTMS Projects* | ✓ Pre-identified projects *(reg. 1316/2013 annex I, part.2)*<br>✓ ERTMS deployment *(reg. 1315/2013 art.13, 39.2, 1316/2013 annex i part i)*<br>✓ Achievement of compulsory technical parameters *(ex. all compulsory parameters stated by art. 39.2)* | ✓ Projects eliminating current or expected capacity bottlenecks *(according to TMS carried out in 2013)* | ✓ Projects contributing to the achievement of technical parameters others than compulsory ones (ex. gabarit etc.) | |

| Transport mode/ Innovation projects | Clusters | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4* |
| **Transport Mode**<br>*IWW & Inland Ports* | ✓ Pre-identified projects *(Reg. 1316/2013 Annex I, part.2)*<br>✓ ECMT Class >= IV *(Reg. 1315/2013 art. 16)*<br>✓ Last mile rail connection to inland ports *(Reg. 1315/2013 art. 16)* | ✓ RIS deployment & projects contributing to good navigation status *(Reg. 1315/2013 art. 39.2)* | ✓ Capacity expansion & safety interventions *(Reg. 1315/2013 art. 13)* | |
| **Transport Mode** | ✓ Pre-identified projects *(Reg. 1316/2013 Annex I, part.2)*<br>✓ Upgrading to express | ✓ ITS (Reg. 1315/2013 art. 19) | ✓ Upgrading/new construction within or | |

[41] According to Article 33 a-d of Regulation EU No. 1315/2013

| **Transport mode/ Innovation projects** | **Clusters** | | | |
|---|---|---|---|---|
| | **1** | **2** | **3** | **4*** |
| *Road projects* | road/motorway *(Reg. 1315/2013 art. 19)*<br>✓ Creation of rest areas/parking spaces *(Reg. 1315/2013 art. 19, 39.2)* | | bypassing an urban node (Reg. 1315/2013 art. 19.e) | |
| **Transport Mode**<br>*Airport projects* | ✓ Pre-identified projects *(Reg. 1316/2013 Annex I, part.2)*<br>✓ Horizontal priority for air SESAR. *(1316 Annex I, part I/ 1315 Art. 31)*<br>✓ Last mile connection to core rail network (*1315/2013 art. 41.3 and Annex II part II, only main airports)* | ✓ Last mile rail and road connections to other core airports *(Reg. 1315/2013 art. 26)* | ✓ Airport capacity expansion *(Reg. 1315/2013 art. 26)* | |
| **Transport Mode**<br>*Seaport Projects* | ✓ Pre-identified projects *(Reg. 1316/2013 Annex I, part.2)*<br>✓ MOS *(1316 Annex I, part I/ 1315 Art. 31)*<br>✓ Last mile connection to core rail + IWW network *(1315/2013 art. 41.2)* | ✓ VTMIS *(Reg. 1315/2013 art. 23)*<br>✓ Seaports capacity expansion within the port area *(Reg. 1315/2013 art. 23)* | ✓ Last mile connection to road *(1315/2013 art. 41.2)* | |
| **Transport Mode**<br>*Multimodal projects* | ✓ Pre-identified projects *(Reg. 1316/2013 Annex I, part.2)*<br>✓ Projects contributing to RRT rail or IWW accessibility *(Reg. 1315 art. 29)* | ✓ Projects contributing to RRT Road accessibility *(Reg. 1315 art. 29)* | ✓ Projects contributing to RRT capacity | |

** Residual interventions*
*Source: PwC / CNC studies, 2017*

### 7.2.1 Calculation of project relevance

Upon completion of the clustering exercise, all projects are allocated to one of the above presented clusters; subsequently, by applying the following points, the project relevance indicator is calculated.

**Figure 19: Project relevance indicator per cluster**

| | CLUSTER 1 | CLUSTER 2 | CLUSTER 3 | RESIDUAL CLUSTER (Other projects) |
|---|---|---|---|---|
| **Project relevance Indicator** | 1,0 | 0,75 | 0,50 | 0,25 |

*max* ← *Project relevance* — *min*

*Source: PwC / CNC studies, 2017*

As showed above, the project relevance indicator may vary from 0.25 up to 1, depending on the scope of the planned intervention.

## 7.3 Assessment of Project maturity

**Project maturity represents** the second criterion group to be evaluated for the project mapping. As a general hypothesis, all the projects "recommended" for CEF funding may be considered mature "*ipso facto*", given the maturity requirements of the particular calls.

All the remaining projects, "Proposed or Not Recommended for CEF funding" are assessed in terms of project maturity through the evaluation of the following criteria:

- *Technical Readiness:* showing high maturity if all necessary technical steps for project implementation (i.e. Detailed Design/Detailed Implementation Plan/Administrative Permits and Licences) have been concluded. Medium maturity is given by the completion of the preliminary technical analysis (i.e. Preliminary project analysis/ Feasibility studies). Remaining projects are considered not mature.
- *Institutional readiness:* all projects included in the Project list shall be considered as mature in terms of institutional readiness. This is due to the fact that such projects have been proposed/revised/suggested by the relevant institutions involved in Corridor implementation.
- *Financial/Economic maturity:* high maturity rate if they have a CBA completed and full financing is guaranteed, medium maturity rate if only one of these two conditions is met, not mature in all the remaining cases.
- *Social/Environmental maturity:* set according to the presence/absence of the Environmental Impact Assessment (EIA): high maturity is given in case of complete/approved EIA, medium maturity in case of EIA under preparation, low maturity in case of no EIA.

### 7.3.1 Calculation of project maturity

To evaluate each of the project maturity criteria (technical, institutional, financial, environmental), it is necessary to rate and award points for each project according to the following levels: Low maturity level= 0; Medium maturity level= 0.5, High maturity level=1. The general assumption is that each maturity criterion has the same relative importance and, accordingly, the following simple calculation can be applied:

$$Project\ Maturity\ Indicator = \frac{Tm + Im + Fm + Em}{4} \leq 1$$

As for the project relevance assessment, the table below shows the overall structure of the project maturity assessment.

**Table 30: Structure of Project maturity assessment**

| Project maturity criteria | Dimensions for project maturity assessment | Status | Maturity Level | Points awarded according to the maturity level |
|---|---|---|---|---|
| **Technical readiness** | Environmental Impact Assessment (EIA) / Detailed Design / Detailed Implementation Plan / Administrative Permits and Licence | Concluded | High | 1 |
| | Preliminary project analysis/ Feasibility studies | Concluded | Medium | 0.5 |
| | Planning stage / pre-feasibility studies | Concluded | Low | 0 |
| **Institutional readiness** | - | - | High | 1 |
| **Financial/ Economic maturity** | CBA & Financing sources | CBA performed & Full financing Assured | High | 1 |
| | | CBA performed OR Full financing Assured | Medium | 0.5 |
| | | CBA not performed AND Full financing not Assured | Low | 0 |
| **Social/ Envi-ronmental maturity** | Environmental Impact Assessment (EIA) | Completed OR Approved | High | 1 |
| | | Under preparation | Low | 0 |

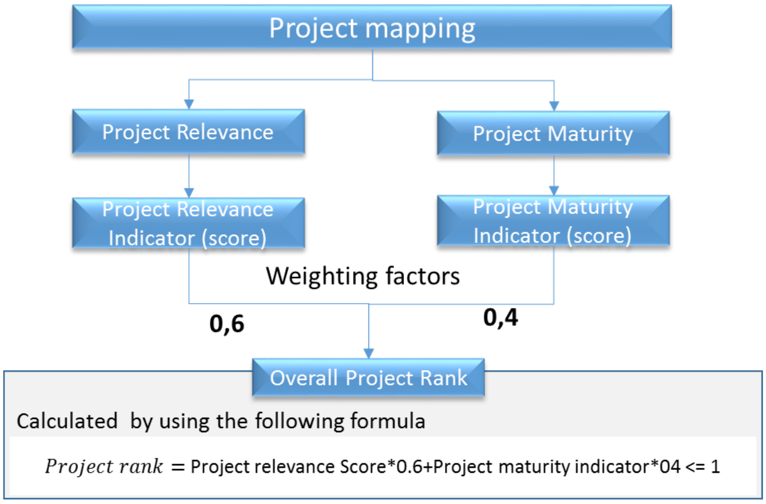
*Source: PwC / CNC studies, 2017*

## 7.4 Calculation

Once each project has been assessed against the criteria and awarded with the number of points for relevance and maturity, a unique overall project value will be calculated by applying different weighting factors to the project relevance and maturity score (0.6 and 0.4 respectively). More specifically, the weighting factors have been introduced in order to assign higher importance on the project relevance, given that the aim of the exercise is to assess contribution on Corridor development as defined by the Regulation.

The figure below shows the structure of the project mapping assessment.

**Figure 20: Project mapping calculation**




*Source: PwC / CNC studies, 2017*

## 7.5 Results

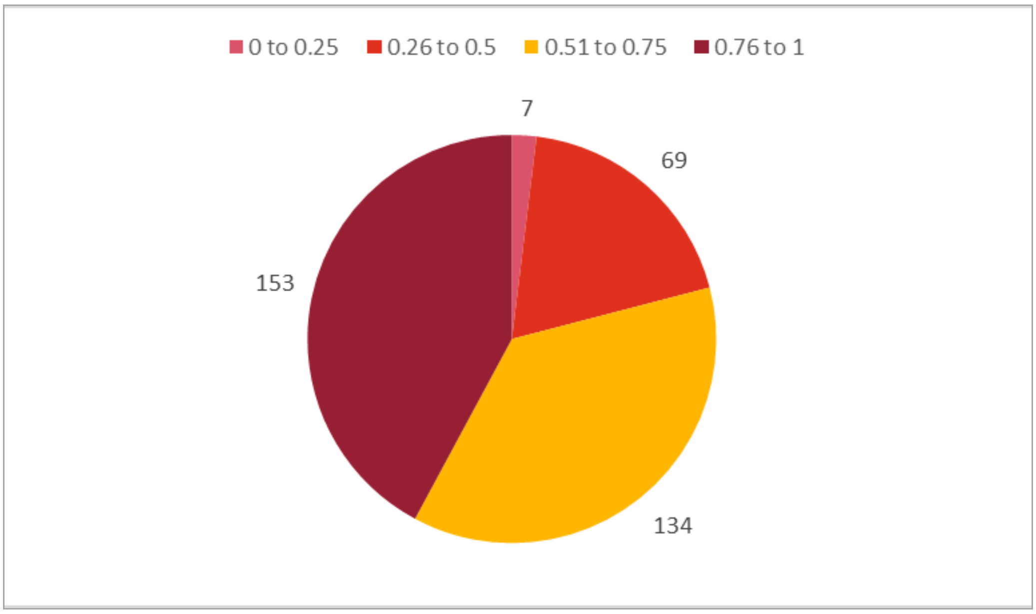
The following section summarises the analysis of the project mapping exercise. The complete table including the outcome of the clustering exercise is provided in Annex 6.

Figure 21 below indicates the overall clustering of the 363 projects. As mentioned in the methodology above, the actions involving only studies were not included in the analysis.

As it can be observed from the pie chart, the overwhelming majority of the projects fall in the high end of the set, i.e. the one in which values assigned to each action span from 0.5 to 1.

**The grand total of projects scoring a full 1** is 47.

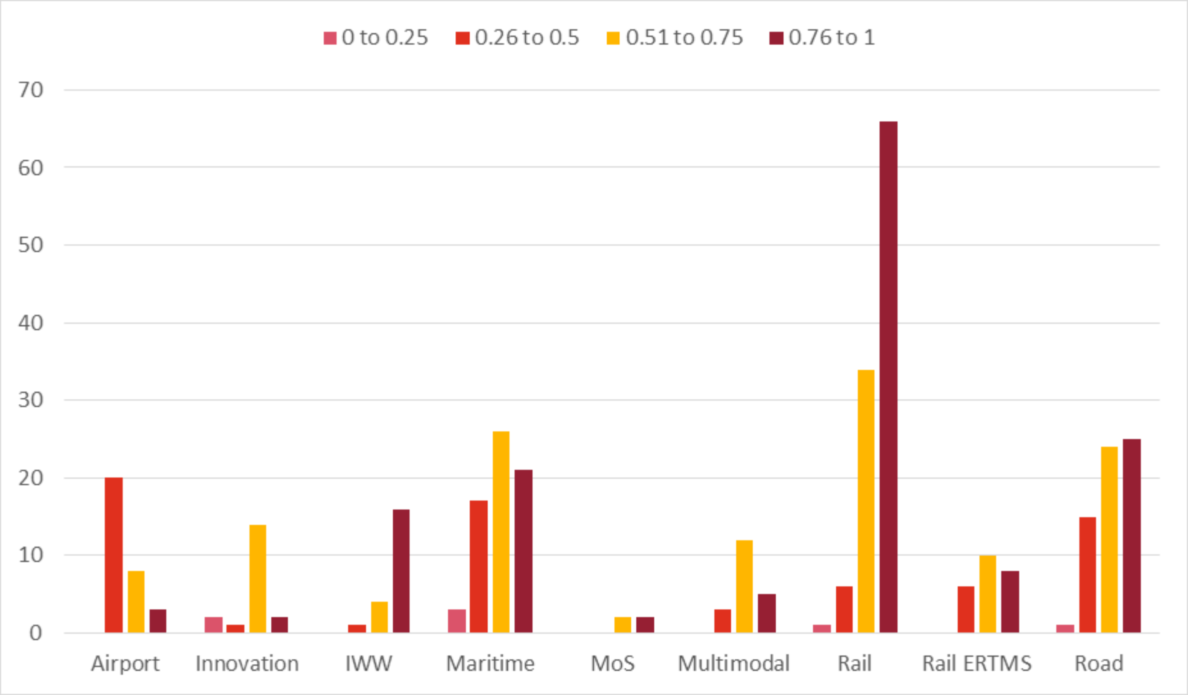
**Figure 21: Number of OEM CNC projects per overall score**




*Source: OEM CNC study, 2017*

A more detailed breakdown per transport mode is provided in Figure 22, depicting the overall picture of projects.

**Figure 22: Number of OEM CNC projects: score per transport mode**

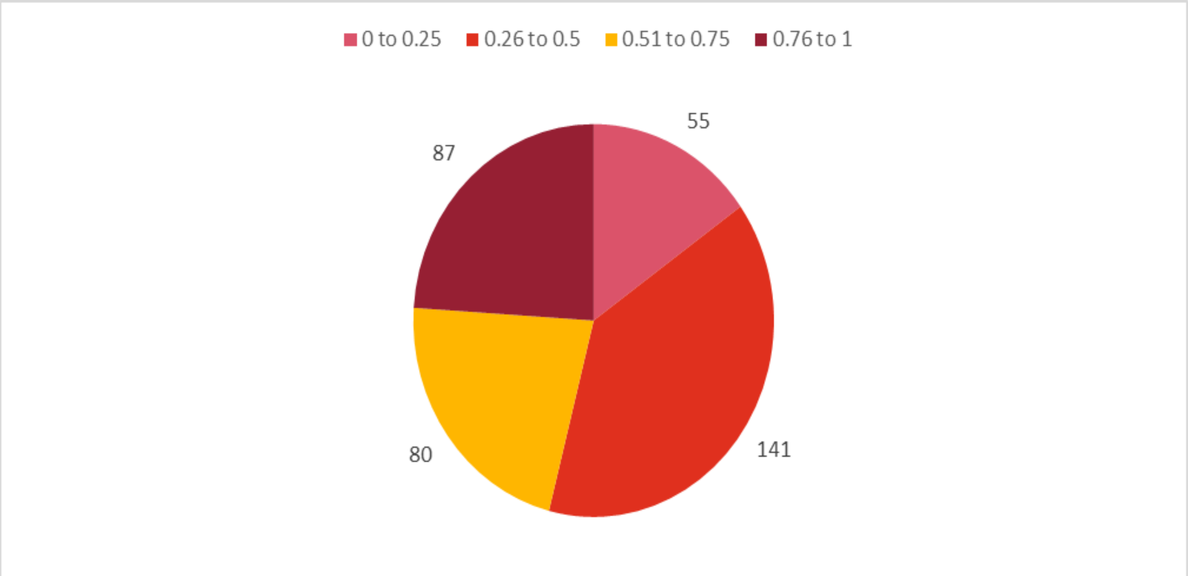



*Source: OEM CNC study, 2017*

Since the mapping exercise is the result of two different indicators, namely relevance and maturity, a deeper look into the singular clustering of these two indicators is hereby provided.

Figure 23 illustrates, in the same way adopted for the overall clustering, the share of projects falling into each one of the clusters: in this case, the only value accounting for the score is the maturity.

**Figure 23: Number of OEM CNC projects: overall maturity scoring**

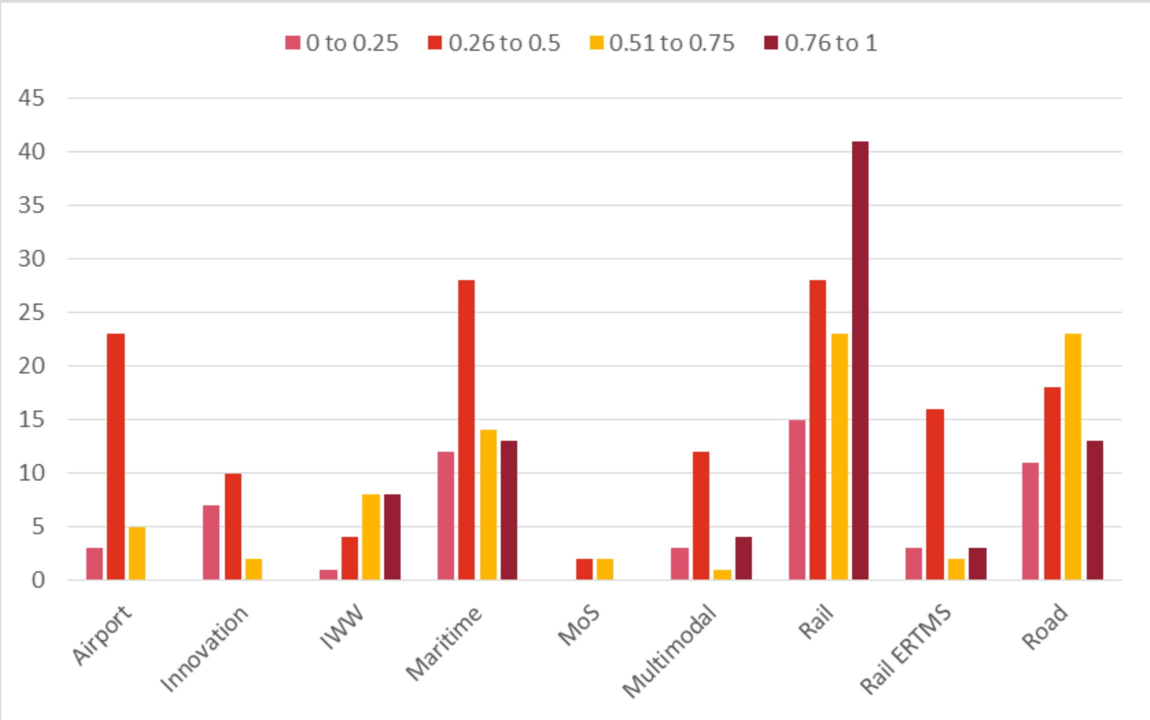



*Source: OEM CNC study, 2017*

The results, as clearly depicted in the pie charts, are not in line with the overall clustering proposed in the previous page. This is explained by the fact that the project maturity only accounts for the 40% of the overall value, meaning that the impact of the maturity indicator could very well not be enough to reflect a trend in the overall clustering.

The breakdown per modal category is instead presented in Figure 24, with rail and road projects combined accounting for the highest share of mature actions: out of a total of 177 actions, 92 rank from 0.76 up to one full point, with 32 scoring a full 1.

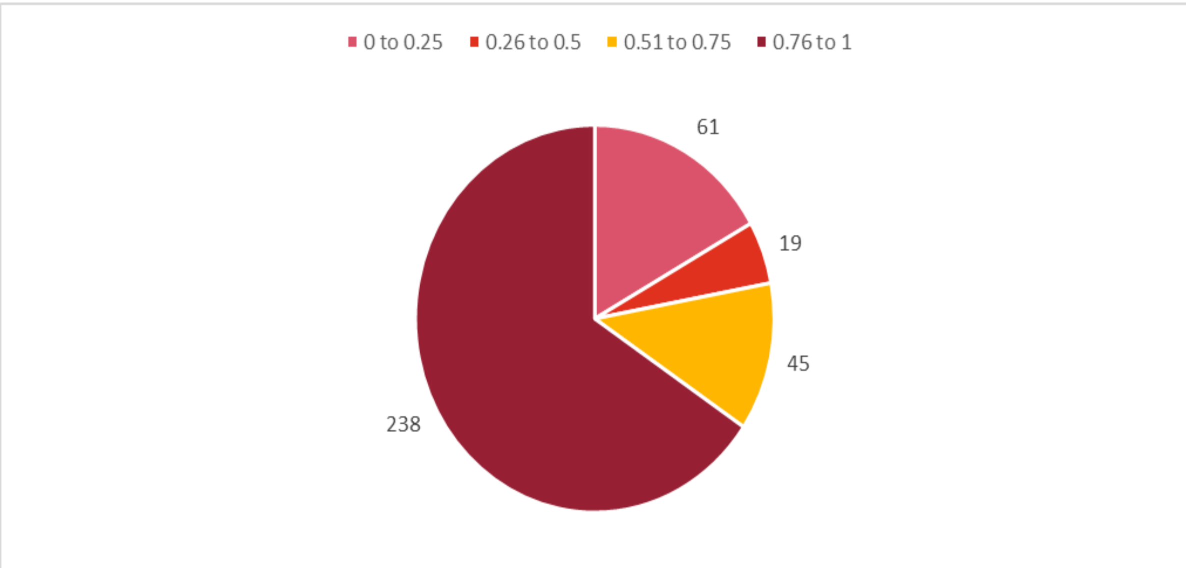
**Figure 24: Number of OEM CNC projects: maturity scoring per mode**




*Source: OEM CNC study, 2017*

Concerning the relevance indicator, the one that determines the overall clustering for a 60% share, Figure 25 below illustrates in the same fashion the distribution of actions among the 4 clusters.

**Figure 25: Number of OEM CNC projects: clustering per relevance**

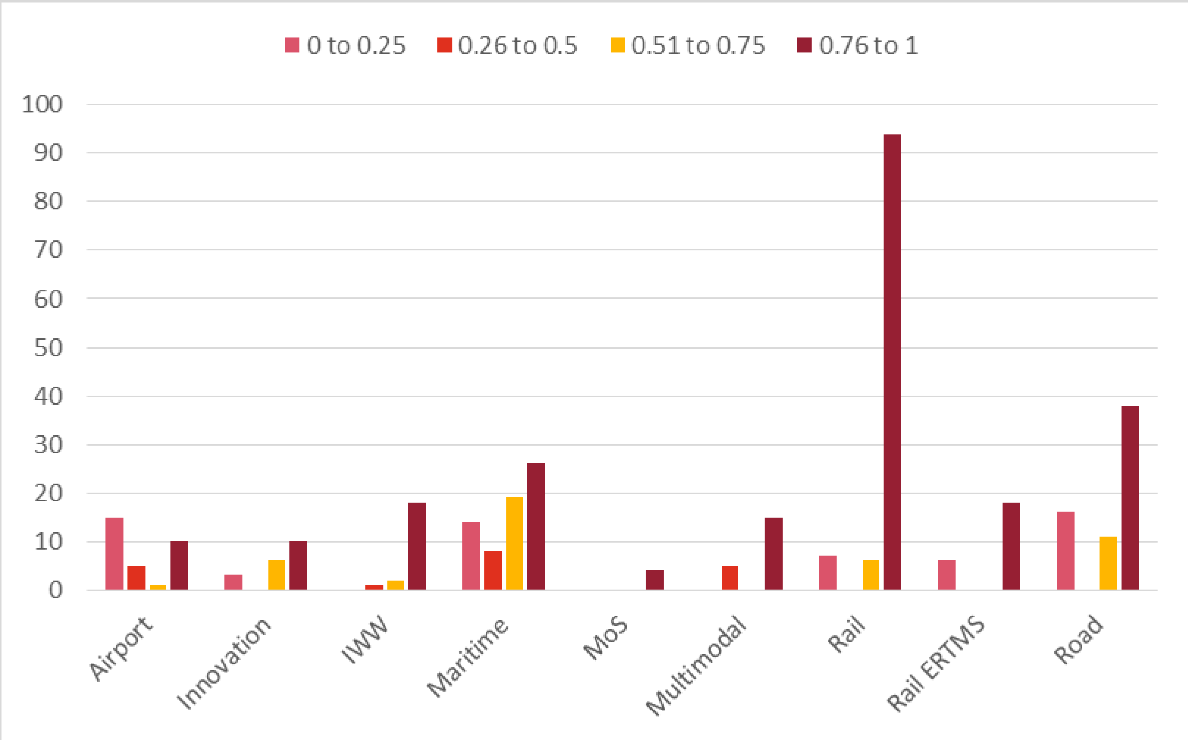



*Source: OEM CNC study, 2017*

As already mentioned, relevance is the more important criterion taken into consideration when performing the mapping exercise: this assumption is easily verifiable by the fact that the trend here is much more similar to the overall one.
As performed previously for the maturity indicator, Figure 26 indicates the modal share of the whole set of the 363 actions.

Relevance, differently from maturity, accounts for only two indicators (maturity indicators are 4 in total, which, combined, give the overall maturity clustering), and takes into consideration two main parameters: is a project innovative? is a project part of an environmental friendly transport mode? The more the answers to those questions tend to "yes", the highest the score of a single action. As expected, rail projects take the lion's share of the "relevant" projects, being the most represented category and among the greenest modes, too.

**Figure 26: Number of OEM CNC projects: relevance indicator per transport mode**




*Source: OEM CNC study, 2017*

Table 31 shows the top three performing projects per modal category.

**Table 31: OEM project clustering: Top three projects per modal category**

| ID | Project name | Mode | MS | Start date | End date | Cost | Score |
|---|---|---|---|---|---|---|---|
| 4105 | Modernization and construction of the line Praha -Vaclav Havel Airport | Airport | CZ | 3/2021 | 3/2024 | 270.33 | 0.90 |
| 4326 | Veleslavin-Praha Masaryk railway station line construction | Airport | CZ | 1/2020 | 6/2024 | 260.00 | 0.90 |
| 4505 | Reconstruction of the Negrelli viaduct | Airport | CZ | 04/2017 | 12/2019 | 47.43 | 0.80 |
| 4058 | Upgrade Middle Weser | IWW | DE | 03/2010 | 12/2017 | 206.00 | 1.00 |
| 4116 | Extension of navigability from Mělník to Pardubice | IWW | CZ | 1/2018 | 12/2020 | 15.44 | 1.00 |
| 4119 | Road bridge over Elbe between Valy and Mělice | IWW | CZ | 01/2017 | 12/2018 | 8.26 | 1.00 |
| 5111 | New Bridge Kattwyk | Maritime | DE | 01/2014 | 12/2021 | 219.00 | 1.00 |
| 4249 | Port of Igoumenitsa: Port Development Phases B and C | Maritime | EL | 3/2008 | 2/2020 | 67.54 | 1.00 |
| 4334 | New Port of Patra: 3A-Section, Phase A. | Maritime | EL | 3/2010 | 2/2020 | 42.48 | 1.00 |
| 1946 | CarEsmatic | MoS | Multistate | 03/2016 | 12/2018 | 17.14 | 0.90 |
| 4526 | POSEIDON MED II | MoS | Multistate | 06/2015 | 12/2020 | 53.28 | 0.85 |
| 5045 | LNG 2.0 - The C02llaborative S0- 2lution | MoS | Multistate | 02/2016 | 11/2019 | 28.40 | 0.75 |
| 4030 | Larnaka Airport Multimodal Logistic (freight) Platform | Multimodal | CY | 01/2015 | 5/2019 | 10.28 | 0.95 |
| 4552 | ADRI-UP - Adriatic MoS Upgraded Services | Multimodal | EL | 03/2016 | 12/2020 | 10.82 | 0.95 |
| 9066 | Cargo Center Vienna South (Inzersdorf) | Multimodal | AT | 01/2009 | 12/2017 | 245.50 | 0.95 |
| 4233 | Construction of new line Kiato-Diakopto | Rail | EL | 6/2006 | 12/2017 | 734.21 | 1.00 |
| 2309 | ABS Oldenburg - Uelzen | Rail | DE | 03/2003 | 12/2022 | 729.00 | 1.00 |
| 4213 | Modernization of Railway line Sofia-Plovdiv | Rail | BG | 09/2017 | 12/2023 | 603.69 | 1.00 |
| 4242 | GSM-R along Kiato-Eidomeni line | ERTMS | EL | 9/2006 | 05/2017 | 31.53 | 1.00 |
| 4243 | ETCS Level 1 on the Athina-Promahonas railway axis | ERTMS | EL | 9/2007 | 12/2017 | 77.35 | 1.00 |
| 4304 | ERTMS along the Sofia-Pernik-Radomir-Kulata railway line | ERTMS | BG | unknown | unknown | 62.05 | 0.95 |
| 4245 | Olympia Odos Motorway: Korinthos- Patra section | Road | EL | 8/2008 | 3/2017 | 2486.70 | 1.00 |
| 4246 | Construction of the Skotina - Evagelismos section | Road | EL | 3/2008 | 3/2017 | 1665.10 | 1.00 |
| 4333 | Ionia Odos Motorway concession: Antirio - Ioannina | Road | EL | 1/2008 | 3/2017 | 1446.60 | 1.00 |

# 8 Jobs & Growth Analysis for Corridor projects

## 8.1 Multiplier-based growth and jobs analysis

### 8.1.1 Overall results

Based on a guideline developed by M-Five, KombiConsult and HACON, each of the nine CNCs undertook an analysis of the growth stimulated by the implementation of their Corridor as well as of the resulting job-years created. The methodology of this analysis followed the approach developed and applied in the study on the "Cost of Non-Completion of the TEN-T"[42]. The core of the method constitute: (1) multipliers that have been derived by M-Five and provided to the CNC study teams together with the guidelines, and (2) the most recent project list as of May 2017 of each CNC.

The results of the growth and jobs analysis are divided into two categories:

- Impact of an **individual CNC**: these results refer to the growth and job impact of each CNC individually. The individual CNC numbers should not be aggregated, as this would include double counting due to the overlaps of a number of projects between the CNCs.
- Impact of the **nine CNCs together**: to generate these results, for each CNC, only those projects were included from the project list, for which the CNC study is responsible to fill in and to update the data on a specific project.

The following tables summarize the results of each category for all nine CNCs. Table 32 presents the impact of each CNC. Planned investments of Corridors over the period 2016 to 2030 are in the range between 43.6 billion € for the Atlantic CNC (ATL) and 191 billion € for the Scandinavian-Mediterranean CNC (SCM). These investments would stimulate a growth of GDP between 356 billion € (NSM) and 1,468 billion € (SCM) by the different CNC. The number of JOBs created, measured in job-years, would be in the range between 1,068,000 and 4,176,000.

**Table 32: Investment and growth and job impact of individual CNCs – including overlaps**

| 2016 to 2030 | Unit | ATL | BAC | MED | NSB | NSM | OEM | RALP | RDC | SCM |
|---|---|---|---|---|---|---|---|---|---|---|
| Investment | bn €2015 | 43.6 | 74.5 | 102.8 | 96.0 | 52.4 | 69.9 | 99.6 | 87.7 | 191.0 |
| GDP created | bn €2015 | 419 | 535 | 622 | 715 | 356 | 517 | 743 | 725 | 1,468 |
| JOB-years created | #1000 | 1,092 | 1,566 | 1,967 | 2,061 | 1,068 | 1,494 | 2,139 | 2,002 | 4,176 |

*Source: MFIVE / CNC studies, 2017*

Table 33 lists for each CNC only the values of those projects for which the CNC study team is responsible to collect the data. Thus, the overlapping projects between different CNCs are counted only once. These numbers are less meaningful for the interpretation of the impact of a specific CNC, but they enable the calculation of the aggregated impact of the 9 CNCs.

The total planned investment on the nine CNCs for 2016 to 2030 amounts to 607 billion €. This investment would stimulate an additional GDP of 4,551 billion € over that period. The number of job-years created by the implementation of the 9 CNC projects would reach 13,077,000 job-years.

[42] Schade W., Krail M., Hartwig J., Walther C., Sutter D., Killer M., Maibach M., Gomez-Sanchez J., Hitscherich K. (2015): "Cost of non-completion of the TEN-T". Study on behalf of the European Commission DG MOVE, Karlsruhe, Germany.

**Table 33: Investment and growth and job impact of individual CNCs - without overlaps and total impact of all 9 CNC**

| 2016 to 2030 | Unit | ATL | BAC | MED | NSB | NSM | OEM | RALP | RDC | SCM | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Investment | bn €2015 | 29.4 | 53.1 | 88.5 | 64.8 | 17.8 | 31.7 | 91.9 | 58.9 | 170.6 | **606.9** |
| GDP created | bn €2015 | 220 | 367 | 540 | 533 | 166 | 263 | 678 | 444 | 1,339 | **4,551** |
| JOB-years created | #1000 | 633 | 1,093 | 1,702 | 1,475 | 438 | 726 | 1,962 | 1,273 | 3,777 | **13,077** |

*Source: MFIVE / CNC studies, 2017*

Comparing these findings with the "Cost of Non-completion" study of 2015, the investments on the 9 CNC have grown from 468 bn $€_{2005}$ to 607 bn $€_{2015}$. Considering a deflator of 1.16, the value from the first study expressed in $€_{2015}$ would be 543 bn $€_{2015}$.

It should be noted that in both calculations there is some uncertainty concerning the actual price base of the investment cost of each project. Also, the values of the „Cost of Non-completion" study refer to the period 2015 to 2030, while the more recent results of Table 33 refer to 2016 until 2030.

In terms of GDP, the numbers are 2,981 bn $€_{2015}$ (2,570 bn $€_{2005}$) in the "Cost of Non-completion" study versus 4,551 bn $€_{2015}$. Apart from growth in investment, the major reason for this increase is the **strong increase of cross-border investment** from 50 bn $€_{2015}$ (43.2 bn $€_{2005}$) to 115 bn $€_{2015}$.

This could be due to two reasons: (1) the number and size of cross-border projects has increased in the project lists, or (2) the classification of cross-border projects was narrower in the first study. Actually, in the first study, MOVE had individually decided which projects should be counted as cross-border projects. In the current analysis, the CNC study teams added a column to classify projects as being cross-border according to the rules of the Regulation No.1315/2013, which suggests that cross-border links include those sections from a border until the first TEN-T urban node. This can cover a substantial distance e.g. in the case of the OEM CNC, all projects between the RO/BG border and the City of Sofia (230 km away from the border) would be classified as cross-border.

In terms of job-years created, the result of the "Cost of Non-completion" study was 8,900,000 job-years created by the implementation of the 9 CNCs. In this recent update, it was concluded that 13,077,000 job-years would be created. Again, this increase is a consequence of higher investment and, in particular, of increased investment into cross-border projects, which to some extent could be a matter of classification, as explained above.

### 8.1.2 Corridor related results

An analysis of the growth and jobs impact of the OEM CNC was carried out by the OEM study team, applying a multiplier methodology based on the findings of the study „Cost of non-completion of the TEN-T". For the analysis, the projects included in the recent OEM CNC project list as of May 2017 were classified into three mutually exclusive categories:

- Cross-border projects
- Innovation projects
- Other and thus average projects

The three categories also present a hierarchy. If a project is marked in the project list as cross-border project, it belongs to that category. If not, it is checked if it belongs to an innovation category. If not, it will be treated as average project. Mixed rail and ERTMS projects are counted with 10% as an innovation project and the remainder as average project.

The analysis considered only those projects that were not completed before 2016. For each of the three categories, the investments were aggregated for projects of the same category.

Thus, the investments planned for the period 2016 until 2030 were obtained. These were the investment figures to which the multipliers presented in Table 34 have been applied to estimate the total growth and job impacts of the Corridor over the period 2016 to 2030.

**Table 34: Multipliers used for the growth and jobs analysis**

| Categories | Type of investment | | | Unit of measurement |
|---|---|---|---|---|
| | Average | Cross-border | Innovation | |
| **GDP Multiplier** | **4.35** | **16.8** | **17.7** | bn€-GDP / bn€-INV |
| **JOB Multiplier** | **16,300** | **37,000** | **38,700** | FTE-JobY / bn€-INV |

*Source: Fraunhofer Study on the Cost of non-completion of the TEN-T (2015)*

The OEM CNC projects for which cost estimates are available and that are planned to be implemented over the period 2016-2030 amount to an **investment of 69.9 billion €$_{2015}$.**, including the completed projects in 2016. The implementation of these projects will lead to an **increase of GDP over the period 2016 to 2030 of 517 billion €$_{2015}$** in total. Further benefits will occur also after the year 2030.

The investments will also stimulate additional employment. The direct, indirect and induced job effects of these projects will amount to **1,494,000 additional job-years** created over the period 2016 to 2030. It can be expected that also after 2030, further job-years will be created by the projects.

## 8.2 Direct Jobs Analysis

### 8.2.1 Methodology

The EU's Joint Research Center of Sevilla (JRC) has developed a regionalized econometrical model in order to provide DG MOVE with an impact estimate of the TEN-T investments along the CNCs. This model allows an Estimation of the socio-economic impact – composed of (a) total direct, indirect and induced jobs, and (b) induced growth (total value in mln EUR) to be obtained by an Input-Output-Matrix, which will be calculated by the JRC. In order to calibrate and feed this model, the OEM CNC study team performed a short-term survey to complement the cost information for selected projects of the 2017 OEM project list.

The additional data to be retrieved by each CNC study team were:

- Jobs directly linked to construction phase, measured in Full Time Equivalents
- Breakdown of total investment costs into 9 subgroups (i.e. planning and design fees, land purchase, building and construction, plants and machinery, technical assistance, supervision, publicity, contingencies, other costs) and per construction year.
- Provision of both above information as per NUTS2 region

- Provision of ratio of projects for which the data is available (and compared to the total project list)

The analysis was performed at Corridor level and included a major cross-border project of EU added value (Praha – Ústí nad Labem High Speed Rail Line #4085, #4086) and innovative projects (C-Roads Czech Republic, CROCODILE 2.0 Hungary). However, problems were faced during desktop research and approach of stakeholders, as it was hardly possible to find promising sources for the requested data for the majority of projects.

As instructed, the research has focused on ongoing works projects with total cost >€ 75 mln according to the updated OEM CNC Project List (April 2017), and similar projects at cross-border sections of the OEM CNC of lower cost. However, the team also searched for jobs and cost information for other works projects (accomplished or future or of lower cost), as well as for OEM works projects with innovative character.

### 8.2.2 Data Source INEA/CEF

INEA was requested to provide Cost-Benefit Analyses (CBA) for a selection of projects. The selection out of the updated 2017 OEM CNC Project List comprised 32 on-going works projects >75 MEUR. For 5 projects thereof, a CEF ID has been disclosed, for other 25 projects any further type of EU funding (Cohesion Fund, CEF, ESIF) was supposed to exist, but without specification. A second list with 4 on-going innovative works projects was provided with a CEF ID.

As feedback, the team received in a first tranche CBA text reports (without Excel tables) for the projects:

- Innovative: C-Roads CZ (#4531) and CROCODILE 2.0 HU (#4013)
- Larger on-going Works:
  - CZ: ETCS L3 on-board deployment / České Dráhy (#4507)
  - EL: Athina – Patra Railway and the Railway Access in city and port of Patra
  - EL: Railway project Tithorea – Domokos
  - EL: Railway project Diakopto – Patra
  - CY: Expansion of Lemesos port – Terminal 2 Vassiliko (#4266)

For the data provided by INEA, the Cyprus port project (#4266) could be used for providing cost categories per year. The same applied for a Greek rail project cluster (855 MEUR), which could however not be directly assigned to one of the projects of the OEM list. A Czech ERTMS project #4507 could at best be split into years. No useful data could be abstracted from the files for the projects CROCODILE 2.0 HU and C-Roads Czech Republic. The Tithorea - Domokos Rail Update is only a study. The **number of direct jobs** created could be derived for one Czech ERTMS project and two project clusters.

CBA data for further 11 smaller projects (ongoing works <75 mln EUR) have been requested at INEA, but could not be delivered.

### 8.2.3 Member State related project information

No project related cost breakdown was available for OEM projects in Germany, Austria, Slovakia, and Hungary.

**Czech Republic:** The overall cost split for two **future** projects could be obtained from the publically available sources.

- **Praha Ring Motorway construction**; sections A5 D0 518 Ruzyne – Suchdol 9,4 km and A6 D0 519 Suchdol – Březiněves 6,7 km (#4091, #4092)

- **Construction of High Speed Rail Line Dresden-Praha** (Czech sections) (#4085, #4086) – cross-border project

No annual cost split could be retrieved. Moreover, those projects are still under design and therefore the data is coming from preliminary (pre-) feasibility studies. The contacted stakeholders (authorities) could not provide further data within the given time frame. Cooperation has been made with BAC.

**Romania:** one project could be assessed, based on available data:

- Modernizing and rehabilitation of TEN-T corridor network on RO territory, section Border rail Curtici-Arad - km 614.

**Bulgaria:** The OEM study team could retrieve data from the MoT, stemming from Major Project Application Forms under Cohesion Fund. These have been proven to be optimal sources if made available with XLS files. In total, **four project** datasets could be provided.

**Greece:** Two sources were assessed,

- the CBAs provided by INEA, which focus on global rail projects that comprise several line sections in Greece. This data also contains annual cost breakdowns; however, total sums deviate from figures provided by Project promoter and information on direct jobs
- Recent cost data provided by ERGA OSE (Railway IM) without global cost breakdowns and without jobs data.

**Cyprus:** Four projects have been assessed.

### 8.2.4 Result/Ratio

As outcome of the preliminary Direct Jobs analysis, the following status could be achieved:

**Global cost** breakdown could be retrieved for 22 works projects, hereunder 4 cross-border sections (CNC study project numbers in brackets).

- 9 Greek projects (4024, 4025, 4233, 4235, 4238, 4240, 4242, 4243, 4310)
- 5 Czech projects (4091/4092, 4085/4086, 4507)
- 6 Bulgarian projects (4218, 4223, global for 4021/4305/4347/4517)
- 1 Cyprus project (4266)
- 1 Romanian project (4187).

The amount of total costs sums up to € **10.4 bln** (out of total € 68.1 bn resp. € 27.7 bn on-going works and studies). Among the projects is the Czech HSR project with €4.5 bn.

**Direct jobs** could be retrieved for one works project in CY and 2 project clusters in Greece.

Therefore, in a nutshell, the total direct jobs linked with selected investments in Greece and Cyprus is 1384 FTE at €1357 mln total cost, **i.e. 1 job per 1 million investment costs.**

### 8.2.5 Other macro-economic information gathered

Desktop research found a recent study for the German MoT having assessed various CBAs of German infrastructure projects listed under the finalized national transport infrastructure programme BVWP 2015[43].

It underlines that the sub-cost item „Planning" in German Road and Rail construction projects is generally supposed to be 18 % (page 53). For Hungary, a breakdown of total average unit construction cost of newly built roads was provided. This shows a sub breakdown of the item Construction and building.

[43] *https://www.bmvi.de/SharedDocs/DE/Anlage/VerkehrUndMobilitaet/BVWP/bvwp-2015-ueberpruefung-nka-endbericht.pdf?__blob=publicationFile*

# 9 Summary of actions already accomplished

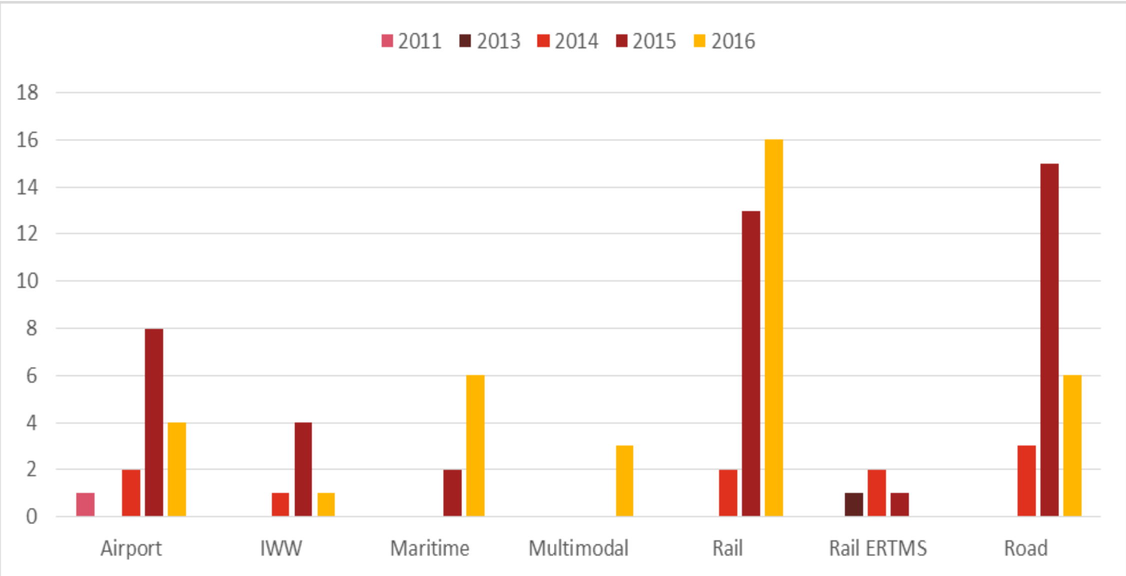
## 9.1 Progress of Corridor Development

Since the adoption of Regulation No.1315/2013, **92 projects** were accomplished[44] along the alignment of the Orient/East-Med CNC **until December 2016**, divided per mode of transport as follows:

- Rail: 32 projects, € 5000 mln
- Rail ERTMS: 4 projects € 125 mln
- Air:15 projects, € 880 mln
- Road: 24 projects, € 2300 mln
- IWW: 7 projects, € 60 mln
- Maritime: 8 projects, € 420 mln
- Multimodal: 2 projects, € 140 mln

Accomplished projects on the OEM Corridor include all modal categories, as shown in Figure 27.

Figure 27: Number of accomplished projects per mode and year



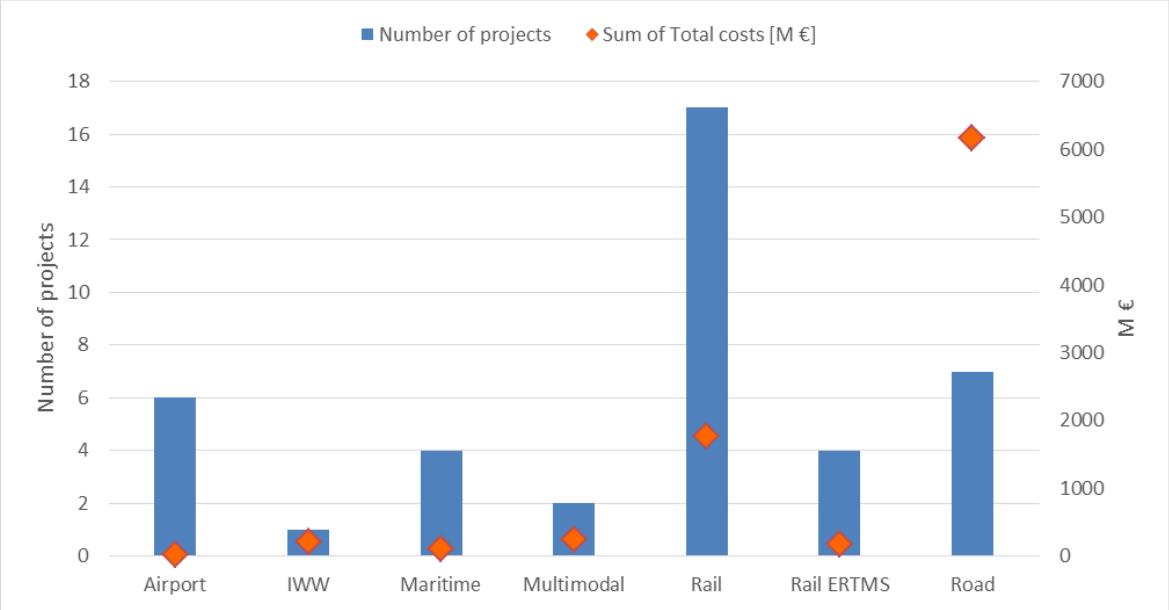

*Source: OEM CNC study, 2017*

Accordingly, supply related Corridor indicators for rail increased between 1 and 5 %-points between 2013 and 2016, the largest increase noted for the electrification (now 88%) and axle load (80%) ones. Between the years 2013 and 2016, there has been a 7% increase in the express road/ motorway KPI and one additional airport has achieved rail connectivity. For the remaining modes (inland waterways, seaports, inland ports and Rail-Road Terminals), there have been no changes in the KPIs during this period.

[44] Total investment: € 8.9 billion

**In addition, 41 projects have been completed** –or are expected to be completed by the end of the year 2017 along the OEM Corridor, for a total value of € 8.7 billion. The chart below gives an indication of the ratio between the number of projects and the total investment per category.

**Figure 28: Projects expected to be completed in 2017**




*Source: OEM CNC study, 2017*

The following sections present the progress of the Corridor development per mode in the period 2013-2016, listing the number and type of accomplished projects. The latter is also reflected in the evolution of the supply related KPIs values for each mode. Reference is also made to the projects expected to be completed within year 2017, per transport mode. Finally, a list of the most prominent projects is presented in terms of investment size and contribution to increasing compliance rates (relative KPIs).

## 9.2 Accomplished rail projects

**36 rail projects (both works and studies)** have been completed since December 2013 with impact on the overall compliance of the rail Corridor. During the first three years of the TEN-T Regulation, 17 rail development projects were finalized. The central rail stations of Breclav, Wien, Sofia, Pazardzhik and Burgas were rehabilitated, ERTMS was deployed in 82 km in Austria, the capacity bottleneck between Praha and Česká Třebová was partly relieved, the Leipzig node and the capacity of the hinterland connection of the Bremen seaport was enhanced, while the last non-electrified section of the Bulgarian OEM alignment, Dimitrovgrad – Svilengrad, was electrified. Moreover, 19 studies / designs were completed, from which a Pre-Planning Study (Vorplanungsstudie) for the border crossing High speed rail line Dresden – Praha is one of the most significant for the Corridor, together with a number of studies regarding preparation for the required infrastructure works for the major non-compliant rail sections in Bulgaria.

**By the end of 2017, 17 Rail works projects** (including 4 telematics application projects in Austria and 1 in Hungary) and 4 studies are expected to be completed, out of which, the most relevant are in Greece, that is, the finalisation of the construction of new sections of the Kiato-Patra line (55 km + 16.5 km) and the installation of ETCS Level 1 trackside in the main railway lines of Athina-Thessaloniki-Promahonas section. Besides Greece, smaller infrastructure modernisation and upgrade projects are expected to be finalised by the end of 2017; more specifically, in Romania, the border section HU/RO until Arad (30 km) and in Bulgaria, the modernisation of the Septemvri - Plovdiv section (53 km).

**Table 35: Supply-related KPIs evolution for OEM rail Corridor (2013 - 2016) in % of modal CNC length[45]**

| # | KPI | Baseline 2013 | Status 2016 |
|---|---|---|---|
| 1 | **Electrification** | 83% | 89% |
| 2 | **Track gauge 1435mm** | 100% | 100% |
| 3 | **ERTMS implementation[46]** | 11% | 13% |
| 4 | **Freight rail line speed ≥ 100km/h** | 75% | 78% |
| 5 | **Axle load ≥22.5t** | 77% | 82% |
| 6 | **Train length 740m** | 47% | 50% |

*Source: OEM CNC study, 2017*

## 9.3 Accomplished IWW projects

Along the OEM inland waterways (7 completed projects), the five completed works projects provided two modernized locks on the Czech part of River Elbe between Mělník and Pardubice and an upgrade of the Mělník port. In Germany, upgrade works on IWW sections Magdeburg – Wolfsburg (Mittellandkanal) and Minden – Bremen (Weser) were completed. Additionally, two studies, the IRIS 3 Europe study project and the elaboration of the German Overall future strategy on the River Elbe were finalised. The above projects did not change related KPIs.

**Table 36: Supply-related KPIs evolution for OEM IWW Corridor and inland ports (2013 - 2016)[47]**

| # | Mode | KPI | Baseline 2013 | | Status 2016 | |
|---|---|---|---|---|---|---|
| | | | CZ | DE | CZ | DE |
| 7 | **Inland waterway network** | **Waterway categorized as CEMT class IV or more** | 90% | 100% | 90% | 100% |
| | | | | 98% | | 98% |
| 8 | | **Permissible Draught (≥ 2.5m)** | 0% | 51% | 0% | 51% |
| | | | | 40% | | 40% |
| 9 | | **Perm. Height under bridges (≥ 5.25m)** | 62% | 59% | 62% | 59% |
| | | | | 60% | | 60% |
| 10 | | **Minimum RIS implementation** | 90% | 100% | 90% | 100% |
| | | | | 98% | | 98% |
| 11 | **Inland ports** | **Connection with CEMT Class IV waterway[48]** | 100% | 100% | 100% | 100% |
| | | | | 100% | | 100% |

[45] Percentages are mainly based on known distances resp. operated sections and may in future slightly deviate.

[46] The calculation of ERTMS implementation is based on operation of GSM-R and ETCS (all levels) and thus may differ from the ERTMS EDP 2016.

[47] The CEMT class IV requirement is not met in certain parts of the Czech Republic, notably the section from Týnec nad Labem to Pardubice, as this section is hardly possible to be used for inland waterway transport. Problems include draught and height of bridges.

[48] The percentage given considers only the 3 (of 12) OEM core seaports Bremen, Bremerhaven and Hamburg, where a navigable IWW connection is geographically suitable.

| # | Mode | KPI | Baseline 2013 | | Status 2016 | |
|---|---|---|---|---|---|---|
| | | | CZ | DE | CZ | DE |
| | | | | | | |
| 12 | | **Connection to rail** | 67% | 100% | 67% | 100% |
| | | | | 89% | | 89% |
| 13 | **Inland ports** | **Availability of alternative clean fuels** | 0% | 0% | 0% | 0% |
| | | | | 0% | | 0% |
| 14 | | **Availability of ≥1 freight terminal open to all operators...** | 67% | 100% | 67% | 100% |
| | | | | 89% | | 89% |

*Source: OEM CNC study, 2017*

**Within 2017**, the upgrade Middle Weser project in the section Bremen-Minden in Germany is foreseen to be completed, which includes works for fairway deepening (2.50m), bridge height (min. 5.25m) and locks (Weser-Schleuse Minden).

## 9.4 Accomplished maritime projects

Eight maritime projects (6 works and 2 studies) were completed with no impact on 2013 compliance levels, which remain at 80% for port connection to rail and 0% for the provision of alternative fuels facilities. The majority of implemented works of higher investment costs contributed to required port capacity enhancements (Ports of Hamburg, Lemesos), as well as the improvement of rail connections (Ports of Hamburg, Bremerhaven). One project significantly improved the VTMIS coverage at the Port of Burgas.

**In 2017, four projects are foreseen to be completed**, the most important being the construction and launch of a hopper barge with an LNG unit in the Bremen/Bremerhaven ports (DE), marking a significant step in the alternative fuels area, when compared against other OEM ports. The remaining three include a feasibility study for the establishment of Port Community Systems in the Port of Burgas and IWW port of Vidin in Bulgaria, gateway-widening works at the Port of Hamburg and further improvement of the IT terminal information and control system at Rostock port (DE).

## 9.5 Accomplished road projects

By the end of 2016, the OEM road infrastructure increased its motorway / expressway compliance from 82% to 88% via the implementation of 22 work projects (2 studies were also completed). Before 2014, it was compliant in Germany and Slovakia and became fully compliant by 2015 in Greece and Hungary. Also, in Bulgaria and Romania, recent works accomplished contributed to a longer OEM motorway/expressway network. The most important gap closed has been the border crossing Corridor section from Makó (HU M43) to Arad (RO A1). Also, the sections of A1 Timisoara to Lugoj (RO), A3 Dupnitsa – Blagoevgrad (BG) and A3 Sandanski – Kulata border (BG), A4 Orizovo – Harmanli (BG) and A1 Lamia – Raches (EL) were newly opened. Other projects related to capacity enhancements on existing sections of German and Austrian motorways. Regarding the availability of alternative fuels, a significant increase of fuelling or charging stations was recorded (year 2016 >1000).

**In 2017, five more projects** with total investment costs of € 6.35 bln have been or are about to be completed. These are D8 section Lovosice – Řehlovice (CZ), and four projects in Greece with a total length of 390 km: Korinthos – Patra (A8 Olympia Odos), Skotina – Evagelismos (A1), Antirio – Ioannina (A5) and Strymoniko – Petritsi (A25), essentially completing the OEM road network in the country.

**Table 37: Supply-related KPIs evolution for OEM road Corridor (2013 - 2016)**

| # | KPI | Baseline 2013 | Status 2016 |
|---|---|---|---|
| 20 | **Express road/ motorway** | 81% | 88% |
| 21 | **Availability of alternative clean fuels (stations)** | n.a. | n.a. |

*Source: OEM CNC study, 2017*

## 9.6 Accomplished RRT projects

3 RRT projects were completed in the years 2014 to 2016, one being the construction of a new intermodal terminal in the Plovdiv area.

**Table 38: Supply-related KPIs evolution for OEM RRTs (2013 - 2016)**

| # | KPI | Baseline 2013 | Status 2016 |
|---|---|---|---|
| 22 | **Capability for Intermodal (unitised) transhipment** | 79% | 79% |
| 23 | **740m train terminal accessibility** | 25% | 25% |
| 24 | **Electrified train terminal accessibility** | 46% | 46% |
| 25 | **Availability of ≥ 1 freight terminal open to all operators** | 67% | 71% |

*Source: OEM CNC study, 2017*

By end of 2017, two new projects are expected to be completed, the first one being the planning and construction of a new Rail-Road terminal (Cargo-Center Wien) in Wien-Inzersdorf, Austria, which also includes the relocation of the RRT Wien Nordwestbahnhof. The second regards the construction of the privately financed and operated new METRANS RRT in Budapest (Csepel Island), Hungary, with an area of 165.000 m². Nevertheless, both projects shall not solve the accessibility and electrification issues.

## 9.7 Accomplished airport projects

Since 2014, the OEM Corridor airport infrastructure was developed through 50 projects, 15 of which have already been completed by mid-2017. Among the most relevant, are two projects enhancing the usability of the Vienna International Airport though an improved connection to the main railway line. These projects, whose total cost amounted to almost € 200 mln, emerge as the most significant out of the set of accomplished actions, as the vast majority of the rest are studies, which do not affect the efficiency of the Corridor before being rendered into concrete interventions. 11 design studies have been finalized in the Berlin node, where various interventions have been studied aimed at the renewal of the Berlin Brandenburg Airport.

The latest completed project concerned the upgrade of the Hungarian ATM system for the Airport Collaborative Decision Making (A-CDM) capability as part of the Local Single Sky Implementation Plan, which constituted a step towards the implementation of the SESAR ATM sub-functionality S-AF 2.1 pre-departure management.

**Table 39: Supply-related KPIs evolution for OEM airports (2013 - 2016)**

| # | KPI | Baseline 2013 | Status 2016 |
|---|---|---|---|
| 26 | **Connection to rail** | 46%<br>(50% - for main core airports) | 54%<br>(50% - for main core airports) |
| 27 | **Availability of ≥ 1 terminal open to all operators** | 100% | 100% |
| 28 | **Availability of alternative clean fuels** | 0% | 0% |

*Source: OEM CNC study, 2017*

**Within year 2017**, six airport projects are expected to be completed, out of which three are studies and concern the long-term infrastructure expansion planning for the Berlin airport (DE), the designs for the connection of the PATHE road axis with the Thessaloniki airport (EL) and the feasibility study to develop and validate the Free Route Airspace Concept of Operations (CONOPS) for the Budapest airport (HU). Work projects include the reconfiguration of the passenger terminal departure area of the Bremen airport, as well as space extensions for security checks and the renewal of a waste water channel at the Leipzig airport in Germany.

## 9.8 Selection of accomplished projects with highest contribution to KPI

Table 40 provides examples of the key accomplished projects, selected by investment size and impact in terms of contributing to achieving the Corridor objectives (KPI).

**Table 40: Key accomplished projects at OEM CNC (selection by mode)**

| # | Project name | Trans-port Mode | MS | Cross-border section | Last-mile | Pre-id. CEF section / project | KPI impact | Project end date | Total costs in mln EUR |
|---|---|---|---|---|---|---|---|---|---|
| 9076 | Vienna Airport: Adaptation of Passenger Rail Station | Airport | AT | | x | x | x | 2014 | 118.80 |
| 9075 | Connection Eastern Railway – Airport suburban line near Kledering with Vienna Central Station | Airport | AT | | x | x | x | 2014 | 63.10 |
| 4059 | Mittelweser Improving navigability | IWW | DE | | | | x | 12/ 2015 | 31.30 |
| 2277 | Hamburg Port Extension, deepening of the fairway (14.5m) | Mari-time | DE | | | | | 12/ 2016 | 199.00 |
| 2279 | Hamburg Port: Container Terminal Burchardkai, New concept of the road and rail links | Mari-time | DE | | | | | 12/ 2016 | 103.70 |
| 5131 | Megahub Lehrte (Hannover) | Multi-modal | DE | | | | | 12/ 2016 | 136.00 |
| 4202 | Construction of a new intermodal terminal in Plovdiv area | Multi-modal | BG | | | x | x | 12/ 2016 | 7.31 |
| 9042 | Vienna Central Railway Station (Wien Hbf) | Rail | AT | | x | x | x | 2015 | 1,006.00 |
| 9074 | Implementation of GSM-R on Austrian A-network / ERTMS Level2 Wien - Breclav | Rail ERTMS | AT | | | | x | 2014 | 81.40 |
| 4215 | Reconstruction and electrification of Plovdiv - Svilengrad railway line | Rail ERTMS | BG | | | x | x | 12/ 2016 | 200.32 |
| 4090 | D8 motorway construction Lovosice - Řehlovice | Road | CZ | x | | | x | 02/ 2017 | 524.93 |
| 4923 | Construction of the Lamia - Raches section of the A1 PATHE Motorway | Road | EL | | | | x | 03/ 2015 | 304.97 |
| 4195 | Construction Nadlac - Arad Motorway A1 | Road | RO | x | | | x | 07/ 2015 | 207.52 |
| 4915 & 4916 | Construction of A3 Struma Motorway Lots 2 & 4 (Dupnitsa – Blagoevgrad & Sandanski-Kulata) | Road | BG | Wider | | | x | 10/ 2015 | 219.40 |
| 9619 | Construction Makó-Csanadpalota-Nadlac Motorway M43 | Road | HU | x | | | x | 07/ 2015 | 155.00 |

*Source: OEM CNC study, 2017*

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# 11 Appendix

- Abstract and Publishable Executive Summary (6 pages; in EN, DE, CZ, SK, HU, RO, BG, EL language)
- Annex 1: OEM Clustering List (Task 4)
- Annex 2: PowerPoint presentations held by Consultant during Corridor Forum meetings no. 5-11 and Working Group meetings