Abstract

This study represents the technical basis for the first and second update of the Baltic-Adriatic corridor work plan by the European Coordinator, Prof. Kurt Bodewig, together with Poland, Czech Republic, Slovakia, Austria, Italy and Slovenia, and in consultation with the Corridor Forum. The study provides an updated analysis of the characteristics of the 1,800 km long intermodal corridor between the Baltic and Adriatic basins, interconnecting 13 urban nodes and their airports, 10 maritime and inland waterway ports and 24 rail-road terminals. The general and specific objectives for the development of the corridor as already identified in the first Baltic-Adriatic corridor study of 2014 have been confirmed and further specified with reference to the requirements set in the Regulation (EU) 1315/2013, also considering the results of the corridor market study. The analysis emphasises the strategic relevance of investing in the following work plan priorities: development of the cross-border sections, completion of the railway Alpine crossings in Austria (Koralm railway line and tunnel and Semmering tunnel), improvement of the last mile connections of ports, modernisation of the rail corridor links in "Cohesion Member States", enhancement of interconnections and transfer operations in urban nodes and ERTMS deployment. The progresses and future challenges of the development of the corridor by 2030 have been monitored and assessed based on the analysis of the corridor project list. Nearly 640 projects have been identified. Also thanks to the support of the CEF Instrument over 80 projects have been already completed and over 550 are under development or implementation, which address the corridor specific objectives and work plan priorities. The development of a fully functional and interoperable corridor, compliant with the Regulation EU 1315/2013 by 2030, is challenged by the low maturity of the initiatives included in the project list, which calls for a more stable and mature pipeline of investments. In order to fully respond to the requirements set in Art. 47 of the Regulation EU 1315/2013, an analysis of the wider elements of the work plan has been performed. This shows that the corridor is contributing to transport decarbonisation thanks to the deployment of innovation. The analysis of the documentation of case studies demonstrates an increasing awareness among the stakeholders of the impact of climate change on the corridor infrastructure and identification of mitigation measures. The development of the corridor is finally significantly contributing to jobs and economic growth in the concerned Member States and Regions as well as in the wider European Union.

Executive summary

The Baltic-Adriatic Corridor (hereinafter BA Corridor) study has been prepared by the BA Corridor study consortium to provide the technical basis for the second update of the BA Corridor work plan, by the European Coordinator, Prof. Kurt Bodewig, together with the six Member States concerned, Poland, Czech Republic, Slovakia, Austria, Italy and Slovenia, and in consultation with the Corridor Forum.

The study comprises the following tasks: definition of the corridor KPIs and analysis of the corridor infrastructure parameters; update, integration and expansion of the corridor project list; confirmation of the results of the corridor multimodal market study; update of the elements of the work plan, including a description of the corridor characteristics, the definition of the objectives for its development and a plan for the implementation of the investments required to achieve the targets set in the TEN-T policy for the core network by 2030. The study also provides an analysis of the wider elements of the work plan, including the impact of the development of the corridor on innovation deployment, on transport decarbonisation and on jobs and economic growth, as well as the identification of the effects of climate change on the corridor infrastructure and the measures identified to mitigate this impact.

Support and follow up of the meetings of the Corridor Forum have been also performed as part of the study's activities. Seven Corridor Forum meetings and four working groups (two for Ports and Rail-Road Terminals and two for the Regions, Macro-regional Strategies and Urban Nodes) have been organised between September 2015 and November 2017. In the same period the BA Corridor study consortium has been also engaged in other meetings of the European Coordinator such as cross-border dialogues and visits to Infrastructure Managers and Baltic-Adriatic Rail Freight Corridor. Participation in the Corridor Forum and additional meetings have seen the involvement of the main corridor stakeholders, including: Member States, Railway and Port Infrastructure Managers and the Management and Executive Boards of the Baltic-Adriatic Rail Freight Corridor, Road and Airport Infrastructure Managers, Regions, Macro-regional Strategies and Urban Nodes, as well as representatives of the EU institutions (i.e. DG MOVE, DG REGIO, INEA).

Finally, the study activities comprise the definition of the basic elements and guidelines for the development of the innovative flagship projects Enhance passengers' transfer hubs in urban nodes along the corridor. This aims at supporting the development of integrated intermodal infrastructure and services between modes, smoothing or eliminating interruptions and barriers of operational, informative and commercial nature at transport nodes, towards a single multimodal market for EU passengers.

Characteristics of the BA Corridor

The BA Core Network Corridor is an 1,800 km long intermodal infrastructure between the Baltic and Adriatic basins. 4,300 kms of railway lines and 3,600 kms of roads interconnect 13 urban nodes and their airports, and a total of 10 maritime and inland waterway ports. 24 rail-road terminals have been also identified along its alignment.

Critical issues on the BA Corridor

Rail

With the only exception of the two Alpine crossings in Austria (Koralmbahn line section Wettmannstätten-Grafenstein within the wider section Graz – Klagenfurt and Semmering Base Tunnel Gloggnitz - Mürzzuschlag), the corridor railway infrastructure is already continuous and in operation. However, several challenges

are to be faced in terms of compliance with the rail infrastructure requirements as laid down in the Regulation (EU) 1315/2013:

- Electrification – the railway infrastructure along the corridor is almost entirely electrified except for the diesel passengers' sections at the cross-border between Slovakia and Austria on the Bratislava-Wien railway line;
- Axle load – the corridor is mostly compliant with the Regulation (minimum of 22.5 t). There are however some corridor sections (7% of the total corridor railway infrastructure) that are not at standard yet, in Poland (some sections on the lines Katowice – Czechowice-Dziedzice – Zwardoń, Wrocław – Jelcz – Opole) and Slovenia (some sections between Zidani Most – Šentilj, where studies and works are currently ongoing);
- Line speed – 28% of the BA Corridor is also not at standard (minimum 100 km/h for freight trains), with relevant bottlenecks particularly affecting the Polish and Slovenian networks, which call for infrastructure modernisation. More specifically, over 840 km of the Polish railway lines (about 20% of the total corridor railway infrastructure) and 270 km of Slovenian railway lines would need to be upgraded to meet the requirement set in the Regulation;
- Maximum permitted length of trains – on most sections of the BA Corridor is shorter than the 740 meters required by Regulation (EU) 1315/2013. The prevailing maximum train length along the corridor is around 600 m, but more severe restrictions exist on specific sections.

Regarding the above parameters, critical issues are still present in 6 out of 9 rail cross-border sections, all of them requiring upgrading and modernisation works: Opole (PL) – Ostrava (CZ); Katowice (PL) - Ostrava (CZ); Bratislava (SK) – Wien (Stadlau) (AT); Katowice (PL) – Žilina (SK); Graz (AT) – Maribor (SI); and Trieste (IT) - Divača (SI).

Concerning train length, only the following national sections are fully at standard: Gdynia Port – Warszawa Zachodnia – Zawiercie and Gdynia Port – Tczew – Tarnowskie Góry in Poland; Púchov – Leopoldov in Slovakia; and Pivka – Koper in Slovenia. As of the other parameters, Poland has already started an extensive investment programme for the modernisation of their railway infrastructure during the period 2007-2013; however further improvements are required for the removal of line speed bottlenecks and increase axle load standards. In the Czech Republic, the passenger line Přerov – Brno is not compliant with respect to speed and axle load standards. Compliance to axle load and speed requirements is already achieved in Slovakia and Italy. In Austria, only the section Wien Meidling – Wien Inzersdorf is classified as non-compliant for speed; however, since it stretches for 6.2 km, and is located in an urban area this is considered not critical at the corridor scale. In Slovenia, gaps exist concerning axle load and particularly speed standards.

ERTMS deployment is progressing and by 2017 the ERTMS related technology was available on 17% of the corridor sections. In Poland ETCS level 1 is available on subsections between Grodzisk Mazowiecki and Zawiercie. In Austria ERTMS (ETCS Level 2) is available on the subsections connecting Bernhardsthal to Wien's main station. In Slovakia the system is in operation on the Púchov – Trenčianska Teplá and Zlatovce – Bratislava railway sections, which are equipped with ERTMS (ETCS Level 1), and ERTMS (ETCS Level 2) is installed on the Žilina – Čadca railway line. In Slovenia all sections except Pragersko – Maribor – Šentilj / Spielfeld-Strass (border AT / SI) are equipped with ERTMS (ETCS Level 1). Albeit not yet in use, the system is also under implementation in the Czech Republic and Italy.

Along the corridor, stations and junctions are generally technically adequate in the Czech Republic, Slovakia, Austria and Italy and are gradually undergoing modernisation and upgrading in Poland and Slovenia. Limitations are however

identified, particularly regarding speed in Brno (Czech Republic), Žilina (Slovakia), Udine (Italy) and Zidani Most (Slovenia). Issues have been also identified in the rail network, stations and/or junctions on the main lines within core urban nodes: speed restrictions exist in Warszawa, Ostrava, Bratislava and Wien as well as in Gdańsk, Łódź, Katowice, Szczecin, Poznań, Wrocław, and Ljubljana. The network is also not at standard in terms of axle load in Łódź and Wrocław, and within the Ljubljana core urban node. 740 meters train operability is possible only in Gdańsk and Szczecin and partially within the Wien urban node. ERTMS is available in Ljubljana and only partially available in Wien; it is not available in the other nodes.

Road

The BA Corridor does not fully comply with the requirements of Regulation (EU) 1315/2013, especially with regard to the type of infrastructure (expressway/motorway standard). The situation is particularly relevant for the Polish road network, whereas the corridor infrastructure in Italy and Slovenia is fully compliant. Currently, 16% of the road corridor infrastructure is constituted by ordinary roads which do not comply with the requirements. The following two road cross-border sections (out of a total of 7 cross-border sections present along the BA Corridor) are neither motorways nor expressways and therefore do not comply with the Regulation: Katowice (PL) – Žilina (Brodno) (SK); and Brno (CZ) – Wien (Schwechat) (AT). Regarding the national networks, issues with the standards are present on segments of the S3, S7/S8 and A1 in Poland, and of the D1 in the Czech Republic. No compliance issues have been identified in core urban nodes where at least one urban motorway/expressway route exists interconnecting between the links outside the node.

Intelligent Transport Systems (ITS) activities are ongoing at the national level with respect to many of the measures foreseen by Directive 2010/40/EU, although European Electronic Toll Collection system – provisions of the Directive 2004/52/EC and subsequent Decision 2009/750/EC – are not yet implemented in the BA Corridor Member States. Alternative clean fuels are already available on the corridor road infrastructure, with many initiatives under development.

Ports

Regarding the analysis of the compliance of the port infrastructure, all ports have at least one terminal open to all operators in a non-discriminatory way and charges are applied transparently. Facilities for ship generated waste are available at all ports, except sewage treatment equipment at Trieste, Venezia and Ravenna. All classified inland waterway ports fulfil the CEMT IV requirement. All ports are furthermore connected to the road and railway links of the corridor. However, last mile railway and/or road port interconnections issues are present and limit the development in all Baltic-Adriatic corridor seaports. About rail, last mile connections' improvements are required to increase the standards of the existing dedicated rail links in terms of electrification, axle load, speed and train length at all maritime ports except Venezia. Improvements of the rail infrastructure within the port areas are also needed in Gdynia, Bratislava and at all Adriatic ports. Improvements to respond to capacity expansion needs in view of future traffic increase are foreseen or already ongoing in Gdynia, Gdańsk and at the Adriatic ports. Due to their location within or in the proximity of urban nodes, measures to reduce/mitigate the impact of rail traffic either at present or in the future are also required in Venezia and Ravenna. As of road, works to increase the standards of the last mile connections are envisaged at the ports on the Baltic sea and at Koper. The internal road infrastructure requires modernisation/upgrading at all Baltic ports as well as in Bratislava, Venezia, Ravenna and Koper. Improvements to respond to capacity expansion needs in view of future traffic increase are foreseen or already ongoing in the Baltic ports, Venezia and Koper. In Gdynia, Szczecin, Świnoujście,

Venezia, Ravenna and Koper solutions to mitigate the impact of road transport on the respective urban areas are also needed.

As of 2017 alternative clean fuels were not available for maritime transport operations at any of the ten corridor ports. LNG fuel is available at the LNG terminal in Świnoujście, where it can be loaded onto road units. Finally, VTMIS and e-Maritime services are available or under development at the ports, although they are not integrated and fully interoperable at the European Union level (RIS deployment is also ongoing).

Airports

The two core airports of Wien and Warszawa (Chopin) are already interconnected to the BA Corridor railway network, which satisfies the requirements of the Regulation. In addition, a rail connection exists for the Szczecin, Gdańsk and Ostrava airports. The interoperable traffic management system for air traffic is currently under development as part of the ongoing Single European Sky Air Traffic Management Research and Development (SESAR) project. The analysis of the corridor KPIs shows that alternative clean fuels are not available at airports.

Rail-road terminals

The 24 rail-road terminals located at the Baltic-Adriatic corridor core nodes are all interconnected to their respective national road and rail networks. About rail interconnections, with respect to the technical compliance of the rail accessibility to terminals, 9 out of 24 rail-road terminals have 740 meters train length accessibility and 18 out of 24 have electrified train terminal accessibility. No specific critical issues have been identified so far that would affect the quality of last mile connections, except capacity constraints at the Poznań railway bypass and Bratislava railway node. Referring to the infrastructure inside the terminals, 5 out of 24 terminals have a maximum length of loading/unloading tracks of minimum 740 meters, 12 terminals do not have electrified rail tracks at terminal. As of road last mile connections, issues have been reported which relate to local urban road accessibility and traffic in Poznań, Warszawa and Wrocław. For the terminals located within seaports and inland waterway ports, similar considerations apply as the ones described for the ports in which they are situated in terms of conditions and issues associated to their accessibility by rail and road. All terminals are furthermore equipped to handle intermodal units. 10 rail-road terminals declare they have at least one freight terminal open to all operators in a non-discriminatory way and application of transparent charges.

Operational and administrative barriers

In addition to the gaps in the availability of an interoperable infrastructure different types of operational and administrative barriers affect the development of the BA Corridor. About freight transport by railways, barriers are under analysis and definition by the RFC5 in cooperation with RNE, which relate to communication between Infrastructure Managers (IMs) Traffic Control Centres (TCCs) or among Railway Undertakings (RUs) or between RUs and IMs at the borders; or to operational rules between RUs and IMs at the borders. International rail passenger market is also affected by issues related to inadequate implementation of previous railway packages or loopholes in previous EU legislation. Such barriers can be administrative (difficulties in obtaining a safety certificate or vehicle), operational (need for staff speaking all official languages along the route, volatility of infrastructure charges, access to operational facilities and services, difficulties to align train paths in domestic timetables to get suitable international paths, lack of the inter-availability of tickets) and also commercial (difficulties to use existing sales facilities on a fair and non-discriminatory basis or to rent space in stations).

Concerning multimodal transport operations of freights at the core ports and rail-road terminals no corridor specific issues are noticed. General aspects particularly relevant for the development of multimodal freight and combined transport fall however within the scope of the implementation of VTMIS and e-Maritime services and solutions aimed at promoting Single Window initiatives to access ports, track flows of vessels and transported intermodal vehicles, rolling stock and goods entering and exiting port areas; and/or simplifying administrative procedures associated to custom, safety and security processes (i.e. the Polish Port Community System under implementation). ICT initiatives at rail-road terminals and between nodes to monitor and increase the effectiveness and efficiency of the logistics chain and its basic operations are missing or associated to the network of operations of the Multimodal Transport Operators, rather than implemented at the European transport system scale. About these aspects the 2014 study "Analysis of the EU Combined Transport" by the European Commission notices how combined transport seems lacking an "open data" ICT platform for exchanging booking, operational and tracking/tracing data between relevant companies involved in the combined transport supply chain. In the same study it is noticed that further to the interoperability issues associated with the characteristics of the rail infrastructure and national systems (also including train weight, axle weight, loading gauge not allowing 4m high semi-trailers or transport of 9'6" high-cube containers) the development of rail combined traffic is currently hindered by total handling costs.

Finally, no corridor specific barriers have been identified which affect other transport modes infrastructure and services. However, in view of the growing trends in cross-border traffic operations and the target for the core network to support the development of long distance traffic across the European Union, due consideration shall be given to the promotion and development of digital links and initiatives for the exchange of traffic data and provision of information to the users. This objective is paramount for all transport modes and for both freight and passenger transport including at urban nodes, in support of the development of cross-modal and borderless commercial solutions of mobility services.

Progress of corridor development since 2014

Remarkable efforts have been made since the inception of the new TEN-T Policy in 2014 for the development of the BA Corridor. Activities for the development and implementation of more than 400 projects have already started for about 46 € billion investment costs. Out of these projects 87 projects have been already completed, for an overall budget of 6.6 € billion. These have positively impacted on the achievement of the corridor specific objectives and work plan priorities. Improvements have been made regarding the railway infrastructure with an increase of the KPIs for freight transport, namely speed (PL, CZ, SI), axle load (PL, SI) and train length (PL, SK, SI). ERTMS technology has been installed on several sections of the corridor in Poland, Czech Republic, Slovakia, Austria and particularly in Slovenia. Among the railway projects the completion of the Eastern Branch in Poland, namely the E65 national railway section between Gdynia and Warsaw is notable. Increase of the corridor KPIs for road transport are also noticeable due to completion of works in Poland and in Slovakia, including sections of the D3 along the cross-border itinerary between Katowice and Žilina. Preparatory works for the development of the rail cross-border sections between Poland, Czech Republic and Slovakia, as well as studies and works for the improvement of the last mile connections of the ports in Poland, Bratislava, Trieste, Venezia and Koper have been also finalised.

Results of the transport market study

The results of the market analysis undertaken in 2014 have been overall confirmed:

- Capacity of the railway infrastructure does not represent a general problem at present, with some railway sections in Austria and in the Czech Republic presenting however high levels of traffic and capacity constraints. Issues are also present on the Koper – Divača railway line due to poor technical parameters of the infrastructure, limiting the capacity below the theoretical level allowed by the number of tracks. Despite the implementation of the investments included in the corridor list congestion may still occur in the future at urban nodes (Warszawa and Katowice in Poland, Brno in the Czech Republic, Bratislava in Slovakia, Wien in Austria and Ljubljana in Slovenia) due to demand growth, increase in the operation of railway services and growth of freight operations at ports; as well as on specific sections (Ostrava-Přerov in the Czech Republic and between Werndorf and Wiener Neustadt in Austria, also as a result of traffic induced by the completion of the Alpine crossings (Semmering and Koralm);
- Capacity of the road infrastructure does also not represent a general problem at present; the only section currently above the identified critical level is on the D4 motorway, within the urban area of Bratislava. Considering the full implementation of all investments included in the project list, the corridor will generally be adequate to accommodate growth in road transport volumes for all the assessed future demand scenarios. Limited and specific exceptions to this situation may occur within or in the surroundings of major urban nodes;
- The transport demand is expected to grow significantly by 2030, both on the rail and road network, although at a reduced pace when compared to the historically observed trends. The investments in the rail and road infrastructure as currently planned to be implemented on the corridor are expected to have a positive, although limited, effect on modal shift. It is only assuming the implementation of rail policy oriented measures that the market share of railway transport may increase significantly.

Objectives of the BA Corridor

The analysis of the characteristics of the BA Corridor and the results of the transport market study, as extensively discussed with the Members of the Corridor Forum, led to the confirmation and further specification of the specific objectives identified in the 2014 corridor study for the development of the BA Corridor by 2030. These have been considered in the definition of the work plan (WP) priorities by the European Coordinator:

- Improving the most critical cross-border rail and road connections, also promoting the development of digital cross-border links for the exchange of traffic data and provision of information services (WP priority);
- Ensuring the timely completion of the ongoing projects at the Alpine crossings in Austria, in order to remove the two missing links along the corridor (WP priority);
- Increasing the infrastructure quality and standards with the target to comply with the technical requirements set in the Regulation (EU) 1315/2013, in particular concerning railways in Eastern Member States (WP priority);
- Enhancing multimodal transport by supporting the optimal infrastructure integration and interconnection of all transport modes at transport nodes – particularly the last mile connections of ports (WP priority) – and the deployment of ICT solutions to simplify administrative processes and improve the performance of the terminals in the wider logistics chain in terms of time savings, reliability and security;
- Improving interconnection in all urban nodes along the corridor between TEN-T and local transport infrastructure, for both passenger and freight traffic (WP priority);

- Supporting the development of interoperable transport networks, in particular through the promotion of transport digitalisation and the deployment of telematic applications and their further technological advancement, with a focus on ERTMS (WP priority).

Implementation of the BA Corridor work plan

More than 550 planned and ongoing investments have been identified for the development of the BA Corridor up to 2030, totalling 76.9 € billion (2015 prices). 50.5% of this total volume of investments is allocated to railways and ERTMS, 25.6% to road, around 14.1% to ports, including their interconnections (3.0%) and MoS projects (0.1%), and 9.8% to airports (7.6%), rail-road terminals (0.7%), innovation (0.8%) and transit and multimodal interchange facilities in core urban nodes (0.7%). 9.2% of the total budget is allocated to cross-border sections related initiatives. The cost of the two Alpine crossings is equivalent to 11.5% of the total investment value. 12.1% of the project list budget relates to the interconnection of the urban nodes.

These investments have been organised into specific actions for the development of the BA Corridor by 2030, in accordance with the corridor specific objectives and requirements set in the Regulation (EU) 1315/2013, and based on the corridor sections and nodes. These form a plan for the removal of technical and operational barriers, and for the development of the corridor as an intermodal and interoperable infrastructure for long distance traffic. The assessment of the impact of these projects on the corridor development shows that the project list is likely to contribute to the attainment of the requirements set in the TEN-T Regulation by 2030 for the core network. The specific objectives of the corridor and work plan priorities have been well addressed in the project list. 186 projects, corresponding to more than 45% of the project list's total investment costs are related to the work plan priorities. The remaining 365 projects are not less relevant if compared to the general objectives of the new TEN-T Policy. Despite this overall positive assessment, considerable financial resources are still required to implement these projects with a gap of over 40 € billion of required financial resources of which over 16 € billion relate to the work plan priorities. In addition to the lack of financial resources, the projects on the list show a low level of project maturity. Referring to the three main administrative steps of project implementation identified in the project list for the 356 investments concerning construction works, it is noticed that land acquisition has been concluded for only 59 projects; the Environmental Impact Assessment has been approved for only 74 initiatives and the project has received final approval by the relevant governmental and administrative authorities only for 63 projects. The lack of a stable and mature pipeline of projects represents a risk for the implementation of all the investment required to meet the corridor development targets by 2030.

Wider elements of the work plan

The analysis of the investments included in the BA Corridor projects list with reference to the wider elements of the work plan supports the consideration that the corridor will contribute to the *deployment of innovation*. Initiatives relate in particular to telematic applications and alternative clean fuels, whereas a gap seems to be present with respect to sustainable transport solutions, especially for freights. Regarding *transport decarbonisation*, the results of the market study show that the environmental impacts of the transport flows along the corridor are expected to increase. This will be mainly driven by the growth of the transport activity along the corridor thanks to its development, which will increase its attractiveness in comparison to the alternative routes. Among the scenarios considered in the study it is only by promoting modal shift to more sustainable modes (rail policy scenario) that the corridor development may mitigate the impacts of the growth of transport activity along the corridor. The negative impact

of the corridor development on the environment can be also counterbalanced by investments in the field of innovation and the gradual market uptake of more efficient means of transport, in particular zero/low emission vehicles. Behavioural actions to rationalise the mobility of passengers and the delivery of freights to reduce the overall emissions generated by transport operations can also have a positive effect in this regard. About the *resilience to climate change*, the case study analysis of the project documentation is showing an increasing awareness among the stakeholders about the impact of climate change on the corridor infrastructure and the identification of corresponding mitigation measures. Finally, the development of the corridor will lead to *jobs and economic growth* with an increase of GDP over the period 2016 until 2030 of 489 € billion (year 2015) in total. The direct, indirect and induced job effects of these projects will amount to 1,403,661 additional job-years created over the period 2016 to 2030.